ency of plant varies greatly according to its size and working conditions of load, but here again it is unnecessary to go into fine detail. An overall efficiency from the water to the electric generator of 80 per cent will be taken as the basis in this Report. Thus the simple formula for the potential electrical horse-power obtainable from any project is:

$$\text{e. h. p.} = \frac{\text{cusecs flow} \times \text{head in feet}}{11}$$

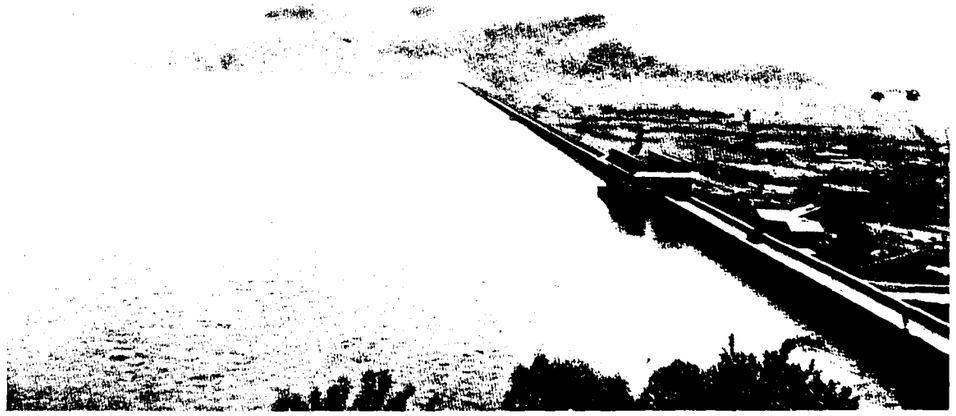
Further technical details will be found in Appendixes I and IV. As an example, the following may be considered;

(*a*) Head or fall 1,000 feet; flow 11 cusecs; power 1,000 e. h. p.
(*b*) Head or fall 100 feet; flow 110 cusecs; power 1,000 ,,
(*c*) Head or fall 10 feet; flow 1,100 cusecs; power 1,000 ,,

2. *Useless sources of water power.*—Having considered the case of the natural waterfall the other extreme may now be dealt with, namely where there is only a small and fluctuating rise and fall in the water. Correspondence and the records of the Patent Offices show that there is a widespread idea that much power is going to waste in the tides and in the slow moving rivers of the plains; this is true, but in the upshot it is commercial and not engineering considerations that must necessarily prevail, and these are against the utilization of such sources of power. Inventors in modern times have long been anxious to utilize the immense force of the tides, shown by their destructive action on the coast and especially on artificial works designed to control their fury; but here there has been no practical result, *not* because the power is absent but because its utilization would generally be ***prohibitive in cost.*** Again, tidal rivers are a fruitful source of disappointment. It may in favourable conditions be possible to impound the rising water by a dam and thus to obtain the benefit of a fall, both when the tide is rising and again when it is falling; but apart from the enormous capital cost that would generally be involved for a comparatively small amount of power there is the additional difficulty that there would be no power available when the waters on both sides of the dam were at the same height. Once again, mindful of the old undershot water wheels that helped the windmills to grind the people's flour, the possibilities of the great slow flowing rivers often appeal to the fancy as sources of power; but here once more, though considerable power may be going to waste, considerations of cost generally prevent any practical use of the power. It comes then to this, that in the absence of a definite and ever-present fall of at least several feet no water-power scheme is likely to mature as a commercial success. If water were the only source of power the outlook would be different; but it is generally in active competition with other agents such as coal and oil, which are dealt with later in this Report.

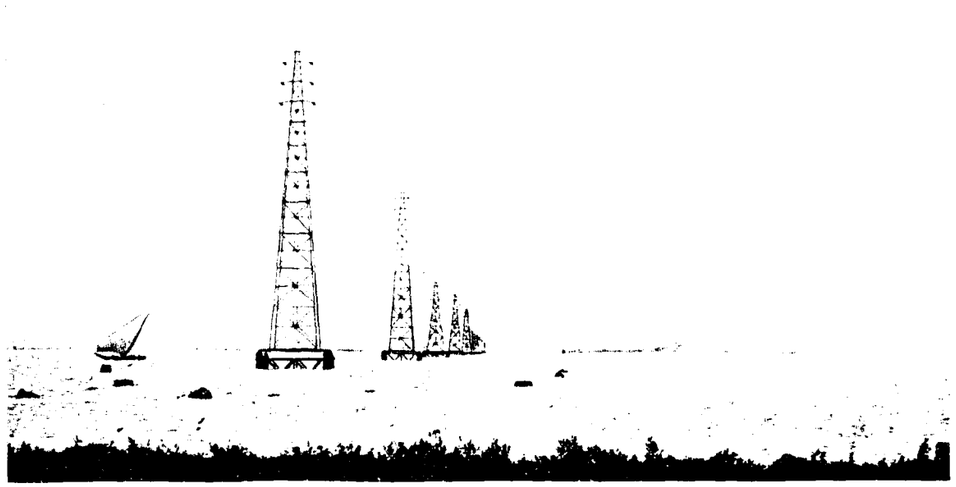
3. *Artificial water falls.*—Strangely enough the possibilities that lie between these extreme cases are often overlooked by the layman until attention is drawn to them, for the greater part of the world's water power is now obtained from what may be called artificial water falls. A stroll along the bed of a hill nullah will demonstrate the enormous power of water running down a moderate slope. Boulders the size of a house will be found insecurely perched in the middle of the stream, with the certainty that they have come down from higher ground and will sooner or later continue their course towards the great rivers; indeed the valleys themselves are sufficient evidence of the power of water to do destructive work. It is the hydraulic engineer's business to turn some of this waste to constructive ends, though his utmost efforts will only be as dust in the balance. In order to utilize the power of a mountain stream it is necessary to divert the water from the rapidly sloping natural bed into a gently sloping artificial channel along the hill side; then, after traversing this for a longer or shorter distance, the accumulated fall of the river bed can be concentrated at one point and a fall of many hundred (or even some thousands) of feet obtained; in fact an artificial water fall has been created.

4. *Reservoir projects.*—So far the existence of a running stream has been postulated, but this may generally be supplemented, and sometimes replaced, by storage of water at the top of the fall; whether this is practicable depends



Tata Hydro Electric Works; Lake Sydenham.

Tata Hydro Electric Works; 82-inch pipe near Forebay.



Tata Hydro Electric Works; 200 feet towers on transmission over tidal creek.

Photo-engraved & printed at the Office of the Survey of India, Calcutta, July

on the configuration of the ground in the first place and on the geological formation when a possible reservoir site has been located. Artificial regulating reservoirs of stone or concrete containing two or three hours' reserve supply against a break in a communicating channel or at the headworks are not here referred to. A further point for consideration in the utilization of natural reservoir sites is the value of the submerged land; this may on the one hand be barren waste or, on the other, highly cultivated land containing villages, the inhabitants of which must be displaced and provided for elsewhere.

The best example of this type of project is that of the Tata Hydro-electric Power Supply Company in the Western Ghats, which is operated entirely from water stored during the few monsoon months; this is regulated to give the necessary flow to the turbines through a fall of some 1,750 feet. Several other similar projects are under construction or investigation in the same district, but in some localities where reservoir sites of large capacity can be traced on the map the rocks are so fissured that a high dam would be useless. The most likely area for projects of this nature, after the Western Ghats, is the Cherrapunji plateau in the Khasia Hills, where the rainfall over a small patch of ground at an elevation of more than 1,500 feet above the contiguous plains is enormous; surveys have not yet been undertaken, but a superficial examination of the ground with an Abney level proved disappointing. Reservoirs of large size would require high dams, and this particular area is subject to severe earthquakes, rendering the "gravity" type of dam dangerous. The future of reinforced concrete has however to be reckoned with, and this form of construction may come to the rescue. A further difficulty here will be that of getting rid of the enormous surplus water during heavy falls, which occasionally amount to as much as 35 inches in a single day, or nearly 2 million tons per square mile of catchment area. Unless there are feasible sites for flank escapes of sufficient capacity it may be impossible to utilize this plateau, even if the dams can be built.

As 100 million cubic feet of water stored will in practice only give some 3 cusecs throughout the year, or 6 cusecs for the dry half year, it will be realized that storage must be on a vast scale where large power is to be developed from it alone, even when working on a very high head. On a low head this type of project is impracticable.

Nevertheless storage on a moderate or even on a small scale may be invaluable as an adjunct to a perennial stream. For whereas power is for the most part only required for some 10 or 12 hours a day, and the requirements fluctuate during this working day, the stream will flow on; so if the unutilized flow during the 12 or more idle hours can be stored it will allow at least double the draw-off during the working hours, and will therefore double the amount of power.

5. *Combined irrigation and power projects.*—India contains a vast system of irrigation works in the form of canals fed both by perennial rivers and from storage lakes. Hitherto the combination of irrigation and power has not made any great strides, although a few canal falls have been utilized and the harnessing of the Periyar Lake has been discussed for a generation. The main disadvantage of such power is its discontinuity; in the first place canals fed by tanks or lakes with a limited supply can only be run when the water is needed for the crops, and, secondly, canals fed by silt bearing rivers have to be closed periodically for repairs and cleaning out. To prevent breaches canals must be closed when rain, sufficient to take care of the crops, falls. Very few, if any, of the Northern India canals have escapes capable of disposing of the supply once the demand slackens, and very few could be provided with escapes at any reasonable cost, if at all. So long as the power is being used to pump water up to irrigate areas uncommanded by the canals themselves, or to drain water-logged land by means of tube wells, stoppages do not matter; for they occur when these operations would be in abeyance. Where however power is to be used for ordinary industrial purposes it may be a serious matter if both the capital and labour employed are kept idle for weeks. Reserve steam or oil plant may then be necessary, and this involves large additional capital cost.

In any part of India where further irrigation works are needed there may be an opening for the combination of these with power supply. Where large reservoirs are involved this is evident, for the tail waters from the turbines may be discharged directly into canals. It is probable that, in order to get suitable ground for such a canal, it may be necessary to sacrifice some "head" on the power plant; but that can well be faced, as such a combined project might pay where it would not do so if confined to either irrigation or power. The cost of the storage works would be met by both undertakings. In the case of the canals fed by perennial rivers the same combination offers attractions. Hitherto, as pointed out at the Punjab Engineering Congress in 1919, the possibility of utilizing canal falls for power purposes has not been taken definitely into account in their design and layout; thus there will often be several small falls in a few miles of canal where a single fall would have been practicable and would have been far better for power development. It is to be hoped that in future this will be borne in mind. Several small falls are however preferred for irrigation purposes on the score both of economy in construction and of facility of command.

6. *Descriptive Classification of water power.*—Having cleared the ground by explaining the "general idea" of water power the various types met with may now be further classified. In the first place a scheme may be developed on

(*i*) a high head
(*ii*) a medium head
(*iii*) a low head.

There is no exact line of demarcation between these, except according to the type of turbine wheel generally adopted. Thus high heads are those in which the Pelton type of jet impulse turbine is used, generally from 300 or 400 feet up to the limit of nearly 5,000 feet; the flow of water required for a given plant is here the minimum. Low heads are those in which pressure or reaction turbines are used, either completely submerged or with draft tubes, extending from the lowest practicable limit of about 3 feet up to about 80 feet and requiring a very large volume of water. Medium heads lie between these extremes and employ a variety of types of turbines, mostly impulse, but generally not of the Pelton type except in America.

The second basis of classification is according to whether the water supply is perennial, or from reservoirs, or a combination of the two.

Yet again, there are various methods by which the head or fall is obtained, *viz.*:—

(*a*) A natural waterfall with merely a pipe line conveying the waters from above the fall down to the turbines in the power house below it, as described in the first paragraph. This may be a high, medium or low fall, fed by a perennial stream, or storage, or both.

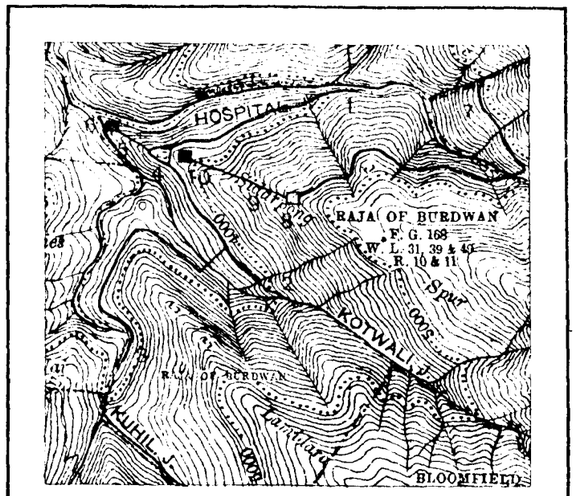
(*b*) An artificial fall created by a dam *alone*, the water being taken from the upper level to the lower level through the turbines. Sometimes the power station itself will be contained in the interior of a hollow dam. Such an arrangement may be utilized for either a medium or a low fall. A succession of rapids in a river is often dealt with in this manner, and a canal fall is a special instance of it also. The water stored behind the dam will generally remain at the highest level, constantly fed by the stream or canal, and if it is drawn upon the fall available will soon diminish or even disappear. If however the waterspread of the reservoir is great it will generally be permissible to use it for regulating purposes, as a few feet of depth may be sufficient when utilized to allow the whole incoming flow of the day to be used during the ordinary factory hours.

(*c*) An artificial fall, developed by tapping a perennial stream or a reservoir at a high level and conveying the water in an artificial channel to a point where pipes can be taken down to a power house at a lower level. Very high heads are invariably so obtained, and the method is also applicable to medium heads and even to very low heads, such as combinations of two or more canal falls. The supply

DARJEELING

LAYOUT OF HYDRO-ELECTRIC WORKS

Scale 2 Inches = 1 Mile



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REFERENCES

Original channels	1, 2, 3
,, reservoir	4
,, pipe line	5
,, power house	6
Extension channel	7
,, reservoir	8
,, pipe line	9
,, power house	10

may be either perennial, or from storage, or from a combination of the two. There is great variety in this class of project. Ordinarily the artificial channel, which may vary from a ditch to a large canal or from a galvanized iron or concrete culvert to a huge wooden flume, is taken along the contours of the hill side on a very gentle slope of from 1 in 500 to 1 in 2,000. Sometimes the stream will make a great hair-pin bend, and a tunnel through the intervening spur will save miles of open channel and many feet of useful head, while avoiding ground on which landslips may occur and cause interruptions to the supply. Again, there may be abundance of water in a high valley sloping very gently away to the plains while on the opposite side of the watershed there is a steep fall offering a far cheaper development of the pipe line and a better site for the power station; here the water may be taken through the watershed in a tunnel and then piped down to a power house in another catchment; or again, several different streams may be tapped and channels from each of them led to a single point where there is a good fall. A perennial flow is almost invariably a feature of such schemes, but this may be supplemented by storage; and this storage either may be of comparatively small amount at the top of the pipe line, for regulating purposes, or may be at the source of one of the channels or in the upper reaches of the stream, for augmenting the supply over long periods.

Instances may be found of all these types and of many minor variations of them, and in any given case it is not difficult to decide which method of development will prove feasible. In dealing with any project that may be classed as "low head" special difficulties are met with owing to the great seasonal variation in the water level; the monsoon rains, or even a local storm may cause a great rise in the level and it not infrequently happens that the rise is greater below the power house than above it, so that the available fall is diminished. In narrow channels this is particularly likely to occur, so a gorge is generally a bad location.

The illustrations and layout maps in this Report illustrate varieties of type (c) above, as will be seen from the data relating to the Darjeeling, Simla and Tata works in Table 1, para. 23. Thus, at Darjeeling (Frontispiece and Map 1) three separate hill streams are brought by small contour flumes to a masonry regulating tank which feeds the pressure pipes of the turbines; this tank is also fed by the tail waters of a subsidiary power station above it which taps one of the same streams at a higher point. In the case of Simla (Plate 2 and Map 2) a single stream is led by a concrete flume to the masonry regulating reservoir; thence a closed concrete pipe leads to the forebay from which the pressure pipes take off. In both these instances perennial flow is depended on, as the storage is only sufficient for a few hours; and settling tanks are provided to deal with the large amount of silt and débris brought along the channels. The Tata works (Plate 3 and Map 3) depend entirely on storage from three lakes, which, by means of canals and a tunnel through the watershed, feed the forebay from which the pressure pipes run down to the power house.

CHAPTER II.—WEATHER AND WATER.

7. *Incidence of rainfall.*—In certain important respects India differs from most countries whose natural resources in water power are now being investigated ; for the rainfall is seasonal, and during many months only occasional thunderstorms break the monotony of dry weather. Generally speaking there is the monsoon period and the dry period, but in the South there are two distinct monsoons, the South-West and the North-East. The variations in the rainfall in different parts of the country are enormous, and the departures from the monthly and annual normals in any given locality are also very great. Apart from canals, it is to the mountainous regions that we must look for water power, and here the rainfall is naturally greatest ; especially in those hills that first catch the moisture laden winds from the sea. The great central plains of India mostly have low rainfall, but here comparatively little power would in any case be found owing to the extremely small slope of the ground and the great variations in the normal water levels.

The arid area in the North-West covers mountainous districts, mostly trans-frontier, and even if power were available it is doubtful if much use could be made of it in such unsettled country. This last consideration applies also to various mountain ranges in the Northern Burma region, which are either "Unadministered Areas" or are inhabited by uncivilized tribes ; but in some of these areas there is good rainfall.

Except in localities where storage on a very large scale is possible, such as the Western Ghats and possibly the uplands of the Central Provinces, the greater part of the *monsoon* rainfall of India must necessarily pass to the great rivers and canals undeveloped for power purposes. Thus for example, take the case of the Jaldaka River in the Bengal Duars, a stream with considérable possibilities ; it has a catchment area in the neighbourhood of 250 square miles above the point where it enters the plains, and the annual rainfall is not less than 150 inches ; probably it may average 200 inches. This nearly all falls in the 7 months of April to October and amounts to some 75,000 million cubic feet, giving an average flow of nearly 4,000 cusecs and a maximum flow enormously greater. Yet the flow gauged in April 1919 was no more than 170 cusecs. Clearly in the absence of a phenomenal reservoir site—and the Himalayas appear to afford few such—most of this water must run to waste. Furthermore the control of such a river, when a single day may bring 10 inches of rain or more, is no light problem ; and this is one of the smaller rivers in the district. It serves however as a good example of many potential sources of power.

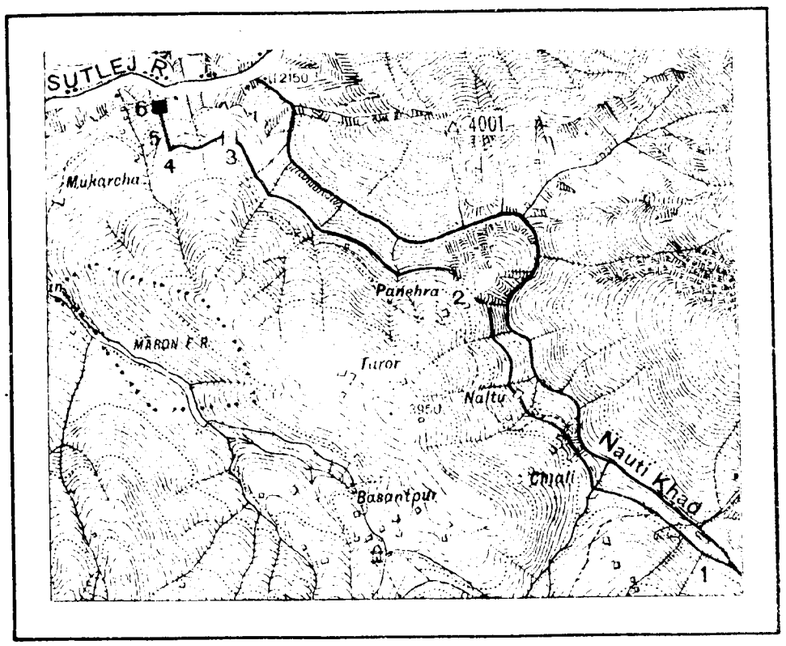
The Bhakra dam project on the Sutlej, now under detailed investigation, has drawn attention to many other sites that may prove suitable for storage both on the Sutlej and Ravi rivers, and similar sites may be found on other northern rivers.

8. *Perennial and seasonal rivers.*—As the result of the conditions discussed in the preceding paragraph many of the rivers and streams of India fall to a very low ebb, or dry up altogether in their higher reaches, before the end of the dry season. Where this is so development by monsoon storage is the only method of getting continuous power, and this is not possible in most localities. It is true that discontinuous water power may be of value in particular instances, either for utilization in industries that are only manufacturing during the rainy season, such as tea, for which the power demand for drying and other processes is very large ; or for any purpose in combination with reserve plant driven by steam or other fuel. In either of these instances however the cost of the power will be higher than it would be if continuous, as the capital charges on the plant are higher in the second case and spread over a shorter working period in the first.

SIMLA

LAYOUT OF HYDRO-ELECTRIC WORKS

Scale 2 Inches =1 Mile



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REFERENCES

Headworks	1
Channel with tunnel and silt tanks	2
Reservoir	3
Concrete pipe	4
Forebay	5
Pipe line	6
Power house	7

The perpetual snows of the Himalayas are responsible for the hot weather flow in most of the perennial rivers of Northern India, and may prove an asset of immense value for industrial power just as they already are for irrigation. Even the comparatively low lying snows will last on well into the hot weather, feeding the springs and keeping up the volume of water. There is however very little of this "White Coal" (*houille blanche*) in other parts of India, and such perennial streams as exist are spring fed. Burma is especially well off in this respect, but often the springs which appear at one point will disappear in a similar cleavage a little further on, so that there is only a slender chance of being able to supplement the flow with storage in ground so badly fissured. The disadvantage attaching to the Himalayan snows is that they lie almost exclusively in trans-frontier regions, and exhaust most of their fall to the plains in Kashmir, Tibet, Nepal, Sikkim and Bhutan. The boundary lies for the most part near the foot-hills, and while the water can be used thereafter for irrigation it has reached the inert stage (paragraph 2) from the power point of view.

9. *Rainfall and run-off.*—Into the highly technical subject of rainfall and run-off it is only necessary to dip for a moment. Clearly all the rain that falls in a given catchment area will not at once (if ever) find its way to the stream in the valley; some will evaporate altogether, or sink into the ground to feed springs in other catchments, or be absorbed by vegetation, and the more gradually the rain is precipitated the greater will be these losses. Very light rain after a dry spell may not affect the flow of the stream in the slightest degree. Again, if the ground is steep, barren and rocky there will be a much more complete flow from it than if it is gently sloping and covered with vegetation. The percentage of the rainfall that reaches the stream is called the run-off.

If the rainfall over a particular catchment area in any period is known, and the stream flowing from it can be gauged, the percentage of run-off can at once be calculated for the conditions obtaining during that period; but the rain-gauge readings must be taken at a number of points in the catchment —the more the better—in order to ascertain the actual amount of precipitation. In addition to the very large differences of average rainfall in different countries and localities, and the great variations from the average in particular years, the distribution of the fall month by month and day by day must be taken into account. Minimum discharges on small catchments may vary 4 or 5 fold in different years, and are extremely difficult to calculate; a long series of rainfall averages will however, indicate to some extent the relation between the unknown discharge of an exceptionally dry year and the known discharge of a particular year. Intelligent guesswork of this nature presupposes knowledge of local conditions and long experience.

Formulæ for calculating the maximum run-off from a catchment have been devised by many Engineers, but they all employ coefficients which it is impossible to ascertain without a comprehensive study of the nature of the area and the rainfall.* It may however be accepted that a study of the daily rainfall observations over a period of 30 years will give a fairly accurate idea of the conditions which are likely to occur in future, and if different percentages of run-off are assumed for light, medium and heavy falls, depending on the nature of the catchment, a fairly accurate forecast can be made.

As a practical example of the method the following empirical table was tentatively adopted by the late Mr. Barlow, in the United Provinces.

Light falls under $\frac{1}{2}$ inch in 24 hours should be entirely omitted unless continuous for several days; falls from $\frac{1}{2}$ inch to 1 inch in 24 hours should be omitted if there has been no fall before or after. Falls from 1 inch to $1\frac{1}{2}$ inch, when not followed or preceded by similar or greater amounts, are considered light.

Medium falls are those from 1 inch to $1\frac{1}{2}$ inch when followed or preceded by any but light falls; also all falls from $1\frac{1}{2}$ inch to 3 inches.

* See chapters on "Rainfall" and "Maximum flow off a catchment" in Buckley's "Irrigation Pocket Book."

Heavy falls are those over 3 inches or continuous falls over 2 inches a day; also all falls of an intensity of 2 inches an hour or over.

Table showing percentage run-off assumed.

	A	B	C	D	E
Light falls	1	3	5	10	15
Medium falls . . .	10	15	20	25	33
Heavy falls	20	33	40	55	70

A=flat cultivated and black cotton soil catchment.
B=flat partly cultivated and stiff soils.
C=average catchment.
D=hills and plains with little cultivation.
E=very hilly, steep and rocky with very little cultivation.

Obviously such a classification would be unsuitable in most parts of Europe or America, but it brings out clearly the nature of the variations to be met with in a particular locality. A thunderstorm with a rainfall of ¾ inch in 20 minutes would give double or treble the run-off of the same fall spread over a day; but nearly all rainfall observations give the daily fall and not the hourly intensity. The classification of daily rainfall over a long period sounds a serious proposition, but is really a matter of clerical labour only. Owing to the disturbing effect of hills, etc. isolated observations at one point of a catchment may be very misleading; hence the necessity of many gauging stations wherever possible. Rainfall contour maps are only useful as a general guide, unless prepared on a large scale from observations made for the purpose.

In India the rainfall varies in different localities from 450 to a few inches, mostly precipitated in about 4 months, while catchment areas vary in nature from waste sand to steep rocky country. In some parts the ground is highly cultivated or covered with dense forest, while in others there is hardly any soil or vegetation; the soil itself varies from the stiffest clay to the lightest loam or sand. With these variables it is easy to realize that the run-off must vary greatly and is incapable of treatment by any general formula of universal applicability.

Evaporation and percolation.—Apart from the fact that a considerable percentage of rainfall is evaporated before it reaches the big rivers, as well as from their surface, the question of evaporation arises wherever long canals or large storage reservoirs are employed. The actual amount of evaporation varies so much that no general figure would be of the slightest value; in India it may be as much as 6 feet in the year, but for details of many known reservoirs Buckley's "Irrigation Pocket Book" may be referred to. Percolation and absorption also account for no small amount of the water entering a canal in natural ground or a reservoir, but the loss must obviously be determined in each case as it arises.

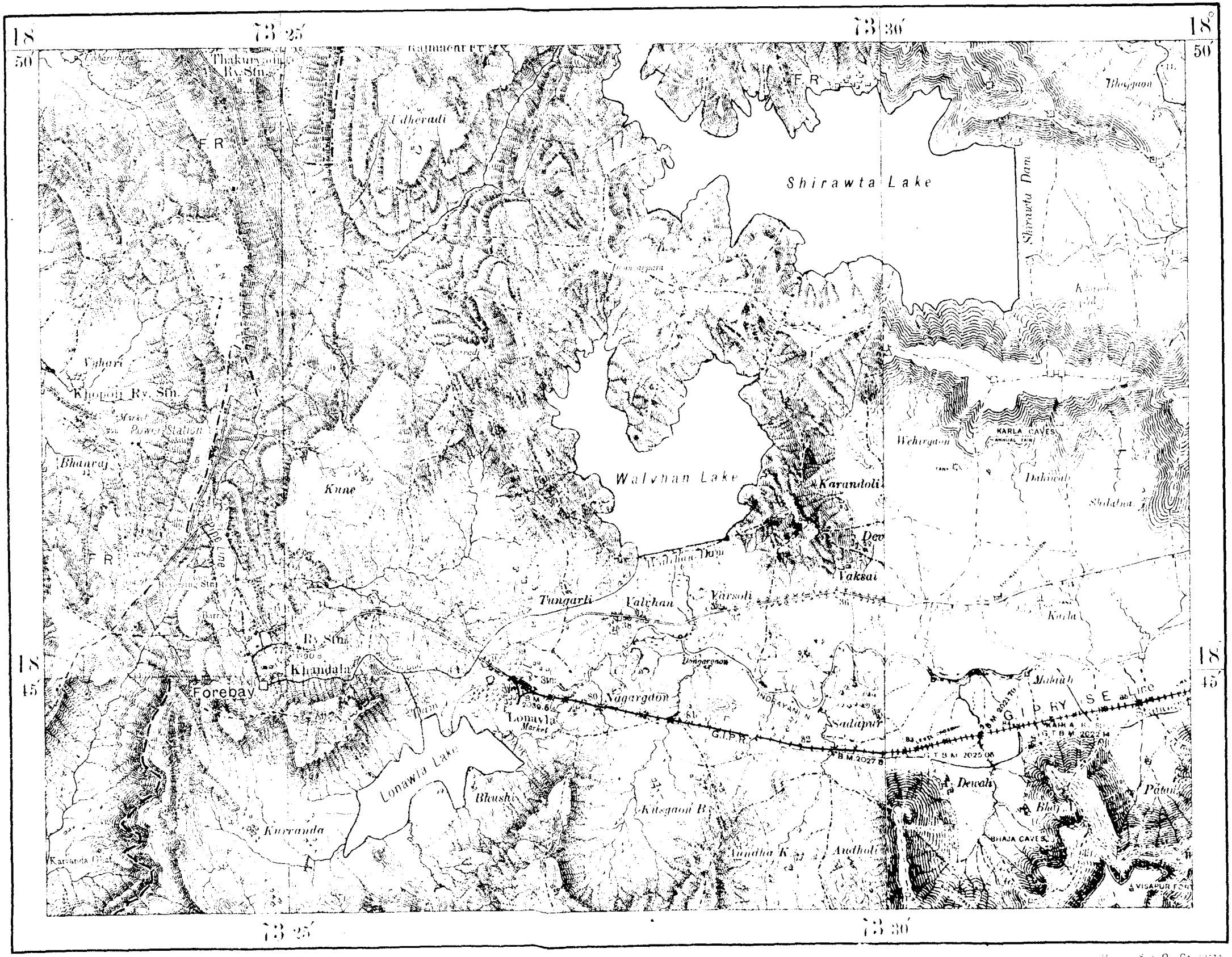
Where rivers are fed from the highest mountains the precipitation is largely in the form of snow, and the immediate run-off is small; the melting of the snow from about April onwards coincides with the driest season, and thus tends both directly to equalize the flow of the rivers and also to feed distant springs. At times however the more sudden melting of the snows brings down heavy floods, whether due to rainfall, as on the north-west frontier, or to hot winds, as in the Himalayas further east. To a certain extent also level marshy ground has an equalizing effect, acting as a sponge; and this property may be very valuable as it can in some cases be reproduced artificially by a series of low embankments and terraces.

10. *The measurement of a discharge.*—Wherever a stream offers possibilities of water power it is necessary to ascertain the minimum flow of water in it; this however may involve waiting for years, as it is only after an exceptionally dry season or succession of dry seasons that the true minimum is reached; and as this was the case in many parts of India in the cold weather of 1918 it may not recur for a long time. A cycle of about 30 years is required to determine the definite minimum. The minimum discharge of any year is however of

TATA HYDRO-ELECTRIC WORKS

GENERAL LAYOUT

Scale 1 Inch 1 Mile



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value, as some indication of the true minimum may then be obtained by examination of rainfall records in the neighbourhood, especially if the average run-off is known. To the skilled observer the method of taking a discharge is familiar; the usual constants will be found in Appendix II. Many persons not accustomed to this work—especially Forest officers and followers of Isaac Walton—may, however, be able to render invaluable help by estimating the flow of streams in out-of-the-way places. The amount of water in cubic feet per second (cusecs) flowing past a given point in any open channel is found by multiplying the cross-sectional area of the water in square feet by its *mean* velocity in feet per second.

Where the correct methods and co-efficients to be employed are unknown, the following very approximate method may be adopted:—

Select a straight reach of the stream where the flow is uniform and where there are no noticeable pools, and mark off with pegs any convenient length of fairly uniform width. Then measure as accurately as possible the width of the stream, and find the *average* depth by soundings at intervals across the stream. Then throw into the centre of the stream a small stick and note the time it takes to pass along the marked length; repeat this 4 or 5 times to eliminate errors. Then the run or length in feet divided by the average time in seconds gives the velocity on the surface. Then the cross-sectional area in square feet multiplied by the surface velocity in feet per second and *divided by two* will give the approximate discharge in cubic feet per second.

For instance, suppose the length marked off is 100 feet and the floats take an average time of 50 seconds in passing along this length, in a stream having a width of 40 feet and an average depth of $1\frac{1}{2}$ feet. This gives a cross-sectional area of 60 square feet. The surface velocity will then be 2 feet a second and the discharge $\frac{2 \text{ feet a second} \times 60 \text{ square feet}}{2} = 60$ cusecs.

The reason for dividing by 2 is that the mean velocity throughout the channel is much less than the surface velocity, and the rougher and shallower the bed may be the greater will be the disproportion; in the worst cases it is about half.

It sometimes happens that soundings cannot be taken in unfordable hill streams, and another very rough method which has proved of occasional use may be mentioned. Gaugings were required of a river, partly snow fed, at its junction with a smaller hill stream. The discharge of the latter was satisfactorily determined, but that of the former could not be measured. The temperature of the larger river was found to be 60°; that of the smaller one 64°; and of the combined river some little way down stream 61°. Then the volume of the large stream is thrice that of the smaller, for

60×3	=	180
64×1	=	64
4	into	244 gives 61°.

CHAPTER III.—LOCALITIES AND SURVEYS.

11. *Geographical considerations.*—Leaving aside for the present the canal falls and low river falls that it may be possible to develop in the plains a glance at the layered 16-inch Atlas sheets of the Survey of India shows that (without going into details) the following mountainous or hilly regions promise medium and high falls, where there is water enough to use them.

(*i*) The whole of the Himalayan and associated ranges that mark the Northern frontiers of India, from the Quetta District in the west right into the Northern Districts of Burma. Perpetual snows feed the great rivers and many of the smaller ones along the whole reach. (Atlas sheets 34, 35, 38, 39, 43, a corner of 44, 52, 53, 62, a corner of 63, 71, 72, 78, 83, 92). Unfortunately a great proportion of this territory lies outside British India; in Baluchistan and Afghanistan on the west, Kashmir and Jammu in the middle West, Tibet and Nepal in the central districts, Bhutan and Sikkim in the East and finally Yunnam in the extreme East. The Western part of the region is in the dry zone, and for the most part is not likely to offer much power; the remainder has considerable possibilities (*vide* rainfall map). Sheet 78 also contains the Khasia hill group, with high plateaux and great rainfall.

(*ii*) The West coast, comprising the hills from the Aravali Range in Udaipur, the whole of the Western Ghats, the Nilgiri Hills, and on down to Cape Comorin (Atlas sheets 45, 46, 47, 48, 49, and the Western part of 58; sheets 40 and 41 have no high ground and scanty rainfall).

(*iii*) The East coast from the Eastern Ghats and Ganjam down to Cape Comorin. Atlas sheets 57, 58, 65, 66, 73, 74; sheet 79 which includes Calcutta offers nothing except perhaps in the patch of the Chittagong hill tracts at the Eastern corner.

(*iv*) Of the remainder of the peninsula, inland, there is prospect of but little power in the parts of Rajputana, Central India and the United Provinces shown on Atlas sheet 54. The Central Provinces have considerable possibilities in the areas shown in Atlas sheets 55 (comprising the Chhindwara area) and 64, while the Bundelkhand and Baghelkhand hills on sheet 63 also merit further investigation. Hyderabad and the surrounding districts on sheet 56 also have considerable elevation, but the rainfall is precarious and there does not appear to be much indication of steep falls to the lower ground.

(*v*) Practically the whole of Burma, both the coast line and the interior up to the Shan States, offer great possibilities, especially as there are far more perennial rivers and streams here than elsewhere. (Atlas sheets 84, 85, 93, 94, 95, 96, 102).

12. *Maps and existing surveys.*—The Atlas sheets of India, which have been quoted in the preceding paragraph, are for the most part complete in the layered edition though a few are still in the preliminary or provisional stages. For the initial examination of a possible water power site no map on a scale of less than 1 inch to the mile is of much value, and then only if it is contoured. Many sheets on this scale have been issued by the Survey of India, but many still remain to be done; and, of those issued, a large number are not contoured but only show hills by "form lines" or "hill shading." Form lines are of little value in deciding how a channel can be taken from one point to another, or what capacity a dam will give, while these can be determined approximately on even a 1 inch contoured map. Hill shading is valueless for the purpose. It is particularly unfortunate to this investigation that so many of the most likely hills have hitherto not been mapped in detail, though it is quite natural that the more civilized areas should have been done first. For water power will as often as not be found in remote and inaccessible hill jungles, of interest only to the sportsman and the Forest Officer. Forest maps, on a scale of 4 inches to the mile, contoured at 500 foot intervals with intervening form

lines, are available for considerable tracts of country, including much high ground that may contain water power. Where this is so these maps are invaluable, but they are apt to end in a tantalizing manner just at the mid-point of a possible project, and there are many gaps in the middle of mapped areas. In addition to the above there are certain areas mapped on the scale of 2 inches to the mile; and the tracing out of contours on these is much less fatiguing than it is on the one inch maps.

A careful study of the largest contoured maps which are available will be found of great assistance in all reconnaissance work. In dense jungle or rough country it is frequently impossible to follow up the course of a stream, and unless the maps are carefully studied it may easily happen that a useful fall or a promising reservoir site is missed. A few examples are given below to indicate the kind of information which can be obtained from maps:—

(*a*) A flat or a steep valley or hill side is shown by the distance between the contour lines. The closer the lines are the steeper the country will be found.

(*b*) The distance between any two contour lines which cross a stream will give the fall in that reach.

(*c*) Absence of village sites and roads or pathways denotes wild or uncultivated country.

(*d*) Numerous habitations on the hill slopes or in a valley in hilly country denote cultivation, and generally springs or perennial water in the streams.

(*e*) When the discharge of a stream is known at a certain point, an idea of the discharge at another site can generally be guessed by a comparison of the catchment areas at the two places.

(*f*) By a study of the nature of the valleys and the hill sides, a fair idea can be obtained of the general nature of the country, and its possibilities with reference to reservoir sites, slopes of the stream, and places where an artificial fall for power purposes can be found.

(*g*) When a stream makes a long hair-pin bend, it is frequently possible to obtain a good fall by diverting the water in a tunnel across the neck of the bend. Several miles of a river can sometimes in this manner be replaced by a short cut diversion of a few furlongs.

(*h*) Sometimes the slopes on one side of a water-shed are very steep, while on the far side they are gentle, when this happens it may be possible to form a reservoir and divert the water through the hill, and by this means obtain a most useful artificial fall.

(*i*) By tracing a contour line along both banks of a stream, from any point that appears favourable for the head works of a power scheme, some idea can be obtained as to the possibility of carrying an open channel along to where there is a steep fall. Often one bank is much more favourable than the other, owing to the absence of cliffs or large nullahs which would have to be crossed or to very bad rock, as on the Jhelum Valley road, where the clay is found now on one bank and again on the other.

Where no contoured map can be obtained it is impossible to decide whether a development is practicable or not without a special survey, a lengthy and expensive matter. An examination of the ground by a trained observer, who knows what to look for, with an Abney level, a pair of aneroid barometers, and a thermometer, will however generally indicate whether such a survey is likely to be justified or not. This however is not likely to be of much value except in cases where the minimum discharge of the stream is already known—and it rarely is—unless undertaken in the driest period of the year, when gauging of the flow can be combined with examination of the ground and the rough determination of heights.

13. *Aneroid surveying.*—For the guidance of any person who may be able to examine new sites for water power it may be explained that while a mere record of the difference in height between two stations as given by an aneroid—*i.e.* between a possible head works and a power house site—is of value, the "reduction" of such observations is not a difficult matter. If the

date and hour of each observation and the temperatures are recorded the reductions can be made when observations have been sent in. An aneroid (and a mercury barometer for that matter) measures the atmospheric pressure, *not* the relative or absolute height of the station; but surveying aneroids are calibrated in feet of altitude as well as in inches of mercury, and the difference of two readings is an indication of the difference of level of the stations. They are normally compensated for the varying density of air at different temperatures, so that theoretically the varying temperature of the *instrument itself* should not affect its reading so long as the *atmospheric* temperature and pressure remain constant. This however, is far from being the case in practice, as may be seen by heating up an instrument. Furthermore a jar may easily cause a large index error. Where difference of altitude can be quickly measured several times in succession, without exposing the instrument to large changes of temperature, results correct to a few feet can be obtained; where however the readings are spread over a day's work in the sun discrepancies of as much as 100 feet may be found after reduction, even in the work of a skilled observer, especially in the intermediate readings during the day's march. There are two corrections to be made:—

(*a*) for the alterations of the atmospheric pressure during the period of the readings, including the diurnal variation;
(*b*) for the temperature of the air.

As regards the former, the best method is to have two aneroids, one of which is kept at one point and read at intervals, so that any rise or fall may be allowed for in the readings of the other. This however is seldom practicable, and the alternative is to apply the average correction for the diurnal variation for India given in Molesworth's "Pocket Book" under the heading "Aneroid levelling." For all practical purposes one inch may be taken as equivalent to 1,000 feet. This correction may amount to as much as 50 feet either way. It neglects any actual changes due to depressions, etc., which can however be obtained from the daily weather reports; but if readings are taken at the start of each day these are seldom of importance.

The temperature correction depends on the added temperatures at the two stations of observation, so these should be recorded at each reading. The difference in height of the readings (assuming the aneroid to be graduated in feet) has to be multiplied by a constant which will be found in Molesworth (loc. cit), varying from unity at $T+t=64°$ F. up to 1·137 where $T+t=188°$ F.

As an example is always preferable to a reference to rules and text books the records and reduction of part of an actual survey are given in Appendix III.

CHAPTER IV.—POWER AND ITS USES.

14. *Census of power used in India.*—In connection with the hydrographic surveys and coal conservation enquiries in various parts of the world endeavours have been made to ascertain the approximate amount of power used. Thus in the Preliminary Report of the Water Power Committee of the Conjoint Board of Scientific Societies we find (page 2):—

> "It is impossible to estimate with any pretentions to accuracy the power now being used in the various countries of the world. Independent estimates, based on such data as are available, tend however to show that it is of the order of 120 million horse power made up approximately as follows:—

World's factories, including electric lighting and street railways	75	million horse power.
World's railways	21	„ „
World's shipping	24	„ „
TOTAL	120	„ „

This includes all steam, gas and water power.

Of the 75 million horse power used for factories and general industrial and municipal activities, a rough approximation of the most probable distribution would appear to be—

United Kingdom	13	million horse power.
Continental Europe	24	„ „
United States	29	„ „
British Dominions and dependencies	6	„ „
Asia and South America	3	„ „

Enquiries were set on foot at an early stage of this investigation to ascertain the approximate power installed in various industries and localities in India. Previously this had only been done for electric power, where it was found in 1917 that the total amounted roughly to 215,000 kilowatts or say 285,000 electrical horse-power, of which 36 per cent. was obtained from water power*. The total units generated amounted to only 550 millions. For demonstrating the backward state of electrical development the following comparison with other parts of the Empire will be of interest. The watts installed per head of population† are as follows:—

	Watts per capita.
Canada	118
Australasia	62
South Africa	57
British Isles	33 = 1 ordinary glow lamp.
India	Under 1

If population be a poor criterion let the area per kilowatt ($1\frac{1}{3}$ horse power) installed speak:—

British Isles	$\frac{1}{12}$ square mile per kilowatt.	
South Africa	1·4 „ „ „ „	
Canada	3·5 square miles per kilowatt.	
India	7·6 „ „ „ „	
Australasia	11 „ „ „ „	Largely uninhabited.

The following figures are now available for the power of all kinds in use in certain parts of India at present; they are only approximations and are very incomplete. They have been compiled by the Directors of Industries or Controllers of Munitions for the most part, and it has been impossible to enter

* List of Electrical Undertakings in India, 1916-17.

† "A project for providing the Punjab with a cheap supply of Electric Power"; F. L. Milne, A.M.I.E.E. (Proceedings of the Punjab Engineering Congress, 1919.)

the full details here. Recommendations are however made for the completion of this necessary work, in para. 31 *infra*.

Assam (all forms of power)—

	Brake horse power.
Cachar	4,940
Darrung	2,980
Haligang	600
Kamrup	290
Lakhimpur	5,268
Sibsagor, Goalpara, Khasia and Jaintia Hills, Nowgong	4,619
South Sylhet	700
Sylhet	3,153
TOTAL	22,550

Bengal—

The returns compiled in this area, by the Controller of Munitions, are particularly comprehensive in their details and are accompanied by a map showing the totals in each district *exclusive of the Calcutta Industrial area.** A few returns have not yet been received. The results are as follows :—

	Brake horse power.		Brake horse power.
Bakarganj	42	Malda	12
Birbhum	34	Midnapore	2,750
Burdwan	15,371	Murshidabad	80
Calcutta area*	excluded	Mymensingh	45
Chittagong	697	Nadia	145
Dacca	874	Pabna	26
Darjeeling	1,824	Rajshahi	6
Dinajpur	25	Rangpur	29
Faridpur	12	Tippera	239
Jalpaiguri	3,109	TOTAL	25,318

The Calcutta Industrial area has the following known power, *viz.* :—

Jute Mills	about	85,000 b. h. p.
Cotton „	„	75,000 „
		160,000 „

In addition it contains the following number of works, of which the power has not been estimated :—

Bone Mills	8	Miscellaneous	9
Chemical works	11	Oil Mills	26
Cotton presses	3	Paper Mills	2
Distilleries	2	Rice Mills	7
Engineering works	36	Rope works	5
Flour Mills	11	Saw Mills	4
Glass work	1	Ship yards	8
Ice Factories	2	Soap works	7
Jute presses	19	Sugar Factories	1

These 162 factories may safely be assumed to have an average of not less than 100 b. h. p. installed, or a total of 16,200 b. h. p.

Bihar and Orissa—

Except for the coal mines, which obviously do not require water power, there are not many factories in this province ; and the low cost of coal and of waste gases in the steel works would, in any case, militate against the substitution of water-power. The indigo industry employs very little plant and that only for a very short period annually. There are sugar factories, mostly small, in Darbhanga, Saran, Champaran and Muzaffarpur Districts ; but their working season is only 6 months, and steam is in any case required for extraction of the juice. Small oil mills are scattered over the Province. Monghyr District contains a tobacco factory using 200 horse-power and the East India Railway Workshops using 2,000 horse-power. Darbhanga District has the Bengal and North-Western Railway works using 125 horse-power and in addition to the sugar mills mentioned above there are proposals for large rice mills. These however, following Rangoon practice, will probably use their own refuse for steam raising.

* The Calcutta Industrial area includes the districts of Calcutta, 24 Parganas, Hooghly and Howrah.

Bombay (10 out of 14 districts ; Bombay City not included)—

	Brake horse power.
Ahmednagar	773
Belgaum	600
Bijapur	1,900
Dharwar	1,031
East Khandesh	7,975
Kanara	25
Kolaba	90
Nasik	560
Poona (including electricity)	1,830
Ratnagiri	...
Satara	140
Sholapur	8,620
Thana	5,906
West Khandesh	3,422
TOTAL	32,872

As there are about 10 times as many Cotton mills in Bombay and Ahmednagar as in Bengal, it may safely be assumed that the power used in these districts for this purpose is not less than about 750,000 b.h.p.

A considerable part of this power is supplied by the Tata hydro-electric works.

Burma—

The Electric Inspector reports that all the existing large mills use their own refuse, chiefly paddy husk and sawdust, as fuel ; they are therefore not interested in water power supply. The Rangoon Electric Tramways also use paddy husk ; at present the clinker, which is almost pure silica, finds no market, but it may be used hereafter for glass making. In these circumstances a census of power is not of much use, and as the letters of the Deputy Controller of Munitions on the subject were not replied to no figures are available. It is estimated that the Cinchona districts of Tavoy will require about 750 horse-power and the mining districts 2,000 horse-power. There may be a demand in the Toungoo area for 600 horse-power for pulp manufacture. The oil fields in Yenangyoung and neighbourhood will require some 15,000 horse-power but this is being arranged for by the companies concerned, who will use their oil for fuel. This is the case now, but at present every well has its own steam engine, with oil-fired boiler, and a comprehensive electrical distribution scheme will effect great economy in fuel consumption.

Central Provinces—

	Brake horse power.		Brake horse power.
Akola	4,936	Nagpur	6,173
Amraoti	4,504	Nimar	2,665
Balaghat	50	Narsinghpur	54
Bhandara	25	Raipur	50
Bilaspur	110	Saugor	20
Buldana	3,548	Seoni	60
Chanda	712	Wardha	5,839
Chhindwara	88	Yeotmal	1,900
Hoshangabad	605		
Jubbulpore	1,420	Total	32,773
Mandla	14		

Madras—

DISTRICT.	Brake horse power.	
Bellary	3,232	
Chingleput	1,783	70 rice mills ; 6 irrigation plants ; 2 water works ; 2 others.
Chittoor	217	7 rice mills ; 3 irrigation plants ; 1 metal works.
Cuddapah	1,162	31 gins and decorticators ; one irrigation plant, 2 water works ; 3 others.
Ganjam	591	7 rice mills ; 6 others.
Godavery	3,220	59 rice mills ; 4 ginning.
Guntur	2,096	24 rice mills ; 15 ginning ; 4 others.
Kistna	7,532	
Kurnool	1,388	5 presses ; 26 ginning ; 2 oil mills ; 5 others.
Malabar	4,149	16 tea factories ; 12 brick and tile ; 35 various.
Madura	812	
Nellore	917	21 rice mills ; 5 others.

Madras—contd.

DISTRICT.	Brake horse power.	
North Arcot	1,810	
Ramnad	1,588	25 rice mills; 9 ginning; 1 electric.
South Arcot	1,227	58 irrigation plants; 35 rice mills; 7 others.
Tinnevelly	4,824	20 ginning; 6 rice mills; 18 others.
Trichinopoly	1,149	47 rice mills; 18 irrigation plants; 4 others.
Vizagapatam	1,871	9 rice mills; 17 various.
TOTAL	39,568	

North-West Frontier Province—

No returns received.

Punjab. (Steam only)—

	Brake horse power.
Ambala	1,020
Amritsar (excluding electricity and oil)	1,563
Bhitak	150
Dera Ghazi Khan	186
Gujranwala	781
Gurdaspur	500
Gurgaon	516
Hissar	825
Jhelum	520
Karnal	558
Lahore (excluding electricity)	2,333
Ludhiana	1,285
Lyallpur	2,491
Multan	1,060
Muzaffergarh	126
Rawalpindi	525
Shahpur	881
Sialkot	284
Simla (excluding electricity)	130
TOTAL	15,734

United Provinces—

	Brake horse power.		Brake horse power.
Agra	2,810	Jallaun	387
Aligarh	1,585	Jaunpur	...
Allahabad	1,648	Jhansi	255
Almora	84	Kheri	52
Badaun	272	Lucknow	2,991
Bahraich	203	Mainpuri	306
Banda	269	Meerut	702
Barabanki	186	Mirzapur	388
Bareilly	1,297	Moradabad	1,138
Benares	1,797	Muzuffernagar	317
Bijnor	243	Muttra	810
Bulandshahr	1,458	Naini Tal	432
Cawnpore	8,864	Nowgong	53
Dehra Dun	485	Philibhit	535
Etah	500	Partabgarh	65
Etawah	780	Rai Bareilly	60
Farukhabad	361	Saharanpur	1,176
Fatehpur	106	Shahjehanpur	940
Fyzabad	238	Sitapur	323
Gonda	341	Sultanpur	21
Gorakpur	2,110	Unao	506
Hamirpur	77		
Hathras	1,627	Total	38,548
Hardoi	350		

This is exclusive of public electric supply and Military Works power stations but includes minor electric installations.

Summary—

	Brake horse power.
Assam	22,550
Bengal	25,318 exclusive Calcutta area.
Calcutta area	176,200
Bihar	2,325 apart from collieries, etc.
Bombay Presidency	32,872
Bombay City area	750,000
Burma	17,750 exclusive of rice mills, etc.
Central Provinces	32,773
Madras	39,568
North-West Frontier Province	...
Punjab	15,734 steam only.
United Provinces	38,548
GRAND TOTAL	1,153,638

15. *Further uses for power.*—For a full discussion of the new industries which may arise in India, if cheap electric power is available, the Report of the Indian Industrial Commission must be referred to. The "Industrial Handbook 1919" issued by the Indian Munitions Board also merits close study. Among these industries may be mentioned the electric smelting of indigenous iron ores and the electrical production of steel and its alloys; electric welding, now extensively employed; the production of aluminium from alumina, prepared from the local bauxite deposits; the manufacture of calcium carbide and its innumerable derivatives; the direct fixation of atmospheric nitrogen into the nitrates of commerce; the electrolytic production of chlorine gas and the preparation of phosphorus and of abrasives like carborundum. All these processes are in actual use in various parts of the world where the raw materials and the power are found. The map in this report has marked on it information regarding the occurrence of certain of these raw materials. In some cases the process is electro-chemical, in others electro-thermal, but in all cheap power and large scale production are essential to success. The following further extract from the Preliminary Report of the British Water Power Committee will emphasize what has been done and what may in future be done in some of these matters:

> "Electro-metallurgy and electro-chemistry have rendered it possible to handle materials not workable by any other means; have made available new materials; and have greatly cheapened the production of many important materials of wide use. Aluminium, calcium carbide, chromium, cyanide, silicon, carborundum, are products rendered commercially possible only by electrical processes, while alkalies, hypochlorite, phosphorus, magnesium, and sodium nitrate are produced most economically by such processes. Great developments have recently taken place in the production of electrolytic copper and zinc and in processes for the electric smelting and refining of metallic ores.
>
> All these processes demand relatively large amounts of energy. The world's production of calcium carbide, for example, was 340,000 tons in 1913, requiring 400,000 continuous electric horse-power for its production, while the energy used at the end of 1915 for electric furnaces in the United States alone was approximately 300,000 electric horse-power.
>
> *Nitrogen Fixation.*—In the utilization of atmospheric nitrogen for the production of nitric acid and the manufacture of nitrates, great developments have taken place during the last decade, and in Norway alone over 400,000 electric horse-power is now absorbed in its production. The world's annual consumption of nitrogen in its various combinations is about 750,000 tons, representing a value of about £50,000,000 and this demand is increasing yearly. Four-fifths of this supply has been produced hitherto from natural nitrate deposits, but in view of the rapid depletion of these deposits, and of the diminution in the fertility of most of the great wheat and cotton-growing areas of the world, the production of artificial fertilizers by one or other system of nitrogen fixation must, in the near future, become a question of national importance.

At the present time the world's consumption of fertilizers amounts to close upon 6,000,000 tons per annum, and this will probably be doubled within the next 20 years. To-day, the efficiency of the electrical production is low, amounting in the case of calcium nitrate to about three-quarters of a ton per electric horse-power year. By adopting the cyanamide process the consumption of energy may be cut down to about one-fourth, but even in this case the production of the equivalent of 12,000,000 tons of fertilizers per annum would require 4,000,000 continuous electric horse-power.

It is estimated that the 260,000,000 acres of arable land in Canada alone may ultimately require some 10,000,000 tons of nitrates per annum to maintain their fertility, and this in itself would necessitate the absorption of an appreciable portion of the whole hydraulic energy of the Dominion.

When to these demands are added those of India, Australia and Africa, it is evident that the fertilizer demand of the Empire will in itself call for an enormous supply of energy."

Apart from ordinary town supply for electric lighting, heating and fans and supply to tramways and railways (especially hill lines) for traction purposes, there are many other industries in which electric power would be welcomed if it could compete with other forms, and in any area where reasonably cheap hydro-electric development is possible within transmission distance this successful competition is simply a matter of relative costs. To take one instance, in a comparatively small area of the Duars, within easy reach of water power, (*i.e.*, the Jaldaka q.v., in chapter 6), it is estimated that fuel equivalent to a working load of about 100,000 horse-power, is used in the tea factories; partly for the production of power from steam engines, but mainly for drying purposes with hot air and fans. Both the motive power and the hot air can be obtained electrically; it is merely a question of comparative costs. Other tea districts are similarly situated. Again, the cotton mills of Bombay are now mostly driven by electric motors fed from the Tata scheme, which have replaced steam engines. There may, given cheap enough power, be a similar opening for jute mills, oil mills, timber working, sugar production, paper pulping and other industries. The two sets of rival conditions that make or mar a hydro-electric project will presently be examined; namely, the competition between fuel and water and that between the freight on materials and the transmission of power.

As regards pumping for irrigation purposes, somewhat wild suggestions have been made under the impression that "water power costs nothing." It is very unlikely that such pumping will pay on any water rate that could be demanded, where the lift is at all great. It has already been shown in para. 1 that under favourable conditions the overall efficiency from water to electrical horse-power at the generator terminals will be about 85 per cent. By way of example let a gross pumping head of 100 feet, from the source of water to the distributing irrigation channel, be assumed; this is probably over the economic limit, but as the power taken is practically proportional to the head the example can be reconstructed for any lower value. Assume further that 2 cubic feet per second (*i.e.*, 12½ gallons or 125 lbs. per second) is to be pumped up this 100 feet, absorbing 22·7 theoretical water horse-power. A modern turbine pump in these circumstances will have an efficiency of 75 to 77 per cent. and will require about 30 brake horse-power to drive it. The electric motor giving this mechanical power will have an efficiency of about 90 per cent. so that it will take some 33·2 electric horse-power at its terminals. If a transformer is necessary the input into it from the line will then be about 34·2 electric horse-power. If the transmission losses are taken at 10 per cent. the line must be fed at the power station with 38 electric horse-power. If there is no transformer here the generator will supply this amount of power, and on the overall efficiency assumed in this report it will use 44·7 theoretical water horse-power. *Thus the overall efficiency from water falling to water raised will be practically 50 per cent. under the best conditions.* The capital charges on the cost of the motor with its housing, its pump and its pipes, together with a share of the charges on

the distribution system and power station, have to be met from the additional revenue due to the supply given. If the lift of the pump were 10 feet instead of 100 then ten times the amount of water could be pumped for the same power, and ten times the acreage irrigated. The proposition would then become more practicable.

Experimental work in sub-soil pumping by means of tube wells has for some years been in progress at Amritsar, Punjab; see table 2. Sir John Benton, K.C.I.E., late Inspector General of Irrigation, took up the matter with keen interest and the work has been in the hands of Captain John Ashford, M.I.C.E. The late Mr. Barlow visited this canal fall development a week before his death, and was greatly struck with the possibilities of the method for adoption in the United Provinces, where the present intensity of cultivation is less than 25 per cent., of the total area. Canal falls abound, as will be seen in Appendix 14, and sub-soil water is plentiful. Mr. Barlow hoped to see experimental work carried out in this area.

16. *Fuel and water power.*—It has already been stated that the commercial possibilities of any hydro-electric scheme depend on two factors, the capital cost of the scheme on the one hand and the cost of the competing fuel on the other. Comparing a steam or oil-driven electrical plant with one water-driven, the latter is almost invariably much more expensive to construct; and all it saves is the cost of fuel, which is only one factor in the cost of generating power. Staff and stores, office and legal expenses, repairs and depreciation are incurred in both. Thus while the actual comparison will be between the price at which electricity can be sold in both cases the real criterion of success is whether the capital charges for interest and depreciation on the *excess* cost of the water power undertaking will be substantially less than the cost of the fuel used by the other. The following extract from an article by the present writer in the Indian Munitions Board's "Industrial Handbook, 1919," reprinted from the Bengal Economic Journal, 1918, on "The future of hydro-electric power in India" will repay study.

"It is obvious that large capital expenditure is necessary on the hydraulic development; furthermore as water power must be developed where it is found a long transmission line is often necessary. For these reasons the total cost of construction is almost invariably higher than that of a steam-driven plant of the same capacity; and the annual capital charges for interest and depreciation are correspondingly higher.

"Against this may be set the fact that the running costs of such a station are relatively low, as no fuel is involved. The total cost of running does not depend to any appreciable extent on whether the plant is fully or only lightly loaded; it is practically *a fixed sum per annum*; so that the cost *per unit* is practically proportional to the total number of units generated. This is not so with fuel-consuming stations. Every extra unit generated then involves the consumption of a definite amount of fuel with a definite cost; and while the total cost rises with the number of units generated and the cost per unit falls somewhat, the latter is by no means proportional to the total units. In any particular case therefore the practicability of a hydro-electric scheme depends on the cost of fuel in the locality where the power is wanted.

"To take an example, assume a plant of 5,000 kilowatts capacity is required at a certain place where sufficient water power exists within transmission distance. Assume the total cost of the hydro-electric scheme and transmission line to be Rs. 50,00,000. (It might be very much less in favourable circumstances.) Taking interest and depreciation together at 10 per cent. the annual cost on this account will be Rs. 5,00,000.

"Let the cost of a steam plant of the same capacity, built where the power is actually needed, be assumed to be Rs. 15,00,000 with similar annual capital charges of Rs. 1,50,000. Now if for simplicity it be assumed that the annual charges for wages, stores, repairs and supervision are the same in both cases (an assumption near enough to the truth) there will be the difference between Rs. 5,00,000 and Rs. 1,50,000 or Rs. 3,50,000 to set off against the cost of fuel for steam raising. Under the ideal conditions of large electro-chemical works this plant, allowing 1,000 kilowatts to be kept for spare and therefore 4,000 for work, would generate about 28 million units (80 per cent. load

factor). Under ordinary industrial conditions the output would be less than half this, or say about 12 million units. Clearly therefore not only the cost of coal but also the load factor of the plant (*i.e.*, in non-technical language the ratio of its actual to its possible output) is of immense importance. If it is assumed that the low amount of only 2 lbs. of Indian coal will be required per unit, with modern plant of large size, the consumption would be 25,000 tons for 28 million and 10,700 tons for 12 million units. As the amount available to make the costs just balance out between steam and water power is Rs. 3,50,000 it follows that with the larger output coal at Rs. 14 per ton would absorb this amount, while with the smaller output the figure would be nearly Rs. 33. From this example (in which the figures are not meant to represent estimates) it will be inferred that as the load factor rises towards the ideal limit the advantage of hydro-electric power increases. Bearing in mind the vast difference in the cost of fuel in different parts of India, due mainly to railway freight, it will also be seen that the distance from fuel supplies is a very material factor. With coal under Rs. 10 per ton it is doubtful if water power could ever compete unless (rare combination) it existed right on the spot and could be developed exceptionally cheaply. On the other hand, with fuel at over Rs. 30 a ton, water power would generally prove cheaper and, for a well-sustained industrial load, invariably. Between these limits proper estimating would be necessary."

A map* has been prepared in the Coal Controller's office to show very roughly the cost of coal at certain places in India which are on the railways; this cost is the selling price at the pit's mouth plus railway freight. Clearly at any distance from the railway the cost will be increased, and that heavily, by the cost of carriage by road. A point which it is desirable to emphasize here is that in certain circumstances water power may be of immense value whether it be within reach of cheap fuel or hundreds of miles from it; *i.e.* where it is required *not* for existing industries but for a new electro-chemical or electro-thermal industry. These, working almost continuously at full load (*i.e.*, with a load factor of 90 per cent. or more), *must* go where there is cheap water power; and when 50,000 horse-power or more is being developed a very large capital expenditure on dams and other hydraulic works can readily be faced.

17. *Freight and transmission of power.*—The popular fallacy that "water power costs nothing" has been examined as regards the initial cost of the plant in the previous paragraph. The cost is generally further increased by that of transmission lines, since water power is seldom situated precisely where it is required. Either the power must be carried to the industry or the raw material and finished products of the industry must be taken to and from the power. Both ways cost money. The following further excerpt from the article in the Munitions Board's "Industrial Handbook, 1919," quoted in the preceding paragraph, explains the matter more fully.

"Where electro-chemical industries on a large scale are in question it is essential that the price of the power shall be very low if the manufactured product is to compete with that produced elsewhere. The cost of power is of course only one item amongst many in determining the sale price of the finished article, but it is a very important item—perhaps second only to the freight of the raw material to site and the finished product to market. Where the conditions of the hydraulic development are such that construction on a large scale is reasonably cheap; where the locality is such that the freight of the plant and materials thereto is low; and where the length of transmission to the factory is reasonable; power can probably be delivered at about one-tenth of an anna per unit including all charges. Indeed, if the cost is much higher than this, the proposition becomes untenable. Obviously the undertaking must be on a fairly large scale to be of any use. The larger the individual units of plant are made the smaller becomes their prime cost per kilowatt and the higher their efficiency. The various electro-chemical industries are favourable to these low costs as they are practically continuous processes, utilizing the whole plant to almost its utmost capacity throughout the year.

* Not received at the time of going to Press.

"In considering the value of sites that may possibly meet these ideal conditions the first point to consider is undoubtedly that of freight and carriage; for it has a triple application. In the first place the raw material must be brought to the site, unless already on it; secondly the finished product must be taken to its market; thirdly the plant must be delivered at the power house. Cases are known where the carriage of plant over 20 miles of mountain roads cost more than its freight from England to the railway terminus. Cheap power is useless if the saving is swallowed up in expensive freight. Where bulky raw material has to be brought to the factory and sent back finished the obvious course is to build an electric railway from the nearest terminus, seeing that cheap power for working will be available. In order to get the plant to the power house there must be a road, and this road should be built so as to afford a suitable track for the subsequent railway. During the construction period a light line worked by steam will probably pay as against other methods of transport of the plant. The tendency of the man who put his travelling crane up after erecting his plant is often only too apparent in these matters, and carriage by coolie is seldom cheap.

"From small beginnings electrical transmission of power has now reached the stage where it is possible to have the factory 250 miles or more from the power station, and it would be unwise to say that the limit of high pressure has been reached. In the case of water power from mountainous country there may be insuperable difficulties of ground or cost in laying out a railway to the site, though the plant can be transported there. Even if these difficulties do not exist, if the raw material of the industry is within the limits of transmission it will probably prove cheaper to erect a long transmission line rather than a railway, which may use more power than will be lost in transmission. It is simply a question of estimating which method gives the cheapest finished product. Either the material can be brought to the power house; or the power to the factory; or a combination of both methods may be the best. Mountainous country has one great asset for transmission in that the ridges form nature's own supports for the lines; with comparatively small towers the valleys offer plenty of room for the dip of the wires on long spans. It also follows that by reducing the number of points of support, by the use of long spans, there are fewer points at which damage from lightning can occur. The loss in transmission can be made almost as large or as small as the designer chooses, according to the size of the wires used; ordinarily about 10 per cent. is allowed. Where steam is used to generate the power the correct loss can be calculated according to Kelvin's law and its modifications, such that the capital charges on the conductors balance the cost of the power lost in them. If more power is required more generating sets can be added indefinitely. With unlimited water power the cost of the lost power is of secondary importance, and larger losses may be advisable than in the former case. On the other hand, if the available power is likely to be all required—and this is generally the case—the line losses may have to be reduced to very low amounts, since every unit available for the factory is of value."

The cost of transmission lines operates detrimentally in two ways; first by increasing the prime cost and consequent capital and upkeep charges, and secondly by decreasing the available energy for sale at the far end, owing to losses in the line. These line losses can be made almost as large or as small as the designer chooses, but if they are made small it is by adding more copper wire, or larger wires, so that this reacts on the prime cost. The statement is often made that a long transmission line only means a loss of about 10 or 15 per cent. of the power generated; true, but it may increase the economic selling price vastly more. It has been recorded (Electrical Times, 55, January 2nd 1919) that the cost of transmission at Niagara, which extends to a distance of 250 miles, ranges from 22 to 86 per cent. of the total cost of the power delivered, according to distance. These figures would be greatly improved on under modern conditions, at any rate with pre-war prices, but they serve as an indication that water power does not "cost nothing."

18. *Admissible cost of hydro-electric Schemes.*—While it must never be forgotten that generalities and averages in engineering problems are

apt to be most misleading it is nevertheless desirable to give some indication, however it may contravene this canon, of the permissible cost of hydraulic developments. A table showing the cost of the schemes now in operation, including power house and plant but *not* transmission, is given in paragraph 23. Obviously, from the two preceding paragraphs, as the cost of fuel rises the permissible cost of water power rises too. But, against this, the further the power has to be transmitted, the greater will the capital cost and losses become. Arising out of both of these truisms it is clear from what has gone before that, other things being equal, fuel has an advantage when the plant is not fully loaded most of the time, *i.e.* when the load factor is bad, while on an exceptionally good load factor water power has an immense advantage. We have then to combine these factors:

Cost of fuel,
Cost of transmission,
Load factor.

To make the matter clear an example may be given, but *it must not be taken as an estimate*; it is full of assumptions, none of which can be laid down as facts. Assume that 10,000 electrical horse-power is required for use in a certain district, and that the alternatives are steam and water power, each the most modern of its kind. Any other power of the same order would come to much the same thing. The steam power station would be placed as a matter of course in the most favourable site within the area; the hydraulic plant would go where nature placed it. Three cases may be assumed, *viz.*, water power on the spot; transmission of 50 miles; transmission of 100 miles. As regards fuel three representative prices will be taken, *viz.*, Rs. 8, Rs. 16 and Rs. 24 per ton for Bengal coal of about 11,000 British Thermal Units calorific value; the first is about the price at the radius from the coal fields of Calcutta, on the railways, and the other prices will be found further off. Four characteristic load factors will also be taken, *viz.*, 20 per cent., 40 per cent., 60 per cent. and 80 per cent. So far the assumptions are admissible. In order to reduce the matter to graphic curves let it now be assumed that the cost of the power station, with all the plant within it, is sensibly of the same order for the steam and water power plant; excluding of course the transmission line and the hydraulic development beyond the power station. The distribution lines, etc., for employing the power at its destination, and the power lost in them, will be unaffected to all intents by the method of generation, and may also be left out of account. Then the cost of fuel on the one hand has to be set off against the cost of the hydraulic development on the other. With modern boilers and steam turbines, using Bengal coal, an average consumption of 1½ lbs. per electric horse-power hour generated may be taken as an extremely good figure, though in a super-station it might be excelled on a high load factor. Using this consumption at each of the stated load factors and prices, though actually the consumption on a poor load factor would be somewhat higher, the following table gives the cost of fuel per annum in column 3.

This has then been capitalized in column 4 at the round figure of 10 per cent. for interest and depreciation to show the sum in lakhs of rupees which can be spent on a hydraulic development on the same spot. Dividing by 10,000, column 5 gives this as the permissible capital cost per electric horse-power installed, where there is no transmission.

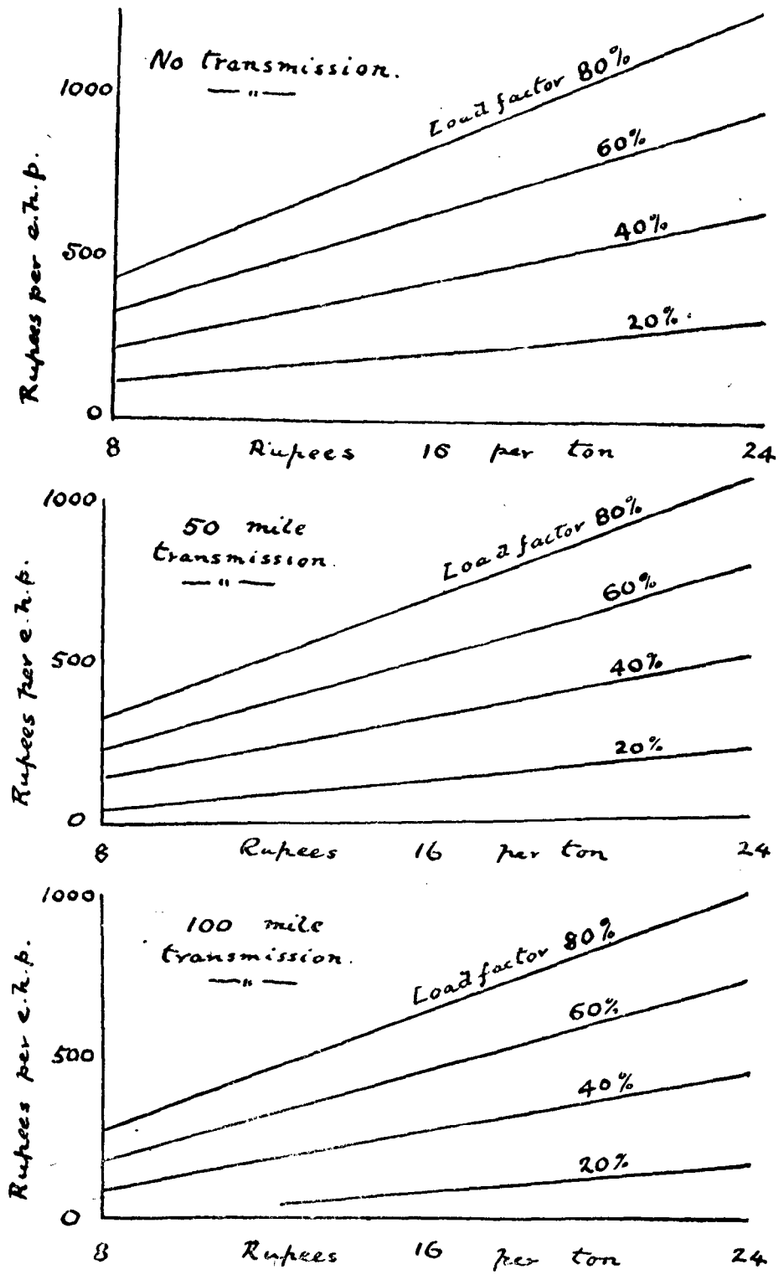
Next, a transmission line of 50 miles is assumed, with a loss of power of 10 per cent. The cost of the line is placed at the reasonable amount of Rs. 10,000 per mile, or 5 lakhs, which is deducted from column 4 and the result is given in column 6. But to deliver 10,000 electric horse-power while losing 10 per cent. the plant must be of 11,200 electric horse-power and the extra capital cost of this at Rs. 100 per electric horse-power (1·2 lakhs) is further deducted in column 7. The values so obtained, divided by 11,200, give the permissible cost of the hydraulic development per e. h. p. installed in column 8.

For the transmission of 100 miles the same procedure is adopted in columns 9 to 11, with a line loss of 15 per cent., an extra capital cost of 10 lakhs for the line, and a plant of 11,750 electric horse-power installed.

Table 1.—Admissible cost of Hydraulic Development.

Load Factor.	Cost of fuel per ton.	Cost of fuel per annum.	Capitalized value at 10 per cent.	WATER POWER AT SITE; NO TRANSMISSION.	TRANSMISSION 50 MILES.			TRANSMISSION 100 MILES.		
				Admissible capital cost of hydraulic development only per electrical horse-power installed. 10,000 e. h. p.	Column 4 less 5 lakhs for cost of transmission.	Column 6 less 1·2 lakhs cost of additional plant for transmission losses.	Admissible cost of hydraulic development only per electrical horse-power installed 11,200 electric horse-power.	Column 9 less 1·7 lakhs for cost of additional plant for transmission losses.	Column 4 less 10 lakhs for cost of transmission.	Admissible cost of hydraulic development only per electrical horse-power installed 11,750 electric horse-power.
Per cent	Rs.	Lakhs.	Lakhs.	Rs.	Lakhs.	lakhs.	Rs.	Lakhs.	Lakhs.	Rs.
1	2	3	4	5	6	7	8	9	10	11
20	8	1·06	10·6	106	5·6	4·4	39	0·6	...	...
	16	2·12	21·2	212	16·2	15·0	134	11·2	9·4	80
	24	3·18	31·8	318	26·2	25·0	223	21·8	20·1	171
40	8	2·12	21·2	212	16·2	15·0	134	11·2	9·4	80
	16	4·24	42·4	424	37·4	36·2	322	32·4	30·7	261
	24	6·36	63·6	636	58·6	57·4	511	53·6	51·9	441
60	8	3·18	31·8	318	26·2	25·0	223	21·8	20·1	171
	16	6·36	63·6	636	58·6	57·4	511	53·6	51·9	441
	24	9·54	95·4	954	90·4	89·2	795	85·4	83·7	712
80	8	4·24	42·4	424	37·4	36·2	322	32·4	30·7	261
	16	8·48	84·8	848	79·8	78·6	700	74·8	73·1	622
	24	12·72	127·2	1,272	122·2	121·0	1,080	117·2	115·5	980

Plotting the values so obtained they become more intelligible. The cost of storage works, canals, regulating reservoirs, pipes, etc., varies so enormously in various instances that each case must be judged on its merits. It is clear, however, that with bad load factors and cheap coal no water power can compete, while at the other extreme water power will generally have the field to itself.



To bring home the fact that the examples given must not be relied on except to establish a principle it may be pointed out that the extremely low coal consumption assumed per electric horse-power hour is nowhere obtained in India at present, and in very few places elsewhere ; it represents the best side of the case for fuel. If an average consumption of 3 times the amount, or $4\frac{1}{2}$ lbs. per electric horse-power per hour, be assumed it will still be better than most Indian power stations can command. Load factors on these stations are mostly of the order of 40 per cent. If the same process of calculation be adopted for these new values the result is to raise the permissible cost of hydraulic develop-

ment considerably. On the 3 assumed costs per ton the outlay may now be Rs. 636, Rs. 1,272 and Rs. 1,908 for a station at site; Rs. 510, Rs. 1,070 and Rs. 1,674, with a 50 mile transmission: Rs. 440, Rs. 980 and Rs. 1,520, with a 100 mile transmission. The curves can, if desired, be extended to show these new limits; and the facts of any specific case will probably then lie within the area of the limits of each.

CHAPTER V.—CONTROL OF WATER POWER.

19. *State control and assistance.*—The British Water Power Committee expresses a strong opinion in favour of State control of all water power, and its argument must be given in full :

"The considerations already outlined would indicate that the conservation and utilization of the water power resources of the Empire is likely to be one of the most important problems in our political economy. The solution of this problem involves many complex questions of law, of administration, and of engineering and economic investigation, if the public interest is to be best served by the development. In view of the immensity of the interests involved, it is urged that nothing short of statutory control of these developments is desirable. The exact method of control is not for the Committee to suggest. So far as is possible private enterprise should be encouraged, but under conditions which would prevent the perpetual rights being lost to the community. In this connection it is worthy of note that Canada and New Zealand have State control over the majority of their water powers, and that in all provinces in India there are Canal Acts which expressly lay down that Government is entitled to use and control for public purposes the water of all rivers and streams flowing in natural channels. In the case of Australia, each State has enacted lengthy legislation in relation to water conservation, but no special clauses appear in respect of developable water power. It is also suggestive that the Administration in Washington is at present taking steps to control the development of water-powers on all public lands and navigable streams in the United States; that, in spite of the revolution in Russia, the provisional Government has recently appointed a Water Power Committee, with absolute control over the development of all water power schemes in the Empire exceeding 300 horse-power; and that the Austrian Government has, during the past session, introduced a bill for the promotion of hydro-electrical development, giving the State the right to acquire any undertaking after the expiration of 25 years, and at the end of any subsequent period of five years.

"It should be recognized, however, that while it is essential that the State should have the right of ultimate purchase, the period of such purchase should not be unduly short or the terms too onerous. It will be remembered that such legislation had the effect of severely handicapping the electric power and lighting industry in the early days of its development."

During the course of this preliminary enquiry the question of the policy to be adopted was discussed on various occasions with public officers, firms and individual engineers. A policy suitable for one part of India may be the reverse elsewhere. Thus in Bombay it is recognized that the chain of great projects extending down the Western Ghats, from the Andhra Valley to the Koyna River, covers all likely power requirements for a long time to come. Here the enterprising firm of Messrs. Tata can provide both the capital, the business organization and the engineering talent required. The help of Government however is required in such matters as land acquisition and water rights, transmission routes and so forth.

Elsewhere it is generally considered that more direct Government assistance will be required. At present there is a vicious circle of industries that require power and power looking for an assured outlet ; and neither side is inclined to make a move unless certain of the co-operation of the other. An example already exists of established water power going a-begging, within transmission

reach of a considerable demand, and whatever the reasons may have been that led to this *impasse* it has undoubtedly had a deterrent effect on similar enterprise elsewhere. There may be cases where the carrying out of a project by Government may be advisable, if investigation proves that the indirect benefit to the country of cheap power will counterbalance a comparatively small return on the capital invested in the power scheme. Generally however the trend is rather in the direction of a Government guarantee of interest during construction and of a minimum return thereafter, which would be recouped, in successful undertakings, by some form of sliding scale or profit sharing, or both. In certain provinces indeed it seems likely that the capital itself may have to be provided by Government as a loan, on similar terms to municipal loans, with a period of repayment equal to the probable economic life of the plant, *i.e.*, nearer 20 than the customary 30 years ; but here again a guarantee of a minimum interest on the one hand and a share of the excess profits over a moderate return on the other hand may be essential if the dependant industries are to be fostered. The principles of Government aid which have been set down should, it is considered, only apply to the development of water power (*a*) by a public utility company or (*b*) for the purpose of an industry in which Government has a particular interest or (*c*) for an industry which it is particularly desired to foster. A company developing power for its own factories, not coming under heads (*b*) or (*c*), would not usually require help.

The further question of indirect encouragement to power concerns by a guarantee to take the products of the industries using the power, on the analogy of that given to the Tata Iron and Steel Co., has also been suggested ; but this is beyond the scope of the present report. Direct Government control of a power scheme, once established, beyond that required for the purposes of finance, is generally deprecated. Attention was called on more than one occasion to the fact that Government is apt to be unwilling to scrap antiquated plant, although by so doing ultimate economy would result. This criticism also applies to a considerable extent to British firms, especially as compared with American practice.

In Madras certain flourishing industries were started as demonstration plants by Government and then handed over to companies as " going concerns " ; the reverse of the ordinary plan that renders a privately started public utility undertaking liable to eventual purchase by Government or a local authority. Each plan has its good points. The suggestion that pioneer hydro-electric plants should be laid down by Government in favourable localities was mooted on several occasions. As a matter of fact most of the existing plants in India have been highly successful, and further demonstration seems hardly necessary except perhaps in localities far removed from the present installations. On the other hand, the risk of loss is small and the indirect gain in a well thought out scheme is certain. It comes to this then, that, whether by means of pioneer installations or by guarantees to private companies, direct Government aid is asked for practically everywhere except in the Western Ghats. The late Chief Engineer of this Survey was himself strongly in favour of *both* courses, and the present writer agrees with him. It may be mentioned here that the Hydro-Electric Power Commission of Ontario proposes to expend no less than £2,897,000 on 12 power stations at various places in the Province.

As regards Government assistance in the preliminary investigation, and even in the detailed survey of sites there is no difference of opinion. To what extent this is necessary or will be given remains to be settled by Government, but any help of this sort will certainly be welcomed. The cost of the preliminary investigation of a site that may prove worthless is very considerable. Again, as regards roads, railways and communications generally, the public naturally looks to Government for help. Before any site can be developed for power it is necessary to be able to convey plant and material there, and the cost of making a long mountain road might easily wreck a promising scheme.

The Water Power Resources Committee of the Board of Trade (a different body to the Committee of the Conjoint Board of Scientific Societies referred to elsewhere) in their Preliminary Report make the following remarks which, *mutatis mutandis*, are to a great extent applicable in India :

"From a broad review of the position, it is abundantly clear to the Committee that, in the development of the water power resources

of the United Kingdom, certain fundamental principles must be observed. For instance :—

(*a*) The whole of a watershed must be thoroughly studied and the fullest use made of its potential water power consistent with reasonable capital expenditure. A development which would only result in a part of the power being utilized should not be permitted if the ultimate use of the whole available power is thereby prejudiced.

(*b*) Proper regard must be shown to the interests of domestic and trade water supplies, fisheries, the drainage of adjacent lands, canals, and inland navigation, and in certain cases to local amenities.

Neglect to give consideration to some of these requirements has been responsible in the past for failure in the promotion of some water power schemes.

(*c*) A part of the available power must be reserved for use by the local population within the watershed, both for present requirements and also for prospective developments.

It is important to remember, however, that in the case of large water powers considerably in excess of local requirements, it would not, in general, be commercially practicable to ensure a cheap local supply of electricity unless the powers were developed to the maximum extent and the bulk of the output utilized by an industry requiring practically a continuous supply throughout the year.

There are two outstanding factors which have been prominent in arresting the wider development of water power schemes on a large scale in this country, namely :—

(*a*) The costly, protracted, and inefficient system of obtaining the necessary authority by means of a Private Bill.

(*b*) The multiplicity of interests to be reconciled.

With regard to the former [(*a*) above] the Committee is of opinion that if the rights necessary for the development of all water powers above a certain size were secured by the State, as and when required, many of the difficulties experienced in the past would disappear and preliminary waste of capital be obviated.

With regard to the question of multiplicity of interests, there is no doubt whatever that the powers now vested in numerous Departments, Boards and other bodies concerned with different aspects of the water problem require thorough revision and co-ordination. Many of the existing interests are, or may be, opponents of water power developments, and if proper use is to be made of the valuable national asset represented by the potential water power resources of the United Kingdom, the need of a simple, inexpensive and expeditious procedure for adjusting the claims of the several interests is vital."

20. *Charges for water power.*—The Government in India already has the control referred to in the extracts in the preceding paragraph, and various leases for the use of water power have at one time or another been granted. Some of these have lapsed, and in most instances there have been considerable discussions as to the rates which should be charged. In at least one instance a rate was initially suggested which would have been comparable to the total cost of fuel for working the undertaking by means of steam. Such a suggestion would be based on a false analogy with irrigation works, where the water is actually consumed, whereas for water power purposes it merely passes through the turbines unimpaired and can be used for any other purpose subsequently.* In fact it is gravity, not water, that is charged for since a given

* It may remove misunderstanding to point out that in the case of irrigation canals the charge made to the cultivator is based not only on the amount of water used, but primarily on the crops which are raised and on the acreage irrigated.

quantity of water will produce under 1,000 feet head one hundred times as much power as on a 10 foot canal fall. Any charge based on the horse-power developed or the number of units generated must therefore be illogical. It is suggested that as a general principle the charge for the momentary use of the water should be a nominal one, and that the revenue should be based on the principle of profit-sharing between the State and the promotor; a suggestion supported by the British Water Power Committee in their concluding remarks (p. 3 *supra*). Exceptions may however possibly arise in special circumstances. Thus, where power is generated from water running in canals constructed for irrigation purposes, not only is the power concern utilizing works already partly constructed but also it may happen that at times water is passed down when not required for the land. In the general interests of the community, which benefits by cheap power as well as by irrigation, it is doubtful if much more should be charged in this case, and it should in any case proceed from the profits of the undertaking and *not* from the sale of water. A much stronger case however is that of reservoir projects. There may be many instances where the cost of a new reservoir would only be justified for the combined purposes of power and irrigation; and in these circumstances the capital cost would naturally be proportioned between the two works. Similarly, if an existing reservoir is used for power purposes the promoters of the undertaking have the use of works, constructed at great cost, without which their project could not materialize. A somewhat higher charge would then be justifiable, even in the form of a charge for the water, since the utility of the reservoir for its prime function of irrigation might be affected.

In California a fee is paid on application for water and also every year afterwards. Mr. Barlow recorded his opinion that "The latter charge is unfair and tends to retard the development of water projects for the reason that it penalizes new projects, as old acquired rights pay nothing. *The interests of the State would be better served by the development due to the greater use of water than by the collection of small sums annually for the use of the water.*"

21. *Leases and agreements.*—Under existing regulations, the sanction of the Secretary of State is necessary for the granting of any concession—

(*a*) If the concession is intended to endure for more than 10 years and is not accompanied by an unconditional power of revocation or cancellation and imposes on the revenues of India an annual liability in excess of Rs. 50,000 ; or

(*b*) Imposes on such revenues, expenditure or liability to damages in excess of Rs. 12,00,000 ; or

(*c*) Involves the cession of property or rights estimated in value at more than Rs. 12,00,000 ;

and the sanction of the Indian Government is necessary—

(*i*) If the period in clause (*a*) exceeds five years and the liability Rs. 5,000 ;

(*ii*) If the sum in clauses (*b*) and (*c*) exceeds Rs. 100,000

Below these amounts the local Government can sanction the concession.

A certain number of actual or draft agreements for the use of water power have been collected, but the legal form which a lease should take cannot be considered in detail in this Preliminary Report, as it is highly complex and requires more information than is at present available. To delay publication for this would be a mistake, as the reconnaissance of new sites and the survey of known ones is at present far more essential than the consideration of the manner of their subsequent employment. Certain general principles have been laid down by the Government of India regarding the grant of concessions which involve monopolies of production and supply (Commerce and Trade. Resolution 1456-216 A of 19th April 1916). Water power and electricity however do not appear to have been specifically considered in this connection, as the Resolution appeared rather to relate to

material things. Thus, while the claims of competing applicants must clearly be carefully weighed, a water power concession for a short period (" strictly limited period ")is the phrase actually used) would be valueless. A period of 50 years would appear reasonable, as it is the period allowed to licensees under the Indian Electricity Act, and is long enough to attract capital. It is suggested that no charge should be made for a concession ordinarily, except perhaps a recovery of the cost of any survey work undertaken by Government beforehand. Where a decision has to be made between the claims of two or more applicants for a concession the claims of a public utility company should, it is considered, have precedence over an application from a purely industrial concern, partly because the latter can always obtain its power from a company, even though it may have to pay a slightly enhanced rate for it. Furthermore a company which is to serve the general public should be of greater value to the State than one which is serving its own interests only. Where the claims of two applicants who wish to float a public company have to be decided between, the concession will ordinarily be given to the one who obtains a license under the Indian Electricity Act from the Local Government concerned. The granting of this rests entirely with the Local Government, but it may be emphasized that it should be allotted to the applicant who is prepared to offer the best terms *to the general public*, rather than preferential terms to the Government. The latter invariably react on the private consumer. The same condition should, it is considered, also govern the grant of concessions for the use of water power. The claims of two competitors who both wish to develop water power for a purely industrial purpose should be settled, if possible, in the same way according to the conditions and rates under which they propose to sell their products to the public.

The conditions under which a concession for the use of water power should be granted to a public utility company should, it is considered, vary from those made for a company concerned with a particular industry. The works of the former can always in the last resort be taken over by a local authority or the Local Government under the provisions of the Indian Electricity Act, and can be continued in use and developed for the use of the public in the case of mismanagement or the insolvency of the concessionnaire. The deposit of a security, when once the works are in operation, does not therefore appear necessary in the case of a licensed company ; nor are any special provisions required for the removal of the works on the expiry or determination of the lease. In the case however of a concession for a purely industrial purpose, seeing that Government must be consulted as to how the site shall be developed, it appears necessary that the lease shall stipulate for the removal of any works that may interfere with the use of the power by other persons on the final expiry of the lease or in case of its determination for breach of the conditions imposed. Here it would seem desirable that Government should hold a substantial deposit to enable it to enforce the carrying out of any such orders, in case other applicants might be prepared to develop the site in a different way.

The dangers to be guarded against in giving a concession are :—

(*a*) The concessionnaire may merely hold his lease until he is bought out by a company. This is not in itself necessarily an evil, so long as power is retained to cancel the lease if work has not been begun and completed within a reasonable time. In order to prevent dog-in-the-manger inaction, a substantial deposit should probably be required, on which interest would be paid. This deposit should be liable to be forfeited if work is not put in hand and carried through within a reasonable time, especially if any other applicant is in the field.

(*b*) The site may be ruined by partial development. In the case of every public utility company it should be a condition that the initial works shall be so carried out that eventually the full possibilities of the site can be utilized if there is a demand for more power. If this condition would render the initial development too costly for commercial success it would be for consideration whether Government should not come to the rescue with a share of the excess capital required. It must always be remembered that in such matters as storage works and canals or channels it is almost essential to build for the full ultimate requirements at the very start ; but it is seldom possible to put plant down for the full power, so the extra capital is for the time being unproductive. In the case of an industrial development company this condition does not appear to be *necessarily* applicable ; but foresight is required if good sites are not to be spoiled by partial development.

(*c*) Existing water rights and future irrigation demands must be safeguarded, or, in other words, no concession should be given until the irrigation possibilities have been fully considered. This, as a matter of course, is always done. The small riparian rights of private persons would seldom offer any difficulty as the whole extent of a hydro-electric scheme will generally only embrace a few miles of a channel. The utilization of the tail waters of the turbines is a more complicated matter. The most effective position for a power station might be such that a possible future canal supply would be jeopardized. In such cases the conflicting claims of power and irrigation should be threshed out by an authority interested, in both *i.e.*, by the Government itself rather than by a Department.

(*d*) Power should be taken in any lease granted to determine the same should the lessee stop using or not make sufficient use of the water power, provided that there are other applicants for its use.

The position as regards payments to Government by public utility companies may be summed up in two propositions.

First.—A company which is brought into existence for the good of the public is already doing a public service, and should not be burdened with special taxes on its construction or working which will inevitably be passed on to the consumer.

Secondly.—Such a public utility company should be given every facility to fight its early struggles, and only when it has achieved a position of prosperity should Government step in to share the profits ; and then only with due regard to the consumer's prospects of a cheaper supply.

It is very desirable in the interests of British Trade that British Standards of pressure and frequency should be adopted in all future hydro-electric work, and the suggestion is put forward that this should be a condition of all leases and agreements for the development of water power.

The Standard Frequency of the British Engineering Standards Committee is 50 periods per second, with 25 periods as a secondary standard to meet special cases such as electric traction. For the latter work even lower frequencies have sometimes been used.

The Standard Pressures of the Committee are as follows :—

Standard low pressures (continuous and alternating).—

(*i*) at the generator, 115, 230, 460, 525V ;

(*ii*) at consumer's terminals, 110, 220, 440, 500 V. Subsidiary standard in 3-phase circuits, 380 V between the principal conductors, giving 220 V between any one conductor and the neutral.

Standard high pressures (alternating) at generator terminals :—

(*iii*) 2,200, 3,300, 6,600, 11,000 V.

Standard primary pressures for alternating current transformers measured at primary terminals :—

(*iv*) 2,000, 3,000, 6,000, 10,000 V.

Standard secondary pressures for alternating current transformers measured at the secondary terminals :—

(*v*) 115, 230, 460, 525 V at no load.

(*vi*) *Standard continuous current pressure* for tramways, measured at motor, 500 V.

Although the Committee did not go beyond 11,000 V, pressures of 15,000, 30,000 volts and upwards are used for transmission of power.

CHAPTER VI.—THE WATER POWER RESOURCES OF INDIA.

22. *No estimate of the total power.*—To ascertain the total possibilities in the way of water power in India, even approximately, will take several years. To be of any value the estimate will have to be based on an examination of the detailed maps and the sites themselves, and of the rainfall records coupled with gaugings of the flow of the streams in each case. It might indeed be possible to obtain some idea of the total from an estimate of the areas of land at different elevations and the mean annual rainfall over those areas. The layered Atlas sheets of India give the former, and the rainfall maps give the latter, and assumptions as to the run-off, quite near enough for so rough an approximation, could be made. The British Water Power Committee in their Preliminary Report, working on these lines, have hazarded a guess that the upper reaches of the Irrawaddy and Chindwin Rivers might be worth a potential 7 million horse-power if a 500 foot fall could be obtained; no doubt a succession of falls amounting in the aggregate to 500 feet was in the Committee's mind, as it is doubtful if more than 50 feet could be developed at any one place on these rivers even by prodigal expenditure on dams and diversions.

Such estimates are however of no practical use in a country subject to a monsoon (or two monsoons) with a long dry season intervening. During the rains, except in the few places where the whole rainfall of a small catchment area can be stored at a high elevation, the vast volume of water flowing down to the great rivers must mostly remain unused. For example, there is an area in the Khasia and Jaintia hills, already referred to, of some 1,200 or more square miles area, with a rainfall varying from a mean of 410 inches over about 100 sq. m. in the middle to 100 inches at the edge; the general elevation is about 4,000 feet above the plains, and the drop is fairly steep on all sides and precipitous near the focus of heavy precipitation. The potential power of this small area is (on these lines) of the order of 4 million electric horse-power as the run-off is known to be extremely high. In the first place however a 4,000 foot drop could not be obtained, nor even half of it, except possibly by a succession of separate developments; secondly the incidence of the huge rainfall is such that, even with favourable reservoir sites, it could not for the most part be impounded; thirdly these sites do not even exist. The example is mentioned to show the fallacies underlying any such estimate.

23. *Water power at present developed.*—Table 2 shows the principle details germane to this Report of the water powers already developed for electrical purposes in India and the adjacent countries, except for a few small plants of which no particulars are available. These embrace high, medium and low falls; works dependant entirely or partly on main storage lakes, or with merely supplementary regulating storage, or with none at all; with and without open channels or special canals; with pipe lines or without pipes in the case of canals. The total plant installed (which includes spare plant) amounts to 111,860 electric horse power (83,000 k.W.) and the cost of installation (as far as it has been ascertained) of the hydraulic works, pipe lines, power house, plant and switchgear up to the outgoing transmission lines (which are excluded) varies as shown in Table 3. The sterling values are calculated at an exchange of 1*s*. 4*d*. to the rupee, at which it stood when all except Darjeeling (1*s*. 2*d*.) were put up. It stands at 1*s*. 8*d*. to-day and may rise further.

[TABLE 2

Table 2.—Existing hydro-electric plants in India.

	Bengal.	Bombay.			Burma.		Kashmir.	
Undertaking	Darjeeling Municipality.	Bhatghar Dam.	Gokak Water Power Co.	Tata H. E. P. S. Co., Ltd.	Burma Ruby Mines.	Kanbauk Wolfram Mine.	Jammu Power Installation.	Jhelum Power Installation.
Location	3 miles from town.	3 miles from Bhor.	Gokak, W. Ghats.	Western Ghats.	Mogok	Near Tavoy.	Jammu, Tawi.	Mohora
Source of water	Hill streams, tributary of Rungeet.	Lake Whiting.	...	Monsoon rain, stored.	Jaynee and Jaybu streams.	Sin Yat Chaung.	Ranbir canal.	Rapids in Jhelum River.
Minimum perennial flow of source (cubic feet per second).	10	150	...	*Nil*	30	*Nil*	500	4,000
Storage — Main (Millions cubic feet).	*Nil*	5,312	...	9,884	*Nil*	82	*Nil*	*Nil*
Storage — Regulating (Hours F. L. supply.)	10	...	...	1¼	*Nil*	*Nil*	*Nil*	Small
Gross head (feet)	275 650	46 to 101	...	1,725	205	2,180	26	395
Length of open channel or canal (Miles).	2·9	...	...	4·6	*Nil*	*Nil*	*Nil*	6½
Capacity of special channel (Cusecs).	Small	...	...	480	...	...	...	560
Length of pipe line (feet)	720 1,450	...	...	13,000	2,250	15,320	*Nil*	750
Capacity of Plant — Installed (e. h. p.)	600	300	2,100	67,000	560	500	910	5,360
Capacity of Plant — For full development (e. h. p.)	660	3,000	...	67,000	560	750	1,340	20,000
Cost of hydraulic development, power house and plant, excluding transmission and beyond. (Rs. per K.W. *not* e. h. p.)	420	...	...	400	495	1,560	317	565
Remarks	Two plants in series, hydraulically, upper tail race led to lower reservoir. See plan and Plate.	Further storage contemplated with a new dam; 24,000 m. c. ft.	...	See plan and plate.	...	...	...	..

	Madras.	Mysore.	North-West Frontier Province.	Patiala.	Punjab.			Travancore.	United Provinces.	
Undertaking	Government Cordite Factory.	Cauvery Power Scheme.	Malakhand canal.	Patiala H. E. Scheme.	Amritsar H. E. Works.	New Egerton Woollen Mills.	Simla Municipality.	Pulivassal H. E. Scheme.	Ganges Headworks Supply.	Mussoorie-Dehra Scheme.
Location	Karteri, Nilgiris.	Sivasamudram.	Malakand	Nidampur	Near Amritsar.	Dhariwal	Chaba on Sutlej River.	Munnar.	Bahadurabad.	3 miles from town.
Source of water	Two Hill Streams.	Cauvery Falls.	Canal diversion.	Ghagar Branch, Sirhind canal.	Fall in Bari Doab canal.	Upper Bari Doab canal.	Nauti Khad stream.	...	Two falls in Ganges canal.	Hill streams.
Minimum perennial flow of source (cubic feet per second).	3	100 without storage; 890 at present.	...	550	1,050 for 240 days.	200	19	...	3,000	8½
Storage — Main (Millions cubic feet).	Two lakes 9 and 12.	500	...	*Nil*	*Nil*	*Nil*	*Nil*	...	*Nil*	*Nil*
Storage — Regulating (Hours F. L. supply.)	*Nil*	*Nil*	...	*Nil*	*Nil*	*Nil*	4	...	*Nil*	½
Gross head (feet)	650	410 to 426	...	8	6 to 9·7	11	540	400	19	1,000
Length of open channel or canal (Miles).	*Nil*	17,000	...	0·2	Short diversion.	*Nil*	2¼	...	Short diversion.	*Nil*
Capacity of special channel (Cusecs).	*Nil*	1,600	...	550	2,300	...	32	...	600	...
Length of pipe line (feet)	2,130	950 to 1,100	...	*Nil*	*Nil*	*Nil*	1,300	...	*Nil*	4,350
Capacity of Plant — Installed (e. h. p.)	1,350	22,650	330	285	270	900	1,680	530	600	2,400
Capacity of Plant — For full development (e. h. p.)	1,350	32,000	...	430	700	...	2,000	...	3,000	2,400
Cost of hydraulic development, power house and plant, excluding transmission and beyond. (Rs. per K.W. *not* e. h. p.)	368	550	630	900	630	...	710	...	300	240
Remarks	Upper and lower lakes connected by pipe 1,580 ft. long. Capacity of lower lake reduced by silting.	Krishnarajasagara Reservoir now partly available for power.	See Table 2 also.	Reserve steam plant; full supply for 260 days a year.	Used for subsoil pumping for irrigation.	Water insufficient often; stand by plant installed.	Extensions in progress. See plan and plate.	...	...	...

Table 3.—Limits of cost of existing hydro-electric plants in India.

	Per e.h.p. installed.		Per k.W. installed.	
	Rs.	£ @ 1s. 4d.	Rs.	£ @ 1s. 4d.
Maximum	1,170	78	1,560	104
Minimum	179	12	240	16
Mean of installations	674	45	900	60
True mean, *i.e.*, total outlay divided by power installed (approximate).	350	23·3	468	31·3

Taking Indian exchange at the normal pre-war figure of Rs. 15 to £1 sterling these figures may be compared with those quoted in the Introduction to this Report. The present exchange position is favourable for the import of plant from the United Kingdom, but is more than balanced by the high level of prices there; so far as expenditure in India is concerned there has also been a great rise in the cost of materials since 1914 while labour shows an upward tendency.

24. *Sites for water power in process of development.*—The only hydro-electric schemes on which actual construction work is going on are that of the Andhra Valley Power Supply Co., Ld., Messrs. Burn and Co.'s Lagyap project in Sikkim, and that of the Burma Mines, Ld., at the Mansan Falls, Upper Shan States. Particulars of these are given in Table 4.

[TABLE 4.

Table 4.—Hydro-electric plants under construction in India.

Undertaking.		Andhra Valley Power Supply Co.	Sikkim; Burn and Co's project.	Burma Mines Ld.
Location	...	Western Ghats.	Lagyap-la, East of Gangtok.	Northern Shan States.
Source of water	...	Monsoon rain stored in lakes.	Lake fed by snows.	Mansan Falls.
Minimum perennial flow	c. ft. per sec.	*Nil*	No details received.	134
Storage, main	Millions c. ft.	12,000		*Nil*
„ regulating	Hours full load supply.	—		*Nil*
Gross head	Feet	1,743		270
Length of open channel or canal.	Miles	*None*		½
Capacity of same	Cusecs	—		254
Length of pipe line	Feet	4,700		996
Plant being installed	e. h. p.	68,000		9,750
Ultimate capacity of site	„	90,000		13,400
Total cost of hydraulic development, power house and plant up to terminals of transmission line per electric horse power.	...	—		Rs. 260 at 1s. 4d.

25. *Sites for water power examined but not so far developed.*—Table 5 contains a list of known sites for hydro-electric works which have been examined or investigated (in greater or less detail) but have not so far materialized. It is quite possible that there may be omissions in the table, as it does not by any means follow that firms or prospectors discovering likely spots will publish their results to the world; on the contrary, they will be more likely to say nothing about them. This was the case with a perennial waterfall near Heho (q.v.), beyond Kalaw, in Burma, where it was subsequently ascertained that a Mr. Alexander had reported on the site as good for 2,000 horse power. Neither the report in question nor the engineer who made it has so far been traced. Too much faith must not be placed in the records of this table as it is certain that large assumptions have in some cases been made on the strength of insufficient data, *e.g.*, reservoir sites not geologically reported on, or discharges based on one set of observations taken perhaps long before the driest period or in a year following a wet year. Nevertheless, as the possibilities of a site are perhaps as often under-as over-estimated the total power is probably not far wrong. Further investigation of the more promising sites, especially as to the discharges and storage possibilities, is essential.

[TABLE 5.

Table 5.—Sites examined but not developed.

Location or Project.	Investigated or examined by	Source of water.	Minimum per-ennial flow.	STORAGE SITES AVAILABLE		Gross head.	Value for continuous power.	REMARKS.
				MAIN.	REGULATING.			
			Cusecs.	Million cubic feet.	Hours F. L. supply or cubic feet.	Feet.	c. h. p.	
Assam.								
Damchera . .	Assam-Bengal Railway.	Jatinga River . .	?	3,000	...	200	7,000	
Near Dibrugarh .	Not known . .		...	...	...	...	26,000	
Shillong . . .	P. W. D. . .	Um Kra, Um Shirpi .	4	0·6	...	590	200	
Baluchistan.								
Fort Sandeman . .	Captain Darling .	Sihaza Nullah . .	8	*Nil.*	2 to 4	110	70	
Bengal.								
Darjeeling I . .	G. P. Robertson .	Pregsa Jhora and Little Rungeet.	25	...	Small .	510	1,200	
„ II . .	A. Stonebridge .	Raman and Little Rungeet River.	...	...	„ .	...	2,200	
„ III . .	„ .	Kahil and Little Rungeet River.	...	...	„ .	...	1,400	
„ IV . .	„ .	Lodhoma River .	...	...	„ .	...	4,600	
„ V . .	„ .	Balason River . .	...	...	...	...	2,200	
„ VI . .	„ .	Teesta River . .	10,000	*Nil.*	*Nil.*	...	26,000	
Kumani, Duars .	J. W. Meares . .	Jaldaka River . .	140	...	?	±1,000	Minimum 13,000 but in tea season far more.	
Bihar and Orissa.								
Mayurbhanj . .	C. H. Douglas and P. W. D.	Barabalong River .	?	2,200	400 m. c. ft.	950	10,000	
Bombay.								
Koyna Valley Project .	Messrs. Tata and A. T. Arnall.	Storage in Western Ghats.	Small .	120,000	...	1,600	300,000	
Nila Mula Project .	Messrs. Tata and H. P. Gibbs.	Storage in Western Ghats.	„ .	18,000	...	1,700	75,000	About to be developed.
Poona . . .	Mr. Visvesnaraya .	Nira Canal . .	315	*Nil.*	*Nil.*	84	2,300	
Burma.								
Heho (Yawnghwe) .	Mr. Alexander; and Messrs. Barlow and Meares.	Heho River . .	60	Very large, but on agricultural land.	...	670	4,000 to 10,000	According to storage.
Cochin.								
Cochin . . .	Mr. G. S. Forbes .	Chalkudi River .	50	1,000	...	577	25,000	
Central Provinces.								
Balaghat . . .	...	Nahara River . .	?	Large .	?	500	9,000 ?	
„ . . .	...	Uskal River . .	...	„ .	?	1,000	4,000 ?	
Chatisgarh . .	...	Indrawati River .	700 ?	?	?	80	5,000 ?	
Silewani Ghat . .	Mr. E. Batchelor .	Reservoirs . .	...	Large .	?	800	Large if feasible.	

Table 5.—Sites examined but not developed—*concld.*

Location or Project.	Investigated or examined by	Source of water.	Minimum per-ennial flow.	STORAGE SITES AVAILABLE.		Gross head.	Value for continuous power.	REMARKS.
				MAIN.	REGULATING.			
			Cusecs.	Million cubic feet.	Hours F. L. supply or cubic feet.	Feet.	c. h. p.	
Kashmir.								
Kashmir, Riazi . .	Kashmir Durbar .	Chenab . . .	...	...	...	...	30,000	
Madras.								
Hogenkal Falls .	P. W. D. . .	Cauvery River . .	550	Large	...	46 to 85	2,500 to 3,500	
Kundah R. Scheme .	„ and H. P. Gibbs.	Kundah „ . .	20	1,600	Fair .	3,000	20,000	Very promising.
Mekadatu rapids .	G. S. Forbes . .	Cauvery „ . .	550	...	...	175	8,500	
Ootacamund . .	H. P. Gibbs . .	Shola water fall, Sandy nulla.	1	0·5	...	1,000	100	
„ . .	„ . . .	Pykara River . .	10	Site, but no details.	...	900 to 3,000	1,000	Involves tunnel through watershed.
Periyar Lake . .	A. H. Garratt and P. W. D.	Periyar Lake . .	...	Vast .	...	1,000	54,000	Negotiations proceeding.
Runnymede (Nilgiri Hills).	J. W. Meares . .	Coonoor and Karteri Rivers.	12	60 (or more).	65,000	1,020 (or more).	2,500 (or more)	Est. cost about Rs. 340 per e. h. p. (or Rs. 450 per kw.)
Siruvani Project .	P. W. D. and R. H. Martin.	Siruvani River, Nilgiris.	4·5	280 to 450	...	1,200	5,000	Site for dam reported unfavourable.
N.-W. Frontier Province.								
Malakhand Tunnel .	Capt. (now Lt.-Col.) Battye, R. E.	Upper Swat River Canal.	1,000	...	...	230	20,000 or more.	
Punjab.								
Bhakra Dam . .	F. Milne . .	Sutlej River . .	2,700	Not to be utilized.	...	330	81,000	
Madhupore . .	Punjab Power Association and F. Milne.	Upper Bari Doab Canal.	1,300	*Nil.*	...	140 to 200	16,000 or more.	
Rasul . . .	Capt. (now Lt.-Col.) Battye, R. E.	Lower Jhelum Canal	4,500	*Nil.*	*Nil.*	80	33,000	
Simla . . .	F. Milne . . .	Nauti Khad extension.	8	20	...	1,600	6,700	Pipe line 5,000 feet.
United Provinces.								
Lackwar Bridge, Mussoorie-Chakrata Road.	U. P. Power Association.	Jumna River . .	1,000	...	?	130 or more with dam.	12,000 or more.	

26. *Possible sites for water power requiring reconnaissance.*—Reference has been made above to the inquiry made for possible power sites in 1905, at which time it is clear from the returns sent in that the conditions that make a "good site" were very little understood, even by engineers of the Public Works Department. The enquiry was begun afresh under Mr. Barlow's direction in November 1918 and was continued up to the date when this Report went to the Press. In every part of India and Burma sites new and old were discussed and an endeavour was made to obtain information on salient points. The results of this preliminary enquiry cannot well be put in tabular form, as there would be too many blanks to the prizes. It will be preferable merely to give such information as has been collected in the form of notes on rivers, arranged by Provinces and, in each Province, in alphabetical order as far as may be. The sites given in Table 4 are mostly repeated, as further information is desirable although more may even now be known than could be put in a tabular statement. The fact that more possible sites are listed in Burma than elsewhere is due to the fact, explained above, that during the first season's tour that Province received more enquiry and attention than all the others combined; the Central Provinces is a good second, but many of the sites there are sure to prove useless. *It must be emphasized that all sites of which practically nothing is known, as well as all which have previously been recorded, are entered in the lists. Until they have been examined it is impossible to say which are worthless and which are worth further survey.* By making the list as complete as possible the worthless ones can, it is hoped, be eliminated once for all after the next season's work.

A mere list of sites makes dull reading, and the matter collected has therefore been relegated to Appendixes 5 to 14. Here some general notes on the conditions in each Province will be given, in alphabetical order.

Assam.—The whole area of the Khasia and Jaintia hills offers great possibilities; other hill districts such as the Garo hills are less civilised and are little known or mapped, but may have favourable sites for eventual development. The road to Shillong runs through dense jungle where the hills and valleys rise and fall very rapidly. Reservoir sites in the lower parts seem unlikely; the slopes of the rivers and their discharges appear too small for any considerable developments of power. Detailed reconnaissance may however disclose reservoir sites; but the jungle is almost impenetrable, except for an elephant. The upper parts can be prospected on foot and appear more hopeful, *e.g.*, the Umian River near Barapani, but there is little information available. The proposed Pandu-Shillong railway can probably be supplied with power for working when sites have been further examined. Discharges are being taken where possible, *e.g.*, on the Um Rai River, near the road. A site near Saitwait village, on Kersh's (?) old road trace, 15 miles below Lynkerdem on the Thanjinath Plateau was also mentioned as worth examination for the Pandu Railway. This has not yet been identified on the map.

The upper plateau between Shillong and Cherrapungi is a rocky country intersected by numerous deep nalas, and narrow valleys, the tributaries of the Shella River (q. v.,) carrying off the drainage, with very quick slopes; no storage of large amount appears possible without dams of great height, while earthquakes render these unsuitable, except possibly in reinforced concrete. This is the region where the rainfall averages 400 inches over a strip of country about 15 by 10 miles. Transport from the plains below Cherra would be difficult as it is all flooded in the rains, though country boats come to the foot of the hills. There is good limestone and coal of good calorific value but bad storing quality. The road towards Laitkynsew may offer reservoir sites. Near Cherra the two best reservoir sites appeared to be on the tributary of the Um Long which runs near the road at mile 30 and on the Um Pynjngithulli near Umsohphi Village. The former is moderately flat, with rice fields and a few huts, on the west side of the main nala; and there is a local pocket which may be suitable for a reservoir. In the same tributary lower down and a little above the falls shown on the map there is another possible site. As regards the Pynjngithulli there is one place much better than elsewhere about half way up the nala above the falls, where the valley is wider and has a less rapid slope. Modern 1 inch contoured maps are available to the east of longitude 91, and examination of these may disclose further possible reservoir sites; but time has not allowed this to be done as yet. There are scores of waterfalls marked on the map, but they are mostly dry the day after rain has ceased to fall. December and January are ordinarily the only really dry months; November and February average about 2 or 3 inches.

The names of streams are often different on the Atlas and detailed sheets, and the alternatives are given.

A list of possible streams and sites for reconnaissance will be found in Appendix V.

Bengal and neighbouring States.—Bengal proper is almost entirely flat and offers practically no chance of water power; and the proximity of the coal fields would in any case militate against the financial success of such undertakings. At various times in the past proposals have been made for supplying power to the great industries on the banks of the Hooghly; either by transmission of power from large stations in the Raniganj coal fields, 100 miles off, or again from the Burabalong River in Mayurbhanj State, Orissa, (q. v.) an even greater distance. The Hooghly River Power Co. was formed for the first of these projects, and a license was granted, but it fell through. The cities of Calcutta and Howrah obtain their supply from the Calcutta Electric Supply Corporation (see Table 2) but hitherto little progress has been made towards supplying the local mills from the power house at Cossipore. The fact no doubt is that, with modern steam engines and boilers, most large factories can obtain their power cheaper by having their own plant; where the plant is old or out of date it may be preferable to purchase power rather than to lay down capital for a new drive, especially as hitherto the cost of purchased power has steadily declined.

In the coal fields area also there have at various times been proposals for central generating stations at the pit's mouth, for use in the collieries. A beginning has now been made in this direction, but the tendency to instal rival plants is strong and cannot make for economy. Recently a considerable part of the "Bengal" coal fields has been transferred to the new Province of Bihar and Orissa.

There are endless possibilities of water power in the Himalayan regions bordering on Bengal in the North, for the most part in Sikkim and Bhutan. Here the rainfall is very heavy, 100 inches and upwards, and the larger rivers are also snow fed. They are however subject to great floods and no reservoir sites seem likely, so that the cost of development will generally be high. A list of sites, some of which may, when further details are obtained, prove worth detailed examination, will be found in Appendix VI.

Bihar and Orissa and neighbouring States.—The possibilities of water power, especially from storage, appear to be considerable in this Province, though as yet there has been little time to investigate sites or determine run-offs and discharges. The region around the coal fields is likely to obtain all the power it requires from that source, and in the absence of "White Coal" there is a paucity of perennial streams. The Palamau and Hazaribagh hills; the Ranchi District; the Mayurbhanj State; and the intervening uplands have produced many suggested sites for reconnaissance as will be seen by the list. A skeleton map of the Province has been prepared in the Chief Engineer's office, showing the sites and other data. Mr. Clayton has found time to visit many of the sites and to take discharges and determine other data, both positive and negative. A list of sites in Bihar and Orissa will be found in Appendix VII.

Bombay.—There are probably endless sites in the Western Ghats, of which the best have already been examined by Messrs. Tata's engineers. The rainfall is heavy, especially at the scarp of the Ghats, where it locally reaches 200 and even 250 inches; but nearly all concentrated between June and September. Storage is therefore an essential of practically every project in this area; the levels are *prima facie* favourable; the fall is generally of the order of 1,000 to 1,800 feet, obtained for the most part by piercing the watershed; the demand for power is large; and the tail water could sometimes be used further on for irrigation. Dharwar, Satara, Poona, Belgaon, parts of Nasik and Ahmednagar and probably the Panch Mahals and Khandesh were the districts specially brought to notice. The Nerbudda and Tapti rivers flow

through the Panch Mahals and sites can probably be located. This is a large cotton growing area. The cost of existing reservoirs in the province varies from Rs. 212 (Gokak) to Rs. 570 (Chankapur) per million cubic feet. Sind is unlikely to have any power.

An excellent layered map showing the sites of existing and projected irrigation and power works has been prepared under the orders of the Chief Engineer, Public Works Department, on a scale of 8 inches to the mile. A list of sites will be found in Appendix VIII.

Burma, with the Shan States and neighbouring territories.—The whole of this Province especially the Shan States, is well furnished with great possibilities of water power except in the comparatively small dry zone. The great rivers for the most part rise very slowly in elevation, but their numerous tributaries, and the feeder streams of these, rise in the hills and often present good falls. There is also more perennial water than is generally found in the peninsula, though there is no "White coal" except in the upper catchments of the Irrawaddy and the Salween. Generally speaking there appears little prospect of reservoir storage, as the limestone which forms so large a proportion of the hills is much fissured. "Natural bridges" where a river disappears completely underground are a common feature of the country; and the reappearance of the stream at large springs elsewhere is consequently also common. The mineral resources of the Province are being developed but have not been fully prospected, for large areas are almost unknown and are unsurveyed. Sooner or later however there should be a considerable demand for power, and it is possible that some of the promising sites may prove worth development for special industries to be established near them. The minimum discharges are in very few cases known, as for the most part no measurements have been made until undertaken for this survey. The rainfall generally over the Province will be seen from the rainfall contours on the map in this report, and some figures are given with each entry in the list of sites. Generally speaking nearly the whole of the rainfall is precipitated in 6, 7 or at most 8 consecutive months of the year; to the extent of about 96 per cent. of the mean annual fall. It follows therefore that, in the absence of large springs, the discharges must fall very low towards the end of the dry period. Unless therefore reservoir sites prove practicable, as to which there is very little information at present, the smaller rivers may not prove of much value.

A map of the Province has been prepared in the Chief Engineer's Office, giving all available information as to roads, railways, irrigation stations, power stations, altitudes and rainfall. A list of rivers and sites requiring reconnaissance will be found in Appendix IX.

Central Provinces and Berar with neighbouring States.—There are few perennial rivers except the Indrawati, Nerbudda and Tapti, so storage will generally be necessary. Sites for reservoirs exist plentifully, but will not be cheap to develop; indeed the relative cost is stated often to rise as the reservoir capacity is increased. It averages Rs. 289 per million cubic feet of water. Owing to the uncertainty of the rains considerable carry-over capacity will in every case be required. The plateaux of the Central Provinces however undoubtedly offer possibilities which are well worth examination; they are generally from 500 to 2,000 feet or more above the surrounding plains, and catch the rainfall. The Satpura plateau, the Vindhyan escarpment with the Malwa plateau, and the hills of the Bastar State embrace the main elevated regions. It is strongly held in the Province that for any large project the combination of irrigation from the reservoirs should be combined with power, and that this combination may be financially successful when neither might be so alone. The local work of the survey (other than topographical) should therefore be undertaken by an officer of the Central Provinces Irrigation Department. Officers of the local administration in the Central Provinces, despite shortage of staff and notice, went to great trouble in preparing an excellent layered 8 inch map of the Province with possible sites marked, together with memoranda on various proposed power sites. In the list of sites given below there are certainly many that are absolutely useless for power purposes, but until they have been examined it is impossible to determine which are in this category; the information is far too sketchy. Some of the reservoir sites for instance are below any likely fall, but may nevertheless prove useful

for irrigation purposes in combination with other tanks higher up the catchment areas.

The average monsoon rainfall of the Province varies between 35 and 60 inches, but is very liable to fall short in particular years. Furthermore it falls almost entirely in 4 months, June to September. There is generally an inch or two in October, and coming after the heavy rains this will give a good run-off and perhaps obviate drawing on the storage. The other months seldom have as much as half an inch.

The memoranda of the Director of Industries, the Under Secretary, Public Works Department, and the Executive Engineer, Waingunga Division, may be specially mentioned. The following list of catchment areas of rivers where the 2,000 foot contour cuts them will be found valuable. It was prepared locally for this investigation.

Table 6.—Catchment areas of rivers in the Central Provinces where the 2,000 feet contour cuts them.

Name of District.	Contour.	Name of stream or river.	Catchment area in square miles.	REMARKS.
Betul	2,000	Taptee	228·00	
Do.	2,000	Wardha	84·70	
Do.	2,000	Khursi	37·50	
Do.	2,000	Purna	93·00	
Do.	2,000	Machna	136·00	
Balaghat	2,000	Deo	91·00	
Seoni	2,000	Wainganga	275·00	
Do.	2,000	Tel River (Tributary of Waingaanga).	178·2	
Jubbulpore	2,000	Mahanadi	46·27	
Mandla	2,000	Nagrar (Tributary of Mahanadi).	34·19	
Do.	2,000	Nerbudda	1,205·88	
Do.	2,000	Kashmeri (Tributary of Halon River).	275·2	
Do.	2,000	Burmer or Burhner	605·6	
Chhindwara	2,000	Kanhan	178·14	
Do.	2,000	Bel	386·39	
Do.	2,000	Sitarewa	94·45	
Do.	2,000	Rench	527·62	
Do.	2,000	Harod	146·47	
Do.	2,000	Umra	51·87	
Do.	2,000	Kulbehera (Tributary of Umra River).	221·92	
Amraoti	2,000	Khandu	33·25	
Do.	2,000	Khursi	38·79	
Bastar State	2,000	Indrawati River	192·00	

A list of sites in the Central Provinces, requiring reconnaissance, will be found in Appendix X.

Madras and neighbouring States.—The hill ranges of Madras offer many possibilities, as yet little examined. In some parts there are two monsoons, and a far more even distribution of rainfall than elsewhere. Madras is also famous for its reservoirs and irrigation tanks, so it is probable that many similar sites may hereafter be found suitable for storage for power. The cost of reservoirs varies from Rs. 134 (Kistna) to Rs. 412 (Periyar) per million cubic feet. The whole Nilgiri area requires special attention, as many sites are known to exist but require investigation of discharges, run-off, reservoir sites and practicable falls. Other hill ranges, less known at present, may prove as good.

A list of sites brought to notice for reconnaissance will be found in Appendix XI.

North-West Frontier Province and neighbouring States.—This district is in the dry zone, with a rainfall averaging 10 to 15 inches but often less. The Swat and Indus rivers, the Kunar (a tributary of the Kabul river from Chitral) and the Kunhar (a tributary of the Jhelum) are all snow fed and therefore have a large perennial flow and great aggregate fall. Other rivers such as the Gumal, Tochi, and Kurram have very large catchment areas over the border in Baluchistan and Afghanistan. Owing however to their position on the frontier and the wild nature of the country, both in its physical and moral aspects, very little prospecting work has been done; indeed it is very unlikely that power sites, however good, could be utilized. Industries of any magnitude, beyond agriculture, are unlikely.

A list of sites brought to notice will be found in Appendix XII.

The Punjab and neighbouring States.—The five great rivers of the Punjab, namely the Sutlej, Beas, Ravi, Chenab and Jhelum, all take their rise among the Himalayan snows, outside British India, descending to the plains in a series of rapids. With the exception of the Beas, which will no doubt be utilized eventually, they are all harnessed for the service of the vast canal system which spreads over the arid plains of the province. There is also much local and indigenous irrigation on the terraces in the hills, which taxes the tributaries considerably; and nearly every little channel of this nature has its primitive water wheel for grinding the village corn. These water rights are jealously guarded. The irrigation interest is therefore paramount, but there is very little likelihood that any water power scheme (other than a canal fall development) could interfere with the canal system, which takes its rise exclusively in the lower reaches. That this is true of the Sutlej is explained below. The potential power of these rivers and their tributaries, even on their dry weather discharges, is vast and need not be calculated; but hitherto they have been little examined for practicable sites for water power where the development would be reasonable in cost. A few miles of the rapids of the Jhelum at Mohora have been developed by the Kashmir Darbar (see Table 2) and this will serve as an index of the power contained in the Himalayan reaches of the five rivers. Hitherto the demand for electricity has been mainly confined to the towns and cantonments of the province, which have either installed small steam or oil plants or have had to forego the benefits of the electric fan throughout the sweltering heat of the summer. The industries that exist are scattered, and there are no great centres where power on such a large scale has been demanded as would invite capital to embark on large projects. It may be hoped that progress may be on broader lines in the future, for all the power that can be demanded can be supplied over and over again from the "White Coal" over the border. The rainfall cannot always be given as even where known it varies greatly over the vast catchments of the large rivers. Generally speaking however the monsoon breaks at the end of June and lasts till September only. A certain amount of snow falls during the winter in the hills, and local thunderstorms, sometimes severe, also occur at any time.

There are many falls on the various canal systems, some of which are capable of giving considerable power for the greater part of the year; all however suffer from the disadvantage of a periodical closure. As regards this source of power it is clear that the Irrigation Department must have the final word as to what may or may not be done. As regards new projects, however, mention has already been made in para. 5 of the fact that two or more small falls have often been constructed where a single fall of greater drop would have been practicable. A little extra expenditure to begin with may make a bad power site into a good one; and it is to irrigation requirements, such as sub-soil pumping or high level pumping, that such power schemes will probably look for their outlet.

The late Mr. Barlow recorded the following note on the subject, in view of the difference in the practice of his own Province (the United Provinces) and the Punjab.

"The Punjab Canals run in rotation, *i.e.*, different branches in different weeks, and the main canals have sometimes to be closed for a month in the monsoon or in winter on account of heavy rain or for silt clearances. There are falls in many places of 8 to 15 feet with good discharges, and these might be used for pumping water for irrigation and by this means reduce waterlogging and also enable certain channels to be closed and the water used elsewhere. The Irrigation Department think that the water rate would have to be raised to enable these schemes to be a paying proposition, but consider that the cultivators will be able to pay it. There are also many local industries on a small scale which would probably come in if this power were provided." A map has been prepared in the Chief Engineer's Office, Irrigation Branch, showing the canal systems and other relevant data.

A list of sites—probably less complete than any other—will be found in Appendix XIII.

United Provinces and neighbouring States.—There are great power possibilities in the United Provinces, especially in the Himalayan and the Bundelkhand and Baghelkhand areas. The rivers from the hills are largely utilized for irrigation, and reservoirs of large size are common; it may therefore be supposed that many unutilized sites for reservoirs are to be found, capable of being used for power purposes before feeding the rivers and canals below. The cost of reservoirs varies from Rs. 149 (Gaggar) to Rs. 448 (Betwa) per million cubic feet. This preliminary enquiry supports the supposition. A table has been locally prepared showing the catchment area, storage capacity, probable maximum flood and cost of many existing or under construction storage works in Bundelkhand; it is not printed here, but is on record. The cost per million cubic feet of useful storage varies however as follows:

Seven cases, between Rs. 800 and Rs. 1,400, all small by comparison, *i.e.* 100 to 600 m.c. ft. useful storage.

Seven between Rs. 192 (minimum) and Rs. 400, varying from 343 to 11,250 m.c. ft..

Ten between Rs. 400 and Rs. 800, of all capacities.

There are many small falls (up to 12 and 14 feet in a few cases) on the irrigation canals. The majority of these are of small account for power purposes and suffer from an annual closure; but a few offer good power and others may perhaps be utilized hereafter for high-level or subsoil irrigation pumping. The complete list of falls over 3 feet is therefore given so far as data have been supplied.

An excellent map of the Province, marking power and irrigation sites, has been prepared under the orders of the Chief Engineer, Public Works Department.

A list of sites brought to notice, with canals at the end, will be found in Appendix XIV.

27. *Native States and territories adjoining British India.*—As explained in the note at the beginning of this Report, the term "India" is used in its geographical atlas sense. Water power refuses to be confined by territorial or political boundaries or by sectional or Provincial interests; it exists where Nature places it, although it may be artificially controlled to some extent. A promising scheme may take its rise in one State, be developed in a second and utilized in two or more others; it may be necessary to modify it so as to meet existing water rights or future irrigation requirements, but here the advantages need to be properly balanced by independent authority. It so happens that a considerable amount of the available water power of India takes its rise outside British territory, and in some cases power sites will eventually be found (where this is not already so) either on a river which is also a political boundary or entirely over that boundary. Certain instances are already given in this Report, and if any places are incorrectly located the Compiler apologizes for the errors. Hitherto the two officers deputed to carry out the Hydro-Electric Survey have been unable to visit a tithe of the sites referred to, and the first reconnaissance of all will certainly tax the energies of a considerable staff for several seasons, while actual survey work is proceeding at sites already favourably reported on. The material in this volume will however show what is required, and much information can be collected in advance by the engineers of the various States which may wish to have their water powers examined. Requests, formal or informal, have been received asking the Chief Engineer, Hydro-Electric Surveys, to visit or report on water power in general or sites

in particular in the following territories, which are arrranged alphabetically:—

ALWAR.—The Sewai Maharajah enquired of the late Mr. Barlow regarding the bund at Bara.

BARODA.—The Hon'ble the Resident at Baroda refers to the Orsang, Oonch and Heran River projects; the Saharmati reservoir projects at Hadol and Dharoi; Khadiar Nala falls in Dhari (Kathiawar), and Mokhadi falls in the Nerbudda. He has been asked if data as to discharges, falls, etc., can be collected. In reply to his enquiry about a visit to Baroda State, he has been informed that inspections are not possible before the next cold weather.

BENARES.—The Karamnasa and Chandraprabha falls are referred to in Chapter 6 of the Report under the United Provinces. The Darbar has been asked that they may be reported on further. His Highness the Maharaja has made a request for a visit to examine the sites.

BHARATPUR.

BHOPAL.—The State Engineer refers to two alternative sites on the Betwa River which it is desired to have examined, and as to which details exist in his office. A visit to the sites next cold weather has been promised.

DHAR.—The Political Agent in the Southern States of Central India has also referred to the Dhari waterfalls on the Nerbudda, which have been reported on by Mr. Hartley. An endeavour will be made to visit the site next year if possible.

HILL TIPPERA.

HYDERABAD, DECCAN.—The Mint Master and Chief Electrical Engineer has enquired if the data of the rivers in His Highness the Nizam's dominions will be of value.

JAWHAR.

KAPURTHALA.—The Darbar intimates that the investigation is welcomed.

KASHMIR AND JAMMU.—The Chief Electrical Engineer refers to the 20,000 H. P. scheme on the Chenab and to the prospects of supplying power to the Punjab from Kashmir.

KOLHAPUR.

MANDI.—The Darbar asks for examination of the confluence Beas and Suketi Rivers at Mandi.

MYSORE.—The Hon'ble the Resident at Bangalore has asked to be informed if the Survey proposes to visit Mysore.

RAJPIPLA.

RAMPUR-BASHAHR.

SIKKIM.—The Political Officer in Sikkim has offered to make arrangements for a visit there in connection with the water powers of the Lagyap Pass and the Teesta (*q.v.* under Bengal and neighbourhood); also the Rungpo. There is evidently great power available all over Sikkim.

SUKET.—The Darbar welcomes the investigation and calls attention to the Suketi, Bhawana Khad, Samal Khad as well as minor streams.

TEHRI-GARWHAL.

28. *Summary of results.*—Taking into account tables 2, 4 and 5, and the sites in Appendixes V to XIV where there is a reasonable prospect of obtaining power to the extent estimated by the persons concerned, the round total comes to about 1,771,000 electrical horse-power actually in sight. The figures, classified both by provinces and by the degree of reliability of the estimate are given in Table 7. *The total is of course vastly below the actual available power which the final results of the survey will disclose.* Thus there are over 130 possible sites, to which attention has been drawn, of which nothing whatever is definitely known; there may be hundreds more yet to be found. Apart from this, however, the great perennial snow fed rivers have been scarcely touched upon; their potential power has not been determined and is in no way brought into the table, except as regards a few definite projects. These for the

most part only bring in a few miles of the river, and a few hundred feet of fall. The calculation of the British Water Power Committee relating to the Irrawaddy and Chindwin Rivers, with their 7 million potential horse power, has been referred to earlier; where it is also explained that as most of the discharge comes down in a few months the actual potential power available for 12 or even 9 months will be far less. Even so, many millions of horse power could certainly be obtained all the year round from the Himalayan mountains *if cost were no object and fuel no longer existed.* Thus the combined *minimum* discharges of the Indus, Jhelum, Chenab, Sutlej, Beas, Jumna and Ravi Rivers amount to over 36,000 cusecs where they enter the plains, equivalent to well over 3 million e. h.p. *per 1,000 feet of fall*; these rivers and the tributaries that feed them rise in mountains up to 20,000 feet or more in altitude, and are not above 1,500 feet above sea level where they enter the Punjab plains. Similar considerations apply to the Ganges, the Sarda, and the many rivers rising outside British India to the east up to the Brahmaputra, and again in Burma to the Irrawaddy and the Salween. What the total power on the minimum discharges may be is incalculable, while on the normal discharges throughout the greater part of most years it is certainly several times as great. (The table is on the following page).

29. *The Key Map of Sites.*—The general map of India on the scale of 64 miles to the inch, which will be found in the pocket, has been specially prepared for this Report by the Superintendent of Map Publication, Survey of India. It shows as far as possible on this scale the rivers, railways, and contours. The possible power sites marked on it do not pretend to be in exact position; they serve to indicate localities merely, as the exact squares where known are stated in the text. A certain amount of information is also given regarding the occurrence of coal, oil and minerals, but this again does not pretend to be complete or very exact. It by no means follows that areas without any entries have no water power; it merely means that no data have been collected so far. Of the hundreds of 4″, 2″ and 1″ maps referred to in the Appendixes hardly any have been examined as yet, as early publication of the Report with a view to future work is more important than completeness.

Table 7.— Probable water-power of India, so far as determined.

Figures are electrical horse power continuous, *not* 12 hour.

Name.	Developed; See table 2.	Under construction: See table 4.	Known sites; See table 5.	Probable sites from list of sites.	Canal falls not included in tables 2, 4, 5.	Total.	Remarks.
Assam	*Nil*	...	33,200+	18,000	...	51,200	About 10 sites unexamined.
Bengal	600	...	50,000+	153,000	...	203,600	2 sites unexamined. The Tista has also vast power.
Bihar and Orissa	*Nil*	...	10,000	2,800	...	12,800	9 sites unexamined.
Bombay	40,000	45,000	189,800	68,500	...	343,300	9 sites unexamined.
Burma	1,060	13,400	10,000	429,000	...	455,000	Over 40 sites unexamined. The great rivers in the north have not been examined.
Central Provinces	*Nil*	...	20,000 ?	133,000	...	153,000	24 sites unexamined.
Cochin	...	...	25,000	...	...	25,000	...
Kashmir	28,300	...	30,000	...	...	58,300	The Himalayan rivers have great unexplored power here.
Madras	1,350	...	94,000	12,000	...	107,350	8 sites unexamined.
Mysore	32,000	...	...	...	...	32,000	...
N.-W. Frontier Province	330	...	20,000	...	...	20,330	...
Patiala	285	...	...	...	...	285	...
Punjab	3,600	...	136,700	16,000 exclusive of the Indus, etc.	108,200	264,500	5 sites unexamined. Small canal falls good for less power during part of year. See also preceding page.
Sikkim	*Nil*	8,000	...	...	...	8,000	...
Travancore	530	...	...	...	...	530	...
United Provinces and Benares	5,400	...	12,000	8,800	11,900	37,600	28 suggested sites unexamined. Canal falls good for more power for 9 months. Vast power in Himalayan rivers, not explored.
Round Totals	115,000	66,400	631,300	840,600	120,100	1,774,000	...

CHAPTER VII—FUTURE WORK OF THE HYDRO-ELECTRIC SURVEY.

30. *Agency for carrying out the future work.*—It is not necessary or within the Compiler's province to lay down exactly how the work necessary to complete this report shall be carried out. In certain of the following paragraphs suggestions are made as regards specific points requiring attention. It is clearly essential that officers shall be placed on special duty, at least during the dry months and during the period when reconnaissance and survey work can be carried out. For this work officers with local knowledge will be required in each Province. In order that the work of the Survey may be of use to Indian industries and Empire Resources it appears essential that the Chief Engineer of the Survey should act as a liaison officer to co-ordinate the work that is being done and to see that it is done in the manner required, to prevent overlapping on boundary rivers, and to draw up progress reports as the work proceeds. In order to save delay and circumlocution he should, if possible, be allowed to correspond directly with all gazetted officers of the Forest Department and of both the Irrigation and Roads and Buildings Branches of the Public Works Department.

In provinces where reservoirs will generally be necessary it is clear that officers conversant with irrigation work must be largely employed; and wherever there is a prospect of combined works for irrigation and power, whether from rivers or reservoirs, the same remark applies. At the same time there may be in such districts other sites of a totally different character, the reconnaissance of which requires a knowledge primarily of water power and the best methods of developing it in each case. It is very desirable that arrangements shall be made at the earliest possible date for resuming field work, and officers should therefore be detailed for this in each Province as early as possible; see paragraph 34.

There is considerable danger that, in the absence of specific demands for power, the work will be shelved. The co-operation of the Water Power Committee of the Conjoint Board of Scientific Societies, which has been offered, may be invited to prevent this happening.

31. *Census of power.*—It is hoped that the somewhat sketchy summary of the power used in certain parts of India, given in paragraph 14 *supra*, will be an incentive to the completion of these tables on comprehensive lines, for which there has not yet been time. It is by no means easy either to collect or tabulate the results in such a way that they will be of practical use, as most power users do not know anything of horse-power. (See Appendix IV). It is however desirable that some approximation should be known as to the amount and nature of the power used over areas of reasonable size, such as districts or sub-divisions of districts. Reference to the permissible cost of hydro-electric schemes in paragraph 78 will show that it depends on their position with regard to power requirements, the cost of fuel at present used, and "load factor," which term is there explained in non-technical language. A census of power should therefore give, for each area, the installed horse-power subdivided under water power, steam power, oil engines, gas engines (if there are any such); the average cost at site of the coal or oil used as fuel and where it comes from; and (in very general terms) the purpose for which the power is used and the ordinary hours and days per annum of working. If a project is likely to materialize all these figures are essential in order that its prospects may be gauged. The first step in a detailed investigation is to draw up probable load curves of the completed scheme in order to see what

plant and transmission lines are required. It is suggested that the final tables shall be drawn up in the following manner :—

Province_____District_____Boundaries of district approximately, by sketch map or otherwise_____

	Water Power	Steam Power	Oil Power	Electric Power	Average Working period.		
	b. h. p.	b. h. p.	b. h. p.	b. h. p.	Days per year.	Hours per day.	
Pumping plant.							
Agricultural plant.							
Textile machinery in factories.							
Machinery in engineering works.							
Other factory plant.							
Isolated plants.							

Source and average cost per ton in district. Coal Rs.
Bulk oil Rs.

By water power, steam power, etc., is meant the direct driving of plant by turbines or engines, not through electricity. By electric power is meant both where the concern has its own plant or where it takes a supply from a power concern.

It is suggested that Directors of Industries, who have supplied the data already included in this Report, should be asked to collect the full data for the Census on these lines, and then to have them analysed and put into form by a mechanical or electrical engineer accustomed to the vagaries inherent in the returns as received. The papers already in hand can be returned for this purpose.

32. *Rainfall records and Map.*—(See Chapter 2). From the records of the Meteorological Department of the Government of India a small scale map, showing average annual rainfall contours, has been published. The Railway and Canal map of India, on the scale of 32 miles to the inch, is also contoured in the same way, with the help of such additional records as the Irrigation Department possesses. Unfortunately these records fail to cover in detail many areas which are out of the orbit of irrigation works and observers, and which nevertheless may prove of great importance to the hydro-electric survey. For here it is the detailed rainfall contours over a definite, and perhaps small, catchment area that are required, rather than the general lines of the continent. In some cases there may not be a single recording station within such a catchment. Where a sufficient number of observations exist the rainfall contours can be filled in from these by following approximately the geographical contours, as this is found to give the most probable results. They may however be very far from the actual truth over small areas. Thus, on the seaward edge of the Western Ghats, the existing maps show a series of contours, at closer intervals as they proceed, from 30 inches up to 100 inches at the edge ; and 150 inches on the seaward plains. It is however well known that in parts the annual fall amounts to 200 and even 250 inches. Any cliff exposed to the moisture laden monsoon currents is certain to arrest them and direct them upwards, and thus

to cause very heavy local precipitation. The cliffs below Cherrapunji are an even better example than the Western Ghats, and there may well be other similar places of which no records exist at all.

There are however hundreds of places in India where rainfall records have been kept regularly for many years, and yet never used except by those who keep them. Thus every tea garden, every coffee or cinchona plantation, has its raingauge and book of records, and these will to a considerable extent be found in the hills that may prove to be likely catchments. It may be objected that the gauges are not of a standard pattern always ; it is quite likely, but a possible 10% error is surely better than an estimate based on the curve connecting two stations many miles away. If the same gauge has been used its readings, and the whole of its records, could be corrected by expert comparison with a standard gauge. For that matter, standard gauges are occasionally seen placed so that trees partially screen them, and great difficulty is always found in obtaining reliable observers. A number of non-official records have already been collected in the office of the Survey.

It is therefore suggested that a large number of additional standard rain gauges shall be obtained and placed in catchments which offer good promise of power. If the localities are such that regular daily observations are impossible the next best expedient is to have gauges that can be read at longer intervals, or self-recording gauges if these are obtainable. It may be observed that the Japanese Government proposes to fix no less than 166 new rain gauge or meteorological stations in the islands for the hydro-electric survey.

Secondly, enquiry should be made through District Officers regarding every private rain gauge of which the records have been kept, and copies of these records should be obtained for the whole period for which they have been maintained. The collating of these records together with those of the official stations will take a considerable time and must be carried out by a trained specialist. The Director-General of Observatories will no doubt be able to advise as to the best method of procedure. Here it is sufficient to point out that the present records are insufficient and that more are urgently required. The rainfall map to be prepared from the official, private and new records should be plotted for each degree sheet of the Atlas of India on the scale of 4 miles to the inch or thereabout. As more data are acquired it should be corrected and brought up to date. The reconnaissances to be undertaken will show the catchments in which new gauges are more particularly required.

33. *Discharges and run-offs.*—(See paragraph 9). Except where required for irrigation projects practically nothing has hitherto been done to obtain the normal, minimum and flood discharges of rivers and streams in India. Still less is the run-off under various conditions known. The staff available for such work is exceedingly limited ; the area in one engineer's charge is often very large ; and the localities where observations are required are generally far apart and frequently difficult of access. It has already been pointed out that long continued observations are necessary, although those made in a single exceptionally dry year may be very valuable. The past season has been such a one in many parts of India, and suggestions were made before this enquiry began to take advantage of it; but shortage of staff owing to the war, combined with other factors, prevented their adoption. Had this work been put in hand at the time of the first enquiry in 1905 an immense mass of invaluable information would have been collected by now. As it is the Lists of Sites show that nothing whatever is known in the great majority of cases. The Report of the Japanese hydro-electric survey shows that 320 new gauging stations are being established in those islands.

As in the case of rainfall, so here the question of accuracy comes to the fore. The whole principle on which the most approved discharges of streams are calculated is based (See Appendix II) on Bazin's experiments on trapezoidal channels. The coefficients given are probably the best obtainable, but when applied to the bed of a hill stream near its minimum discharge they are mere approximations even in the hands of a skilled observer. Results worked out at two places slightly differing in character—probably neither of them really suitable although the best that nature has provided—will often differ as much as 10 per cent., although in canals and other "trapezoidal channels" consistent

results are obtained. Considerations of this nature led the late Chief Engineer of this Survey, himself a most experienced observer, to write the "Elementary Note" now reprinted in Appendix I, in which those unaccustomed to take discharges are asked to determine the cross-sectional area of the channel and the central surface velocity and to divide the product by 2 in every case. Such a method, which could be put in practice by any amateur, would give results of infinite value as compared with our present blank ignorance. It is for consideration, in view of the importance of the problem and the urgency of its solution, whether during the next few years it would not be possible to employ selected students from the local engineering colleges on this work, under P. W. D. supervision, during the two or three driest weeks before the monsoon breaks or the snows begin to melt, as the case may be. If the matter is left to the ordinary agency of the Public Works Department the results will assuredly be more accurate, but they will take many more years to collect. Bearing in mind the fact that Bazin's coefficients are not based on experiments on streams of the nature referred to, it will be most valuable if any officer with the necessary experience, stationed where a suitable hill stream exists, could make some careful experiments. It is suggested that a weir should be built from which fairly exact gaugings of the actual flow can be obtained. Then, in the reaches above or below the weir, a number of suitable reaches free from pools should be selected, as uniform as can be found. The type of bed referred to will generally have a hydraulic mean depth of unity or less, during low water at least, and the roughest of beds, with discharges of 10 to 100 cusecs. Cross-sections will then be taken and mean cross-sections plotted in the usual way. The existing coefficients are nominally at least based on the maximum central velocity; but it is suggested that in investigating the matter both this and also the mean velocity from a number of observations at various parts of the channel should be observed. Doing this at several different places with different characters will probably enable arbitrary coefficients to be worked out applicable either to the maximum or mean velocity. In selecting the reaches very little labour will often suffice to even up the width of very small streams and to check back flow. Still water will generally exist in places, but at least coefficients worked out from definite measurements are likely to be less inaccurate than the best now published.

Normal and maximum flood discharges can probably be better determined by means of self-recording gauges, and a dozen of these were ordered by the late Chief Engineer as a start and have been distributed. The type selected was the Stevens Water Stage Recorder, with time scale one-tenth of an inch to 30 minutes and gauge height scale one-sixth, *i.e.*, 2 inches of pencil movement corresponds to one foot of float movement. The time-scale is 4·8 inches to 24 hours and the roll of record paper is 25 yards long, thus lasting 6 months. The Hon'ble Mr. W. J. Howley, Chief Engineer, Madras, has also ordered some other types of the same instrument for his own experimental purposes, and information will be available regarding these later on. *Early steps should be taken to order any recorders required for next season's work.*

34. *Reconnaissance of Sites.*—In order to obviate unnecessary work in other directions the first thing required is a general reconnaissance of all the possible sites already brought to notice, or to which attention may be called after the publication of this Report, so as to eliminate those which are certainly worthless at present. Some will be found useless for all time, either because the natural discharge, or the possible discharge from reservoirs (capable of being filled), is too small; or because a suitable head, having regard to this discharge, cannot be developed. Other sites will be written off for the time being because there are better ones in the neighbourhood, or because the cost of their development cannot at present compete with fuel-developed power in the district. Yet another class may prove so remote from power users at present as to be apparently worthless for that reason; but here reconnaissance is needed as such a source may in the end prove valuable for special work not dependant on existing industries. Although the cost of communications to such a site might be very large it has seldom proved a bar to development if there are sufficient mineral possibilities at the far end. (See paragraph 17).

It is suggested that an effort should be made to carry the reconnaissance of sites as far as possible during the coming season. To this end it is suggested that there should be placed on special duty (*a*) Irrigation engineers for sites where reservoirs may be required, or where irrigation from the tail waters may be involved. (*b*) Mechanical or electrical engineers, acquainted with water power development, for other sites. In this connection the suggestion may be thrown out that Government Electrical Engineers may be made more use of. From an inside knowledge of the work on which they are for the most part employed it is clear that this would offer a far better field for their energies for a time; and they are trained engineers. The assistance already acknowledged from this source in one province was great; and there are other officers who have been actually engaged in the construction of hydro-electric works. Again it may be possible, if early action is taken, to secure the services of suitable engineers from the officers and men of the Territorial Forces who will soon be demobilized. It is almost certain that there are some among them who are engineers by profession and who have prospected for water power elsewhere; indeed applications have already been received from some.

35. *Survey of Sites.*—Reference has already been made to the assistance which it is hoped that the Surveyor-General of India may be able to give, in the matter of continuing the topographical survey to districts at present unsurveyed in detail and of revising old non-contoured maps. It will be necessary to see that there is no overlapping here, as clearly the work done in this way will obviate similar general work by other agencies. On the other hand, the specific survey of known sites is rather an engineering matter, dealing with limited parts of a small area, and this will no doubt be undertaken by survey parties in each province, after reconnaissance has proved whether the site is worth it. The following instruments were ordered by Mr. Barlow from the Mathematical Instrument Office, on the 31st January 1919, to reach India by September 1919, *viz.*:—

Tacheometric Plane Tables, 24″ × 22″ with outfits	9
Levels, reflecting Abneys, Steward's pattern, in sling leather case	9
Barometers, 'Aneroid, 4½″ diameter, bronzed, surveyor's reading between 25″ and 31″ and from 0 to 6,000 feet, in sling leather case.	9
Levels, Ziess, Watts pattern, No. 1, complete with stand in box	57

In addition, the Officer-in-Charge, Mathematical Instrument Office, was advised that the following articles would be required from stock, *viz.*:—

Levelling staffs, Sopworth	57
100 foot tapes	57
Measuring chains, 100 foot	57

The numbers in the above list were based on an estimate of what would be needed in each province; it seems probable, however, that a far greater number of surveyor's aneroid barometers (paragraph 13) will be required for reconnaissance work during the next year or two, including some for use in the Himalayas reading to 10,000 feet, and a further 20 have since been indented for. Application should be made for any needed.

To select, from the data so far collected, the sites which should be dealt with first is no easy matter. On the one hand it is clear that those situated where an early demand for power is likely to arise should receive preference; but there are few places at present of which this can be definitely stated. On the other hand, the fact that special industries on a large scale may be created where power can be cheaply obtained must not be overlooked. Cheap power is the text of the articles on the Chemical and Metallurgical Industries in the Indian Munitions Board "Industrial Handbook 1919." It is there stated that "As an index to the price of energy permissible it may be mentioned that for calcium carbide it should not exceed 0·10 anna per unit or £3·65 per kilowatt year and for aluminium £5 per kw. year." (Page 131). Elsewhere it is pointed out that in North America and Scandinavia current can be generated from water power at 0·05 anna per unit. It will be long before any new works, under present prices, can reach these figures.

In the opinion of the writer, backed in those cases discussed by that of the late Chief Engineer, the following list represents the lines upon which the

work may best proceed in the various provinces, according to the lists of sites in the Appendixes.

Assam.—General reconnaissance of the Khasia, Jaintia and Garo Hills coupled with specific survey of the Cherrapunji plateau for reservoir sites. The possible electrification of the Pandu Shillong Railway should be borne in mind.

General reconnaissance of the Jatinga and Ka Yeng Rivers and of the Maibang Valley, coupled with specific survey of the most promising of these. Other things being equal, the two former are a good deal nearer the tea districts of Silchar and Sylhet, but a matter of 30 miles is not of great importance.

Bengal.—Survey of the group of Darjeeling streams above the Great Rungit, to ascertain the best of a score of competing sites.

Survey of the upper reaches of the Jaldaka River and tributaries on the British side, coupled with further examination of the problem of electrifying the Duars tea factories.

Survey of the Tista River.

Bihar and Orissa.—A general reconnaissance of sites is essential before it is possible to say which are worth survey. Meantime however the Burhabalong, Sankh and Subarnarika Rivers are almost certainly worth careful investigation and survey.

Bombay.—Within the area of the Tata group of schemes it is unnecessary at present to do further work. The Kalinadi River and the Sharavarti at Gersoppa are clearly indicated for detailed examination and survey.

Burma.—Practically nothing definite is known of the majority of sites in this province, and until further information is collected it is difficult to suggest where to start. It appears worth while making a definite survey for reservoir sites above the Anisakan Falls, for Maymyo needs; and if sites are found the existing scheme should be overhauled completely so as to make full use of the small power possibilities. The Heho falls have already been partly surveyed, and it is certainly worth while completing the work with a view to the extension of the railway and the electrification of its hill sections. A demand for other power seems probable.

Beyond these the following rivers merit reconnaissance as being the ones of which some information is already known: the Bernard Myo, Konwet and Kin Chaung in the Mogok district; the Yetagon falls and Myitnge in the Mandalay region; the Mindon Chaung in Thayetmyo district; the Nam Et, Panlaung and Zawgyi within transmission distance of Kyaukse and Mandalay; the Namma and the Shweli, either of which may be capable of great power, the latter having been stated as worth 300,000 h. p.; the Sittang and Thaukyegat in the Toungoo area; the Tavoy district generally, as there is a power demand there. Three of the largest suggested sources are omitted so far. A large amount of work has already been done in connection with the harnessing of the Irrawaddy rapids, and this should be carried forward to the stage where it is possible to judge what power is available and about at what cost, not in great detail at present but on broad lines. The Kanti falls on the Chindwin and the Hatgyi rapids on the Salween are also worth prospecting, even though they are out of reach of present needs, as they may prove to have great possibilities. The Yunzalin near Papun is also promising.

Central Provinces and Berar.—Here again it is not easy to choose between innumerable projects regarding few of which anything definite is known. Early reconnaissance of all the sites will enable some to be eliminated and others chosen for detailed work. The Balaghat area is the most likely to require power and within reach of it the Nahara and Uskal Rivers seem to offer the most promise; examination will show if either is worth detailed survey. The many streams and reservoir sites in the Melghat area and on the Chikalda plateau should provide some good sites, and these should be examined and if necessary surveyed. The group of schemes comprised in the "Silewani Ghat project" should be examined in detail, together with the Kanhan River, as both are within reach of Nagpur which can absorb much cheap power. The Bina River in Saugor District; the Chornai River; the Chitrakot Falls on the Indrawati as well as the Marble Rocks on the Nerbudda, near Jubbulpore, also merit full investigation.

Madras.—The Periyar project will soon, it is hoped, emerge from the stage of prolonged investigation into realization. The whole Nilgiri area merits further examination including the Kundah River, Karteri and Coonoor scheme, Pykara and Siruvani Rivers. It is understood from the newspapers that definite proposals have been made regarding the development of the Kundah River, which is probably the best site of all these; if so the remainder can wait. The Anamalai Hills, including the Aliyar River, and the Sirumalai Hills should also be prospected and, if the result is favourable, surveyed. The Machkund River in Vizagapatam District appears likely to have great power, which may soon be needed for the harbour developments.

North-West Frontier Province.—If power is required here the Kashmir Durbar can provide it from works already in existence on the Jhelum. It is doubtful if it is worth while to investigate further sites in view of the peculiar conditions.

Punjab.—The project for utilizing the power of the Sutlej near the Bhakra dam site is the first that claims attention. Without endorsing all the statements in the paper on this subject, referred to in the List of Sites, Punjab, it clearly merits further investigation and the drawing up of careful estimates. It appears to be clear that the scheme can in no way interfere with the irrigation dam project, and, if that is so, it should receive every encouragement. Once the dam is built it will be difficult if not impossible to make the tunnel without emptying the reservoir, and a really comprehensive scheme for supplying cheap power to the province will be lost. For this reason also the tunnel, if built, should be of the full capacity required. Should the investigation prove satisfactory it becomes a question of the demand for power within reach. As a "demonstration plant" with good chances of success the late Mr. Barlow considered this one most favourable. Probably if the tunnel and diverting weir were constructed by Government a company would come forward to develop the power.

There are also the many known canal falls in the province, and exact information exists regarding them. If it is known that they are available for development, on easy terms, it seems probable that companies may come forward.

Apart from the above, the whole Himalayan area requires prospecting, including the Kulu rivers and Sutlej tributaries; and the Haro and Jablat Rivers, as to which enquiries have already been made by a firm, should be examined and, if found good, surveyed.

United Provinces.—Certain reaches of the Jumna have already been fully examined and their development may be hoped for. The canal falls are mostly of small power, but their value is also definitely known. Beyond these the Himalayan rivers generally require prospecting and of these the Alaknanda, the Bhagirathi, the Bakher and Belan Nadis, the Nayar and the Sardah seem the most promising. The Karamnasa and Chandrapraba schemes in Benares State also merit detailed examination.

36. *Training in Hydro-Electric Engineering.*—So far as is known the question of training engineers in Indian Colleges in the specialized work of water power has not hitherto been taken up seriously. The impression prevails that water power is a branch of irrigation work which can be taken for granted, but this is not so, although these two branches of engineering run on parallel lines so far as low falls and reservoirs are concerned. The electrical part of the problem of water power is again quite separate, for it will be seen that this Report contains hardly a word about electricity from start to finish. The essentials for an engineer who is investigating water power sites are that he shall have a sound knowledge of mechanical and hydraulic engineering, for power problems cannot be dealt with satisfactorily and thoroughly except by an engineer trained in power problems.

This matter has been receiving attention in Great Britain, as the following extract from the Second Report of the Water Power Committee of the Conjoint Board of Scientific Societies will show. It should also be taken up in India, where at present there are comparatively few engineers trained to deal with water power problems.

"*Training in Hydro-Electric Engineering.*—In view of the great developments in hydro-electric engineering which are inevitable throughout the Empire during the coming decade, it would appear to be of the greatest

importance that the engineers of Great Britain should be prepared to take a commensurate part in such development. In the past large scale hydro-electric engineering has been confined very largely to Canadian, American, or Continental engineers and corporations, and unless some definite and early endeavour is made in this country to make up the leeway, it is probable that the bulk of the Empire's future water-power will be developed outside the country.

"While there is some indication that strong financial and manufacturing interests are now considering such developments, the Committee would draw attention to the lack of facilities in our Universities for giving the necessary specialized scientific training to the young engineer wishing to enter this field of engineering.

"The Committee would emphasize the fact that an adequate supply of suitably trained engineers is essential to the attainment and maintenance of such a position in the hydro-electric world as is commensurate with the importance and capacity of the British Engineering Industry. It attaches great importance to the early provision of training facilities of such a standard as those, for example, at Cornell University, in one or more of the Engineering schools in this country, and would recommend that its views in this matter be brought to the notice of the Minister of Education and of the Secretary for Scotland."

37. *Conclusion.*—It has been the endeavour of the Compiler of this Preliminary Report to collect and arrange in logical order all the relevant information regarding the Water Power Resources of India which is available; to explain in non-technical language the various branches of the subject; and to lay down, in this final chapter, a tentative programme of work that will lead to the successful conclusion of the investigation now begun. While this work is being carried out the interlaced question of industries is in strong hands, and the combination of power and industries is essential to the prosperity of both. At the present time, while prices are high on the one hand, exchange is favourable for the import of plant on the other. There will however be keen competitors in the market for orders, and the British manufacturers of pipes, turbines, generators and switchgear must see to it that they are not left stranded. Hitherto they have been content to take the small orders and to let the large ones go to countries that have specialized in water power. It has even been asserted that engineers from abroad are essential to the proper erection of plants when received. It is high time that these fallacies should be disproved, and His Majesty's Trade Commissioner in India has this matter in hand.

To have acknowledged the source of every item of information in this Report would have increased its volume without adding much to its utility. The thanks of the Compiler are due to all and sundry who have assisted; particularly to Chief Engineers of the Public Works Departments and their Superintending and Executive Engineers; to Conservators of Forests and their Assistants; and to officers of the Munitions and Industries Departments. Above all acknowledgments are due to the late Mr. G. T. Barlow, C.I.E., whose untiring energy stimulated others to give their scant leisure to this work, which an unkind fate did not allow him to complete.

Simla, 29th May, 1919.

J. W. MEARES.

APPENDIX I.

Elementary notes by the late Mr. G. T. Barlow, C.I.E., Chief Engineer, dated 23rd March 1919, on the Preliminary Investigation of Water Power Sites for Electrical Purposes.

1. *Object of the investigation.*—The chief sources of energy which are at present known are coal, oil and water power. The two former are easily handled and transported, and in most places are more convenient and cheaper than water power, but their supply is limited, and their cost must sooner or later increase. A knowledge of the water power potentialities of the country is therefore of the greatest importance, not only in the conservation of energy, but also in the economic development of the country.

At present very little is known about the water power resources of India and Burma, because they mostly lie in the hills and jungles which are sparsely inhabited, and rarely visited by any officials; only rough survey maps exist of many parts.

The object of the preliminary investigation is therefore to locate the favourable areas and sites, to ascertain the discharges of the perennial rivers, and to collect other information through the Local Officers, which will enable detailed surveys to be carried out expeditiously by a special staff during the cold weather.

The object of the survey is *not* to prepare estimates for town lighting and electric fans, but to obtain details regarding favourable sites that can be made of general use to the Public. These details will show where and approximately how much power is available, and will also give other useful information which will enable any Company that requires power to know where and how to set to work to prepare the detailed plans.

To discover the localities of all the existing water power resources of the country is desirable whether a demand for power exists at present or not. The most unlikely places to-day may in a few years' time be the centres of Industrial, Agricultural or Mining activity. India and Burma are immense countries, but even though this is so, if intelligent and willing assistance is given by the Local Officers it will be possible to eliminate the useless areas, and to concentrate the survey work in the promising localities.

2. *Definitions of technical terms, etc.*

(*a*) *A typical Hydro-Electric Scheme* consists of a perennial river or of a reservoir or both for the supply of the water; this water, except where a natural fall already exists, is diverted into a separate channel by means of weirs or regulators, and is then run in an open channel along the hill side at an easy slope, or in a tunnel through the hill, till a suitable site has been reached for running the water down the hill slopes and obtaining the requisite fall for power purposes. The water is then run down the hill side in steel pipes to the power house which is situated at the bottom of the hill above the High Flood Level, and finally the water is escaped back into river; sometimes the water is diverted through a watershed into another river. From the power house transmission lines are constructed to convey the current to the factory or to other consumers. In the preliminary investigation only the details regarding the *supply of the water* and the *height of the fall* are required though details regarding other relevant points will be welcomed.

(*b*) A *Cusec* means a cubic foot per second.*

(*c*) *Head.*—The vertical difference in level (in feet) *i.e.*, the height of the fall between the inlet and outflow of water used for power purposes is called the *Head.* In all preliminary works it is sufficient to note the actual head available.

*NOTE.—The small water driven flour mills, found in the Himalayas, take from 3 to 4 cusecs. J. W. M.

(*d*) For water power purposes the "fall" means the difference in height between the level of the water where it will be taken from the stream and that at the place where it will be returned to the stream and it may be made by :—

(*i*) a vertical drop in a river or canal,

(*ii*) a series of rapids making, in a short reach of one or two miles of a river, a total fall of so many feet, or

(*iii*) an artificial fall which can be made in a reach of, say 4 or 5 miles, in a river with a *steep* slope, by taking off the water and running it along the hill side at a *gentle* slope, or in a tunnel through the hill to another valley ; and then, at a suitable place, running it down the hill sides back into the same or into another river bed.

For power purposes (*i*) and (*ii*) are merely superior to (*iii*) because the length of flume or open channel to the entrance of the pipe line is cheaper, and more convenient for regulation purposes.

(*e*) *Storage reservoirs* are natural or artificial collections of water situated above the fall, which are commonly called tanks or lakes. The water is collected during the monsoon periods or at other times when there is excess water, and is used for irrigation or power purposes, or for both. These reservoirs, which must be constructed above the fall, provide the necessary discharge in period of low supply in the river, and also collect the water which is running in the river when the water power plant is closed down, or when irrigation is not required.

(*f*) When it is found that a stream dries up or falls very low for a short period before the break of the rains, then in order to maintain a constant power, some storage must be provided.

(*g*) *One cusec running constantly* throughout the year is equivalent to 31·5 million cubic feet of storage, but allowance has to be made for evaporation and percolation losses, so that to obtain the equivalent of that constant discharge a storage of 35 million cubic feet should be provided. For one month the storage necessary may be assumed at 3 million cubic feet and for one day 100,000 cubic feet.

(*h*) The *Catchment area* of a stream at any point is the area draining into the stream at that point.

(*i*) *Watershed* is the boundary line between two catchment areas.

(*j*) The *Electrical Horse Power* that can be generated will be approximately $\frac{\text{Cusecs} \times \text{Head in feet}}{11}$, or $= \frac{\text{Cusecs} \times \text{Head in feet}}{15}$, when expressed in *Kilowatts* instead of Horse power.

3. *Sites suitable for producing power.*—Navigable or tidal rivers or waters are useless for water power purposes, because the cost of development is very great, and the power obtained is small. The power available depends on the product of the fall obtainable and the minimum discharge that can be relied on at the driest time of the year. A navigable river may have a large discharge but the slope of the river bed will be extremely small, and in a reach of 4 or 5 miles it will be impossible to produce more than a few feet of artificial fall. The product of the discharge multiplied by the fall will therefore be small while the cost of harnessing the river, and the cost of the other works will be very great. One thousand cusecs falling 5 feet will give the same power as 5 cusecs falling 1,000 feet, and it will be readily understood that the cost of developing the latter will be far less than that of the former. The best sites are therefore small discharges with big falls ; say 50 to 200 cusecs falling 400 to 2,000 feet, but medium discharges of say 200 to 500 cusecs falling medium heights say 100 to 400 feet are also good, while large discharges (say anything above 1,000 cusecs) falling small heights of say 5 to 50 feet are expensive in construction, and therefore poor if anything better is available.

From this it follows that the best sites are generally those found in hilly country and on the tributaries of the large rivers, and that the power sites available in the large rivers themselves and on canals are seldom really favourable.

The ideal site is one where several small snow or spring fed streams collect in a high level valley above the fall, and then drop many hundred feet in a short length of the stream into a lower valley, where sound rock suitable for a dam is found at the exit of the upper valley ; where the run off from the catchment area will be sufficient to provide the necessary storage ; and where the valley is flat and uncultivated, which will enable additional storage to be collected by means of a low dam, without destroying cultivation.

All these conditions seldom exist in one place and one has generally to be content with a stream the discharge from which disappears for a couple of months before the rains, or with an indifferent storage site where the valley has a quick slope, and a high dam will be required to store much water, or where the rock is poor, or submergence will necessitate the removal of villages and the payment of heavy compensation for the loss of cultivation, and so on.

In the preliminary investigation however there is no necessity to give great consideration to all these points, it will be sufficient to find a perennial or nearly perennial stream where there is a good fall. The details of the storage site can best be left for expert survey work later on.

Any site is worth considering where the product of the minimum discharge in cubic feet per second multiplied by the height of the fall in feet is not less than 16,000. Anything less than this is too small for industrial purposes though it may be of use for town supply.

4. For preliminary reconnaissance an Aneroid Barometer to measure heights, a watch with seconds hand, and a tape measure or a 10 foot rod are all the instruments necessary.

The points to note are :—

(*a*) Approximate discharge and Head available.

(*b*) River and site on river, by reference to the 1″ maps or by latitude and longitude.

(*c*) Accessibility, *i.e.*, how to get to the site, and nearest road, rail or river communications.

(*d*) General remarks (when known) on the height that the high flood water rises, whether a storage reservoir appears possible, nature of the country, geological formation, difficulties, market for power and any other points of interest which may affect the cost, construction, or upkeep of the works.

Where it is impossible to observe an accurate discharge, or where the correct methods and co-efficients to be employed are unknown, the following very approximate method may be adopted :—

Select a straight reach of the stream where the flow is uniform and where there are no marked pools, and mark off with pegs any convenient length of fairly uniform width. Then measure as accurately as possible the width of the stream, and find the *average* depth by soundings at intervals across the stream. Then throw into the centre of the stream a small stick and note the time it takes to pass along the marked length ; repeat this 4 or 5 times to eliminate errors. Then the run in length in feet divided by the average time in seconds gives the velocity on the surface. Then the cross-sectional area in square feet multiplied by the surface velocity in feet per second and *divided by two* will give the approximate discharge in cubic feet per second.

For instance, suppose the length marked off is 100 feet and the floats take an average time of 50 seconds in passing along this length in a stream having a width of 40 feet and an average depth of $1\frac{1}{2}$ feet. This gives a cross-sectional area of 60 square feet. The surface velocity will then be 2 feet a second and the discharge $\frac{2 \text{ feet a second} \times 60 \text{ square feet}}{2} = 60$ cusecs.

5. A careful study of the largest maps which are available will be found of great assistance in all reconnaissance work. In dense jungle or rough country it is frequently impossible to follow up the course of a stream, and unless the maps are carefully studied it may easily happen that a useful fall or a promising reservoir site is missed. The 1″=1 mile contoured maps are excellent and the 4″=1 mile Forest surveys are even better.

A few examples are given below to indicate the kind of information which can be obtained from maps :—

(*a*) A flat or a steep valley or hill side is shown by the distance between the contour lines. The closer the lines are the steeper the country will be found.

(*b*) The distance between any two contour lines which cross a stream will give the fall in that reach.

(*c*) Absence of village sites and roads or pathways denotes wild or uncultivated country.

(*d*) Numerous habitations on the hill slopes or in a valley in hilly country denote cultivation, and generally springs or perennial water in the streams.

(*e*) When the discharge of a stream is known at a certain point, an idea of the discharge at another site can generally be guessed by a comparison of the catchment areas at the two places.

(*f*) By a study of the nature of the valleys and the hill sides, a fair idea can be obtained of the general nature of the country, and its possibilities with reference to reservoir sites, slopes of the stream, and places where an artificial fall for power purposes can be found.

(*g*) When a stream makes a long hair-pin bend, it is frequently possible to obtain a good fall by diverting the water in a tunnel across the neck of the bend. Several miles of a river can sometimes in this manner be replaced by a short cut diversion of a few furlongs.

(*h*) Sometimes the slopes on one side of a water-shed are very steep, while on the far side they are gentle; when this happens it may be possible to form a reservoir and divert the water through the hill, and by this means obtain a most useful artificial fall.

Addendum to elementary note.

Useful Hydraulic Data (in round numbers generally).

Flow.

1 cusec flow = 1 cubic foot per second = 62·4 lbs. per second,
= 60 cubic feet per minute = 3,744 lbs. per minute,
= 374 gallons per minute,
= 3,600 cubic feet per hour,
= 86,400 cubic feet per day,
= 2·6 million cubic feet per month,
= 31½ million cubic feet per year.

Regulating storage.

100,000 cubic feet stored will give 1·16 cusecs for 24 hours.
„ „ „ „ 2¼ „ „ 12 „
„ „ „ „ 4½ „ „ 6 „
„ „ „ „ 9¼ „ „ 3 „
„ „ „ „ 27¾ „ „ 1 „

Main storage.

31½ million cubic feet stored is equivalent to 1 cusec for a year; but owing to evaporation and percolation more storage would actually be required. In round figures :—

1,000 million cubic feet stored will give 30 cusecs continuously for a year.
„ „ „ „ 40 „ „ „ 9 months.
„ „ „ „ 60 „ „ „ 6 „
„ „ „ „ 120 „ „ „ 3 „

Reservoirs.

1 acre = 43,560 square feet,
1 acre of water 1 foot deep = 43,560 cubic feet,
1 square mile = 640 acres = 27·88 million square feet,
1 square mile of water 1 foot deep = 27·88 million cubic feet, which will (in practice) give a flow of about ¾ cusec for 12 months, or a little over 3 cusecs for 3 months.

Catchments.

1 inch of rain = 100 tons or 3,640 cubic feet per acre. = 64,000 tons or 2·33 million cubic feet per square mile.
In practice, however, only a percentage, and often a small percentage will reach the reservoir; see paragraph 9.

Power from flow.

On the practical basis assumed throughout this report $\frac{\text{Cubic feet flow} \times \text{head in feet}}{11}$ = electrical horse power.
If 15 is the divisor, the result is in kilowatts.

Power from storage.

(*i*) Regulating. $\frac{\text{Thousands cubic feet stored} \times \text{head in feet}}{42}$ = e. h. p. hours.
If the divisor is 56, the result is in kw. hours or B. O. T. units.
(*ii*) Main. $\frac{\text{Millions cubic feet stored} \times \text{head in feet}}{370}$ = e. h. p. years.
If the divisor is 500, the result is in k. w. years.

APPENDIX II.

Coefficients for ascertaining mean velocity from greatest surface velocity in channels.

Hydraulic mean depth.	Very smooth channels-cement.	Smooth Ashlar or brickwork.	Rough channels. Rubble masonry.	Very rough channels earth.	Channels with detritus.
Feet.					
·25	·83	·79	·69	·51	·42
·5	·84	·81	·74	·58	·50
·75	·84	·82	·76	·63	·55
1	·85	...	·77	·65	·58
2		·83	·79	·71	·64
3		...	·80	·73	·67
4		...	·81	·75	·70
5		...	...	·76	·71
6		·84	...	·77	·72
7			...	·78	·73
8			...		...
9			·82		·74
10					...
15					·75
20					·76
30					·77

The hydraulic mean depth is found by dividing the cross-sectional area in square feet by the wetted perimeter in feet. The mean values of several cross-sections along the chosen length of channel are used. For most streams and rivers in the hills the coefficients in the last column will be used. It will be observed that with a hydraulic mean depth less than 0·5 foot the coefficient is slightly below the figure suggested in Mr. Barlow's note (Appendix I); this however will almost always give conservative results.

APPENDIX III.

Part of an aneroid survey—see paragraph 13.

The entries in the field note book were as follows:—

Date.	Time.	Station.	Temp. F.	Reading of aneroid.	
April 4 .	6·0	I	72	1870	Outward journey.
„ . .	8·45	II	83	1853	
„ . .	10·0	III	92	2055	
„ . .	12·0	IV	96	2850	
„ . .	12·10	VI	91	2972	
April 6 .	5·30	VI	66	3002	Return journey.
„ . .	7·0	V	69	2150	
„ . .	7·30	II	74	1900	
„ . .	8·30	I	80	1795	

Reduction by Molesworth's curve for diurnal variation in Calcutta and for air temperature by means of curves given in Molesworth and Deschanel, as follows:—

Outward journey.

Station.	Diff. by aneroid feet.	Correction for diurnal.	Result feet.	K	Final difference, feet.	
I, II	Fall 18	+40	Rise 22	1·096	Rise 24	24
II, III	Rise 202	+3	Rise 205	1·115	Rise 230	1,264
III, IV	Rise 795	−3	Rise 792	1·130	Rise 896	
IV, VI	Rise 122	*Nil*	Rise 122	1·130	Rise 138	
					TOTAL RISE .	1,288

Return journey.

VI, V	Fall 852	−23	Fall 829	1·075	Fall 891	1,157
V, II	Fall 250	−5	Fall 245	1·084	Fall 266	
II, I	Fall 105	−5	Fall 100	1·095	Fall 110	110
					TOTAL FALL .	1,267

It will be seen that while the reduced results between the terminal stations agree very well, giving a mean difference between them of $\frac{1,288+1,267}{2}=$ 1,278 feet, the two common intermediate readings do not agree; between stations 1 and 2 the outward journey gives a difference of 24 feet and the homeward 110 feet, while the discrepancy is balanced between stations 2 and 6, traversed by a different route. Unless the instruments can be carried in special lagged cases, so that the metal work cannot get heated up differently at various parts, these discrepancies will occur. A second instrument carried at this time showed equally discordant results at intermediate stations, and the two did not agree any better *inter se*. No doubt if a long halt could have been made at each station, to enable the instruments to settle down thoroughly, the results would have been more even; but this is generally impossible.

Station I was found by a 4″ Forest map to be at *about* reduced level 990 feet. Adding the mean rise between 1 and 2′ *i.e.*, $\frac{24+110}{2}=67$ feet, Station 2 will probably be within 50 feet of R. L. 1,057. Station 3, with only a single reading, is 230 feet higher and the result, 1,287 feet, may be 100 feet out. Station 4 similarly may be taken as about 2,183 feet, with a similar margin. The terminal station 6 is probably within 15 feet of 990+1,278 mean or 2,268 feet, as the results accord well and the Bengal weather reports showed that no considerable change of pressure occurred in the interval; station 5 is about 891 feet, below this, or say 1,377 feet within 100 feet. The reductions made from the second instrument confirm these probabilities.

A subsequent test of the two "compensated" aneroids, one kept in the shade as a control and other placed in the sun, showed that the latter in both experiments rose very rapidly; the relative change due to the temperature changes of the instrument itself were 60 feet and 84 feet respectively in the course of an hour or so. This no doubt accounts for the discrepancies at intermediate stations.

APPENDIX IV.

Mechanical and Electrical Power.

The British, and practically International, horse-power is the power obtained when energy is being expended at the *rate* of 550 foot-pounds a second or 33,000 foot-pounds a minute. Applied to water power, if 330 lbs. of water (5·28 cubic feet) are discharged per minute under a head of 100 feet (giving a static pressure of 43·3 lbs. per square inch) the energy expended will be at the rate of 1 horse-power. This, however, is theoretical, or water horse-power, w.h.p. If a turbine and pipe system having an efficiency of 90 per cent. are employed to utilize this flow and fall, the mechanical or brake horse-power obtained on the shaft will be 0·9 b.h.p. If this mechanical power is used to drive an electric generator, the efficiency of conversion being 95 per cent. under the particular conditions, the electrical horse-power obtained will be ·9×·95 =0·855 e.h.p. The value of the horse-power in foot lbs. per minute is in each case the same, but the fraction available diminishes. The output of the generator, 0·855 e.h.p. × ·746 gives the exact electrical equivalent, *viz.*, 0·636 kilowatt, as 1 e.h.p. =746 watts or ·746 kilowatts. To round up the example, if this ·636 of a Kilowatt is converted to heat (where the efficiency is necessarily 100 per cent.) it will give out ·636 of 57·3 or 36·4 British Thermal units per minute, which is equivalent to 28,200 foot-lbs. per minute, out of the 33,000 with which the example started. Thus horse-power is a *rate*, not an *amount*, so "500 h.p. per minute" is meaningless; the total amount of electrical power generated in any particular time is expressed in e.h.p.-hours or kilowatt-hours. If 500 h.p. (373 k. w.) is exerted for one minute the resultant energy is 500/60 or 8·33 h. p. hours or 6·21 k. w. hours. These elementary explanations are only given because the letters received from engineers show that they are required.

No mention has so far been made of "indicated horse-power" and "nominal horse-power." The former represents the power developed *in the cylinders* of a steam or oil engine, as calculated from the indicator diagram, and will generally be from 7 to 18 per cent. higher than the effective b.h.p. developed on the crank shaft. Nominal horse-power is a term surviving from the earliest days of the steam engine, and is practically meaningless now. The b.h.p. of an engine may be two or three times the n.h.p. as the term related to the size of the cylinders and length of stroke without regard to the steam pressure actually used. Where returns for the census of power are submitted in n.h.p. an endeavour should be made to ascertain the b.h.p. developed by comparison with other cases. Otherwise the n.h.p. should be multiplied by 3.

APPENDIX V.

List of sites in Assam.

Bhugai River (Garo Hills).—Unsurveyed in detail, but has a rainfall of 100 inches of which 91 per cent. falls between April and October. Appears unlikely to afford any good site judging by the ¼-inch map. The catchment area however is some 85 square miles at Selhat Haut, where the Naranga tributary flows in. (Map 78 K. 7).

Bogopani River.—see Shella River.

Cherrapungi.—see Shella River.

Damring River.—see Krishnai River.

Didram River.—see Jinari River.

Digru River.—see Um Tru.

Dudhnai River (Garo Hills).—Nothing is known regarding this stream, or its tributaries, the Manda and Chichura but it is probably worth reconnaissance as the rainfall is high and the slope rapid. At the junction of the above tributaries the Manda has a catchment of about 40 square miles and the Chichura about 70 square miles. About 105 out of 115 inches of rain falls between April and October. (Map 78 K 13).

Jadukata or Kynshiang River and tributaries (Khasia Hills).—Appears to have considerable possibilities, the rainfall being between 100 and 150 inches of which 94 per cent. falls between April and October. There are many falls, and reservoir sites may be found in the Nongstoin area. The catchment area above the falls of 70 feet, with others near by, in latitude 25° 26′, longitude 91° 8′ is about 24 square miles. (Map 78 O ; 3, 7, 10).

Jatinga River.—The possibility of using this river for the electrification of the hill section of the Assam Bengal Railway has been considered by the Agent. The proposal is to dam the river just below the junction with the Ka Yeng (q. v.) near mile 277, up stream of the hair-pin bend near the railway tunnel. (There are no detailed maps of the river area available at present). The area flooded would be about 2½ sq. miles, and with a 90 foot dam and mean depth of water of 45 feet the storage would be some 3,000 million cu. ft. The rainfall is said to vary between 144 and 250 inches in the catchment, mostly falling between March and October. It averages 84 at Haflong and 174 in the Jatinga Valley. The above storage would give about 380 cusecs for the 6 dry months and 12 hours a day. The catchment area of the combined streams is about 96 sq. miles above here. The power station would be near Damchara Station, where a head of about 200 feet could be obtained, with a long canal on difficult ground and perhaps a long pipe line so far as is at present known. The site may be good for 7,000 e. h. p. or more. It seems probable that a higher dam than 90 feet would be required to give the storage indicated, and this might involve the submergence and re-alignment of several miles of the railway in difficult country. The dam site requires further examination. Rock outcrops in several places on both banks, and is hard and compact, with the strata often vertical, sometimes twisted, and frequently broken. It is sound enough for a weir to stand on, but not for water to fall on unless heavily protected. It is probable that the river bed was once 100 feet deeper or more, and the present flat valley has been formed by the hills slipping down on the left bank and blocking the river. A lake was formed and in course of time its overflow has scoured out a new channel, but this is still much above the old level. There is a possible flank escape (not examined) on the left bank some little way back, where rock should be found, as evidently the river at one time escaped by this route. The dam would probably run across the river at a sharp angle, but the line would have to be trenched for examination and this would be most difficult. Further examination in detail is required before a verdict can be expressed on the scheme. See also Ka Yeng River and Maibang. (Map 83 G 4).

Jinari, Jinjaram or Didram River (Garo Hills).—This has not been prospected; it has a catchment area of about 100 sq. miles at Roksaun, with about 100 inches of rainfall, and the slope is rapid. The stream is unsurveyed

on a large scale, but looks unpromising on the ¼ inch map. 91 % of the rain falls between April and October. (Map 78 K 5, 9).

Ka Yeng River.—This from the layered maps looks more favourable than the Jatinga river (q. v.), into which it flows just above the site mentioned on the latter. There is apparently a good reservoir flat some 2 or 3 miles from the Railway bridge, but it proved inaccessible in the time available.* The dam here would be well above the railway. The flow was found to be about 5 cusecs only in December, but the rainfall is about 150 inches here over a catchment of 30 sq. miles, mostly falling in 6 months. (Map 83 G 2, 3; unsurveyed).

Kulsi River (Khasia Hills).—This appears promising on the map, but has not been examined. It is a perennial stream and has good falls. Rainfall is 100 inches, mostly between April and October. There are large lakes in the reserved forest area, which could probably be dammed at the exit; but the fall would be that due to the dam only. The catchment area to the lake exit is over 100 sq. miles. (Map 78 O 5).

Krishnai or Damring River (Garo Hills).—Near the Jinari (q. v.) and the same comments apply. Catchment area at Chelteret about 200 sq. miles. (Map 78 K 9).

Maibang, Assam-Bengal Railway, hill section.—The railway station here is in the middle of a large flat valley, several miles long, with steep cliffs on the east side where good rock appears to outcrop. This valley is near the highest point of the line, and it falls steeply away towards Lumding. The valley is cultivated, but the railway could be cheaply diverted. The discharge of the river (name unknown) in December was only a few cusecs, but rainfall is high—about 100 inches. The site is most suitable for a large reservoir, as the valley is flat, the rock apparently good, and an excellent saddle escape exists on the east. This site is considered well worth examination. From the Atlas sheets the catchment area is about 80 sq. miles. (No maps available, but on 78 G 2 or 3).

Monas River.—This flows into the Brahmaputra from Bhutan, and has a large perennial flow. The fall after it enters British territory appears considerable. (Map 78 J 13).

Shella River (Bogopani River in Atlas; Khasia Hills).—This is within the belt of 200 to 440 inches of rain and consists of steep sided gorges, already cut down almost to plains level. Unless reservoir sites are found on the upper reaches in the Cherrapunji district (see General Remarks on Assam; para. 26) it is doubtful if the stream is of any use. If storage exists the catchment areas at almost any point are far larger than is necessary; excess water, not deficiency, will be the difficult problem. The months of December and January are almost dry; November and February receive an average of 2½ inches; March averages 8 and October 15; so the distribution is unusually good. As the country is mostly steep and rocky the run-off will be very high, as all falls are heavy. By way of an index to the dry weather discharges 27 very small feeders of the Shella River were gauged in the area immediately west of Cherrapungi. All these flow into the Um Long and Um Pynjngithuli, which meet at R. L. 1,700 feet, 3½ miles due west of the Dak Bungalow, and attention is called to possible reservoir sites above here in para. 26. January 1919 had only one measurable fall of rain, 0·63 inch on the 20th, and the combined discharges of the streams amounted to only 3 cusecs early in February. That month was quite dry. March had 0·92 inch on the 3rd and 4th only, and the combined discharges later in that month were under 2½ cusecs. April had 13 inches of which half fell between the 17th and 23rd, the remainder being distributed in small falls. The combined discharges taken just after these heavier falls amounted to only 8 cusecs. The Umsohphi reservoir site at the 100 feet contour is just over 1·1 square mile in area by the map. (Map 78 O 11, 15).

Shillong.—A small scheme was drawn up for lighting this hill station from the neighbouring falls on the Um Kra and Um Shirpi, but it offered no facilities for extension beyond about 150 e. h. p. A printed report on the site is in existence. Gaugings of the Um Kra taken at Mawlai Bridge gave from 11¼ cusecs at the end of December 1918, dropping very steadily to a minimum of 6·3 cusecs early in April 1919. The decrease is about 1 cusec per mensem in winter. Above Bishop's falls the Um Shirpi dropped steadily from 10 cusecs

* Since examined and found unpromising.

at the end of December 1918 to a minimum of 6·3 cusecs early in April 1919, with the same decrement. (Map 78 O 14).

Umian River, Khasia Hills.—This crosses the main road at Barapani, where a reservoir site may exist. There is however little information as to the fall available below, as the river soon passes to parts of which no detailed maps exist. The catchment at Barapani is about 20 sq. miles. Rainfall about 100 inches, mostly falling in 7 months, *viz.*, about 94 %. (Map 78 O 14 and 83 C 1,2).

Um Kra ; see Shillong *supra*.

Um Rai River, tributary of the Um Tru (q.v.). This has been gauged where it passes near the Gauhati-Shillong road, and where it is perennial. At mile 41 the discharge fell gradually, with large variations, from an average of 20 cusecs in January 1919, and 10 cusecs in February, to 6¾ in March and 5 in the early part of April. The lowest record was 1 cusec. At the Laroh rapids (not identified) the discharge fell from 38 cusecs average in January and 28 in February down to 22 in March ; the lowest record being 15 cusecs. Rainfall about 100 inches. (Map 78 O 13).

Um Shirpi.—See Shillong *supra*.

Um Tru or Digru River.—(Khasia Hills). This and its branches, which pass the Gauhati Shillong road, may offer some power, but not much information is available except that the river is perennial and has some good falls. Detailed examination of the maps has not yet been made. The catchment area above the junction with the Um Rai appears to be about 60 square miles, but it is difficult to trace out exactly. Rainfall about 100 inches, of which about 94 per cent. falls between April and October. (Map 78 O 9,13).

Someswari River.—(Garo Hills). Unsurveyed in detail, but looks promising on the layered and ¼ inch maps. At the junction where the Ramthang and Semthang from the west join the Rangdi from the east the catchment areas are about 300 and 170 square miles, or 470 in all. Rainfall over 100 inches, of which 90 per cent. falls between April and October. (Map 78 K 10, 11, 14, 15).

APPENDIX VI.

Bengal and neighbourhood.

Chittagong.—A small scheme was drawn up for utilizing the Karnaphuli River near this town, but no details are available. Rainfall about 100 inches. (Map 84-B, unsurveyed).

Damuda River.—There appear to be some possibilities in this river in connection with an irrigation project, but they have not been investigated from the power point of view. The development would, it is believed, be expensive. The rainfall averages 50 inches in the area. The Port Commissioners of Calcutta are interested in the reservoir project, as the monsoon flush is required to keep the River Hooghly clear. Several reservoirs were proposed, one of the upper ones creating a fall of 100 feet, some of which could be utilized. The lower reservoir, into which the tail waters would discharge, was designed for a capacity of 20,000 million cubic feet ; and the river bed below this has a slope of about 10 feet per mile. The prospects are not alluring, owing to the proximity of the coal fields and the high cost of any development. (Map 73-M).

Darjeeling District.—The present plant (See Table 2) is incapable of supplying the whole district and various schemes (Table 5) have been drawn up for further power. None of these are particularly comprehensive and detailed examination should improve on them. The Great Rungeet River is mostly out of British territory ; the Little Rungeet River with its tributary hill nalas is in all cases suggested, and these are certainly capable of development. They have a catchment area of about 200 square miles. It is probable that at least 1,000 feet head can be obtained with a minimum discharge, from the Little Rungeet and the Kahill Nala alone, of 40 cusecs. The 2,000 foot contour offers a favourable channel line, and the drop would be made to the Great Rungeet where these streams meet it, at about R. L. 1,000 feet. No storage sites (other than for regulation) are probable; but power to the extent of 3,000 e.h.p. may be obtainable. Rainfall 120 inches well distributed from April to October. The following gaugings were made on the 4th April 1919, when the flow was exceptionally low, at points selected as likely to be reliable, and capable of being combined into a single scheme. The coefficient locally adopted has been changed from 0·66 to 0·5, as the hydraulic mean depth is extremely small and the beds are full of boulders and no really good cross sections are possible ; the readings however were carefully made, and the reduced results are dependable.

Raman 48 cusecs ; Lodhoma 17 cusecs ; Rungriate 4½ cusecs ; Rilling 7 cusecs ; Little Rungeet 22 cusecs ; Kahil 7 cusecs ; total 105.

(Map 78 A 7 and 8, survey incomplete towards Sikkim).

Duars District.—In addition to the Jaldaka (q. v.) on the border there are to the East some half dozen much larger rivers, mostly snow fed, falling into the Duars and Goalpara from Bhutan. The Amo Chu or Torsa, Chin Chu or Raidak, Sankosh, Saralbhanga, Manas, as well as smaller streams, all come from very high ground and must have great possibilities; but no maps are available, and no prospecting has been done. Probably the power sites will be outside British India entirely.

Jaldaka River.—(or Hidden Stream). This lies on the border line between Kalimpong (Darjeeling) and Bhutan and flows into the Duars; its upper reaches are in Tibet and Sikkim ; the road up from Kumani Forest Bungalow is negotiable by elephants for some distance ; it crosses and recrosses the boundary, over the river, which is barely fordable to men at the lowest water in April before the snows melt. The main river is apparently fed from the snows of the Jelep La, north of Gnatong in Sikkim ; a considerable tributary, the Ne Chu, joins the main river where Sikkim and Bhutan meet the Kalimpong boundary and a fair one on the left bank ½ a mile below. The catchment area here is about 130 square miles. The streams were gauged in the first week of April 1919, when the discharge was believed to be the lowest ever known ; it was about 130 cusecs at the junction, where the elevation was found to be about 2,000 feet. The tributaries lower down were nearly dry in March 1919. The rainfall is not less than 150 inches, and the flood discharges are vast, probably over 40,000 cusecs at times. The slope of the bed is fairly

steep throughout, down to the plains near Sipchu Ghat (some 12 miles) where the elevation is about 680 feet. The upper part of the area has not been surveyed, but it is probable that a channel could be taken along the right bank, in British territory, at about contour 2,000, to a point near Kumai Tea Estate, where a drop of 1,000 feet or more may be obtainable—but the lower part of this again has not been contoured. Neither the stream beds nor the hills along the route appear to afford good facilities for even regulating storage, but further investigation is required. If this development is impracticable other sites lower down may not prove so; there are several places where a dam might (with difficulty) be built to impound a fair lake, and the river does not carry much silt normally, but the escape would have to be over the dam. The river appears likely to afford at least 12,000 e.h.p. continuously without any storage. Its possibilities are, however, vastly greater, as if harnessed it would be required for the tea districts of the Duars; Mr. A. H. Abbott of Octavius Steel and Company, who are managing Agents of many of these gardens, first drew attention to the potentialities of the river. Tea plucking does not begin until the first rains produce new leaf; and as soon as the early rains begin the discharge rises. Furthermore, before the tea season is in full swing, the snows begin to melt and supplement the cold weather flow. It is very probable therefore that by the time the power would be wanted there would be from 50,000 e.h.p upwards available; but whether this could be developed at a single site is somewhat doubtful. An artificial channel or flume of large capacity (several hundred cusecs) would have to be carried for many miles along the hill side, across several large tributary nalas, and possibly along precipitous or treacherous ground. As, however, the industry awaits the power the scheme is well worth detailed examination. The submontane tea area of the Duars covers about 1,000 square miles, all within easy transmission reach of the site. Some 90 million pounds of tea are prepared in a season, requiring the equivalent of some 85,000 tons of coal, costing at pre-war rates over 13 lakhs of rupees. The greater part of this fuel, about 60 per cent, is used for drying purposes, to heat air which is driven by fans through the leaf at a temperature of about 220° F. The volume of air required is considerable, but the heating of it electrically, by means of resistance coils, is a simple matter, already done on as large a scale in other industrial drying operations. The power required for this purpose is large, but susceptible of exact calculation. The district is probably able to absorb the whole of the power that can be economically developed from the Jaldaka River, during the season from April to December. (Map 78 A. 12, 16. Partly available on 4″ scale; part unsurveyed on border of Sikkim and Bhutan.)

Sikkim.—Messrs. Burn & Co., Ltd., of Howrah have obtained various forest and mineral concessions in Sikkim, including the right to develop electrical energy from water power. After investigating a scheme to utilize the Tahung Chu and Zenn Chu at their junction they finally decided to develop power at the Lagyap Pass site, east of Gangtok. The source of power is a perennial stream flowing from a snow-fed lake at a high altitude and eventually finding its way to the Tista River. The site is near a gap on the watershed, through which the stream will be diverted to the west, without a tunnel. It will then be carried along the hill side to where there is a steep drop of 2,000 feet into the Roro Chu or Tahsourche nala. Communications are difficult. The site is estimated to yield some 6,500 e.h.p. continuously at an overall cost of about one-tenth of an anna per unit. (No maps available.)

Tista River.—This is a snow-fed river with a minimum discharge of 10,000 cusecs. The slope of the bed where it enters the plains is about 10 feet a mile for 20 miles; and until well into Sikkim, above the junction with the Great Rungeet, the slope does not materially rise. The river is subject to enormous floods from its 3,000 or more square miles of catchment, and although capable of yielding much power the development would be an expensive one. There is little doubt that a dam would be the only method of controlling the floods and concentrating a fall (*i.e.*, its storage would not be drawn on); and to construct this would offer engineering great difficulties owing to the high minimum discharge. Assuming that a 50 foot head could be obtained by this means, as is probable, this would give some 45,000 e.h.p. continuously; and more than one such place could in all probability be found. The river in its lower hill reaches may be estimated as good for at least 150,000 e.h.p. *at a price* (Map 78-A).

APPENDIX VII.

List of Sites in Bihar and Orissa.

Barakar River: see Usri River.

Burhabalong River (Mayurbhang). Mr. (now Major) C. H. Douglas, late of the British Westinghouse Co., investigated a power site on the upper reaches of this river many years ago, having a fall of some 900 feet, and he expressed the opinion that 40,000 e.h.p. or more could be developed with the aid of storage. It is probable, however, that only a single gauging of the discharge was made, which may have been by no means at the lowest time or in a dry year. The reservoir site at that time was unbroken jungle, and not surveyed in detail. The rainfall in the surrounding plains is 60 inches, of which 90 per cent. falls between May and October; it is certainly much higher in the Mayurbhang hills, which rise to over 3,000 feet. The site has now been re-examined under the orders of the Chief Engineer, Public Works Department, Bihar and Orissa. It is reported that there are two main reservoir sites which will cover over a square mile each and store some 1,200 and 1,000 million cubic feet respectively; while the first of these, situated below the junction with the Bukwa stream below Simlipalgarh, can be increased greatly by raising the proposed dam higher than the 120 feet originally proposed. These sites are 2 and 5 miles above the fall, and smaller regulating dams can be built close to the fall with a capacity of 400 million cubic feet more. The fall itself is 795 feet high but can be raised to 950 feet by carrying a channel along the eastern side for a length of 2,500 feet, thus confirming Mr. Douglas' opinion. It is probable that the site is capable of a development of 10,000 e.h.p. at least, and Mr. Douglas' estimate has not been disproved. (Map. 73 J. 8 and K. 5.)

Durgaoli River, tributary of Karamnasa, Shahabad District. At Kadbar Khoh, 9 miles from the river's source, there were reported to be storage possibilities, but the Chief Engineer finds the valley unsuitable owing to the rocks being much fissured vertically and horizontally. Rainfall 40 to 50 inches nearly all between June and September; catchment area about 27 square miles only. The site is reported by the Chief Engineer to be useless, as the minimum discharge in 1918-19 was only $\frac{3}{4}$ cusec. The Bichli (Mojhli) site, close to the former, is equally useless and dries up entirely. (Map. 63 P. 14.)

Garrha Nadi, Singhbhum District, at Dutaura, 4 miles north of Dhirol Public Works Department bungalow on Chaibasa-Moholia Road, has been examined. There are good storage possibilities (at heavy cost) and the catchment is large, but the fall is probably not more than 50 feet. The flow was 7 cusecs in February 1919 at this site, where the stream breaks through the hills. It is 4 miles north of the Haldopokhar Road. (Map 73 J. 6.)

Kakolat Fall, Gaya District. This is 10 or 12 miles south of Nawada in the hills running east from the Job Nadi. An article in "Indian Industries and Power" says "At the very minimum this may be expected to yield 25,000 horse power" but it is, on the other hand, reported by the Commissioner, Patna Division, to run quite dry in the hot weather. The discharge was 2 cusecs in February, 1919. Large storage is therefore essential. The catchment area is extremely small and the available fall is only 160 feet. The site is reported as quite useless by the Chief Engineer. Rainfall about 50 inches nearly all falling between June and September. (Map 72 H. 10.)

Kanchi River.—The Raota (or Dasan Ghag) fall, 6 miles south of Taimara, in the 19th mile of the Ranchi-Bandu Road, is about 150 feet. The catchment area is about 260 square miles and the rainfall 50 to 60 inches, of which that falling in June to September is alone of real value. The minimum discharge in 1918-19 was $4\frac{1}{2}$ cusecs. No reservoir can be formed at the fall, but without storage no great power can be expected. A site for a reservoir exists 20 miles above the fall and others may exist. Possibly the fall can be increased also. (Map 73 E. 8, 12.)

Kao River, Shahabad District. Above junction with Kudra, at Tarachandi. Has been examined and site reported by the Chief Engineer as useless. (Map 72 D. 1.)

Karo River, Ranchi District. At Perua Ghag, 6 miles south of Topkara, which is 6 miles from Torpa on the Khunti-Kamdera Road, there is a fall of 100 feet. The catchment area is over 500 square miles, and the minimum discharge in 1918-19 was 1 cusec. Storage is probably available 3 or 4 miles above the fall, which can also be increased by a suitable take-off. Rainfall about 50 inches, mostly between June and September. (Map 73 F. 1.)

Mohana River.—Tributary of Phalgu river, Hazaribagh District, 10 miles south of Grand Trunk Road. The Tamasin and Harikhal falls have been examined, and there appear to be storage possibilities 10 miles above Itkhori and possibly elsewhere. The falls are 50 and 60 feet respectively, and extra head can be obtained by taking off at Itkhori. The catchment area will be about 200 square miles at this site. The minimum flow is negligeable. Rainfall 50 inches, of which only that between June and October, amounting to 92 per cent. will be of any real use. (Map 72 H. 3, 4, 8.)

Nindi River.—There is a 200 foot water fall at Mauzah Nindi, Thana Bishunpur, 4 miles north of Serandag and 10 miles east of Bishunpur. The catchment area is about 12 square miles only, but the monsoon rainfall is 50 to 60 inches by the map and probably more on the crest of the hills. Storage will be essential and the site will probably not allow of sufficient to be of any use. (Map 73 A 7).

Papaharan River, Padampur Zemindari, Sambulpur District. The Narsinghnath or Kapildhar fall, 97 miles south-west of Sambalpur, and 20 miles south of Padampur is about 900 feet all told, but the catchment area is only 2 square miles with a minimum discharge of about 4 cusecs. It had previously been reported that the fall came from "a vast sheet of water at the top of the hill"! The stream, however, is sacred, and the Narsinghnath temple is below the main fall, so it is impossible to utilize the site. (Map 64 P. 1).

Phulwaria River, Shahabad. Has been examined at Zibhar Khund, where there is a fall of 450 to 500 feet, but the discharge is very small and storage impossible. The site is useless. (Map 63 P. 9.)

Sankh River.—There is a site under examination 3 miles from Rajdera, on the southern end of the Pakripat-Natarhat Plateau. The catchment area is only 32 square miles with a rainfall of 60 inches, confined almost entirely to June to October. The Rajdera fall is 175 feet and it is believed that a reservoir can be formed above it, increasing the practicable head by tunnelling through to the river. There are mines near. The power is unlikely to be sufficient for alumina reduction, but bauxite is found within reach. The minimum discharge in 1918-19 was only $\frac{3}{4}$ cusec. (Map 73 A. 3).

Ibid.—The Perua Ghag fall lower down the Sankh River, 12 miles north of Kochdega and 4 miles east of Kundra on the Gumla road, is about 23 feet, and the catchment area here is over 900 square miles. The bed some miles above the fall is wide and a reservoir site may exist, but storage would be costly. The fall is dry except in the rains, being on a loop of the river, but the main discharge is reported as having been not less than 144 cusecs in 1918-19. (Map 73 B. 5.)

Son River.—It is stated by the Chief Engineer that any storage scheme on any tributary of this river might be of value for irrigation for the Son Canals.

Subarnarika River.—The Hundrughagh fall, of about 312 feet, is 13 miles north of Angara at the 61st mile of the Ranchi-Purulia Road and 20 miles from Ranchi. Extra fall can be obtained by taking off 4 or 5 miles higher up stream. The catchment area is roughly 500 square miles with rainfall between 50 and 60 inches, nearly all falling between June and September; and the cold weather discharge is about 60 cusecs, falling to a minimum of 12 in 1918-19. There is no suitable reservoir site at the fall, but many higher up, all expensive however in arranging for surplus flood water. Probably the site is capable of giving 1,600 e. h. p. or more. (Map 73 E 7, 11, 15.)

Another site has also been examined 4 miles west of Chandil Village, where a storage site exists requiring a dam 600 to 1,000 feet long, to store an enormous volume of water up to 100 feet above bed without flooding the railway. Here the catchment area is over 2,000 square miles. There is a subsidiary site lower down, which might serve as a permanent dam to give the necessary head and two possible additional storage sites further up stream. The cold weather discharge is fair, but the stream must occasionally run dry in the hot weather,

as the dam at Sakchi has no flow at times. Rainfall 50 to 60 inches, mainly confined to June to September. The site will be very expensive to develop, and the power could not compete with waste gas from the Sakchi furnaces. (Map 73 J 1 and 5).

Usri River.—Hazaribagh District. At Usri, about 7 miles from Giridih, just below the crossing of the Gobindpur road, a fall of about 180 feet is obtainable where the junction with the Barakar river is. A good storage site exists above and has been surveyed by the Bengal Irrigation Department in connection with the Damodar flood regulation. Believed to be worth some 1,200 e. h. p. which would be useful for the construction of the neighbouring dam on the Barakar River. Of the total rainfall of 50 inches 86 per cent. is due to the June-September monsoon. The proximity of the coal fields renders it unlikely that the fall will be used. (Map 72 L 8.)

APPENDIX VIII.

List of Sites, Bombay.

Bhatsa River.—There are said to be falls in this river at the site indicated near Shahapur, but no details are known except that the rainfall in the catchment of nearly 400 square miles is very high, probably 200 inches or more in the Ghat area, from local information, though there are no records of the Meteorological Department there. It practically all falls between June and September. (Map 47 E 7.)

Gangavali River.—The Magod falls on this river are said to be 800 feet high and have a catchment of about 280 square miles with good rainfall of from 30 to 75 or possibly 100 inches. No details as to minimum discharge. The rainfall is heavy during June, July and August, but there is generally a fair fall in May, September and October also. (Map 48 J 9, 13).

Igatpuri,—Western Ghats. There are possibilities of a further storage project here (site not identified), but it is unlikely to be developed until the present Tata schemes have all materialized (See Andhra Valley ; Nila Mula ; Koyna). Rainfall 75 inches or more, and over 100 in parts, nearly all falling between June and September. (Map 47 E.)

Indus River.—If the proposed barrage at Sukkur is built there may be considerable power available and high level irrigation may afford an outlet for it. It is too early to discuss this.

Kalinadi River.—The Borkund falls are said to be worth examination; also the Vincholi falls, and lower still, the Lalguli falls of 500 to 850 feet according to length of canal. The catchment is in the high rainfall district of the Western Ghats, *viz.*, 100 inches or more, and is about 280 square miles in area at the junction with the Dogi, near the lowest fall; but the minimum discharge is not known ; it was 200 cusecs at Lalguli in the summer of 1905, date not given. A fall higher up the river, near Londa, is also believed to exist ; probably this refers to the rapids at Supa, which have been surveyed for power required at Dandeli, as proposed by the Conservator of Forests, Southern Circle. The area has considerable industries, and the tail waters could be used for irrigation. The Executive Engineer, Kanara, estimated (in 1905) that with storage the Lalguli falls were able to give 60,000 e. h. p. but further investigation is required. (Map 48 I, 7,11,12).

Koyna River Project.—This is already entered in Table 5 as having been investigated by Mr. A. T. Arnall. The catchment area is 346 square miles in the Western Ghats. The proposed Helwak Lake will have a draw-off capacity of 120,000 million cubic feet, giving 300,000 e. h. p. continuously. The water will be tunnelled through the watershed and the head is 1,600 feet. Rainfall said to be 150 inches, though shown on the 75 inch contour in the rainfall chart; but the precipitation at the edge of the Ghats is extremely high all along. (Map 47 G 10, 11, 14, 15.)

Malaprabha River.—Belgaum District. There are falls in this river at the point indicated, but no details are known at present. The catchment area is about 250 square miles and extends through the zones of 30 to 100 inches rainfall, which mostly falls between May or June and September. (Map 48, M, 1.)

Mula River.—There are two rivers of this name. One is dealt with under the Nila Mula Project below. The other rises in the Trimbak hills, which have a rapid drop from about 5,000 feet elevation down to 2,000 feet. The catchment area at the site indicated appears to be about 180 square miles, with a monsoon rainfall averaging 30 to 40 inches but probably far higher in the upper reaches; it is confined however to the monsoon period. (Map 47 E 11, 15.)

Nila Mula Project.—This is already entered in Table 5 as having been investigated by Mr. H. P. Gibbs. The catchment area is 111 square miles in the Western Ghats, and the proposed Nila Mula Lake is estimated to have a draw-off capacity of 18,000 million cubic feet, giving 150,000 e. h. p. for 3,600 hours per annum, so that for tabular purposes the power may be given as 75,000 e. h. p. continuously. The water will be taken through the watershed in a tunnel and the head is 1,700 feet. Rainfall about 150 inches, though on the contoured map it is in the area of 75 inches. (Map 47 F 6, 7, 10,11.)

Nira Canâl Project.—Poona. See Table 5. After the new Bhatgar Dam is built much more power will be available, especially if the Vir Tank is enlarged to pick up the tail waters and store them for irrigation. The Ing falls or rapids also appear to offer some power for 8 months ; some 1,700 e. h. p.

Pravara River.—Rises in Trimbak hills near the Mula River (q. v.) and has the same characteristics. The Randa falls have about 200 feet drop and are said to be able to give 3,500 e. h. p. continuously. The site appears promising from the maps, and the monsoon rainfall is said to be very high, from 150 to 200 inches. The catchment at the point indicated appears to be about 80 square miles. (Map 47 E 10 and 14.)

Sharavati River.—District Canara. The Gersoppa falls on this river have a drop of some 800 feet, and it is believed they have been examined for power, though no details have been received. The falls are within 20 miles of the sea and near Bhatkal Harbour, which is under investigation as a port. The monsoon rainfall is from 75 to 100 inches during June to September in the catchment of about 150 square miles, and reaches 150 inches over part of the Ghat area. (Map 48 J 12.)

Tadri River.—The Lushington falls are said to be 300 feet high, and are worth investigation as no discharges are known to have been taken. Monsoon rainfall between 100 and 120 inches over a catchment of perhaps 250 square miles ; reservoir sites may be found. (Map 48 J 11 and 15.)

Vaitarna River.—There are waterfalls in this river at the site indicated by the map, north of Tansa Lake, but no details are available. The rainfall (mostly between June and September) is upwards of 75 inches and the catchment of the order of 200 square miles. (Map 47 E 2, 6).

Canal Falls, Bombay.

Canal.	Position.	Fall in feet.	Minimum flow except at closure cusecs.	Working period in days
Gokak Canal.				
Wadarhatti Branch . . .	Mile 5/7	4	10	240
„ „ . . .	„ 6/5	5	10	„
„ „ . . .	„ 6/6	3¼	10	„
It is possible that these falls might be combined, no information is available.				
Pravara Left Bank Canal.				
Fall No. 1	Mile 34	4¼	114	325 (4 closures of 10 days).
„ 2	„ 35	12½	114	„
„ 3	„ 36	9	114	„
„ 4	„ 36	4½	114	„
„ 5	„ 43	9½	58	„
„ 6	„ 43	14¾	58	„
„ 7	„ 44	10	58	„
„ 8	„ 45	7	30½	„

Combinations of falls are apparently possible here also.

APPENDIX IX.

List of Sites in Burma.

Anisakan River, Maymyo, tributary of Myitnge. The Deitdawgyi falls on this river have a drop of about 1,000 feet, almost sheer down, and the minimum discharge is said to be about 2 cusecs in May. The catchment area is quite small, of the order of 20 square miles. There are possible reservoir sites, though these have not been surveyed, close to the falls. One appears to be 30 to 40 acres in area. It is possible that other small streams can be diverted into the catchment. No canal is required and a short pipe line only. There is little doubt that such power as is required in Maymyo can be obtained at reasonable cost from this project, 200 to perhaps 500 e.h.p. The rainfall is about 50 inches; 96 per cent. of this falls between April and November, and a considerable carry-over will be required from storage, especially as crops probably absorb most of the small flow in the dry months. The stream is also called Nadaungya Chaung. Minimum discharge in 1919 was 2 cusecs at Htonbo near Sedaw. (Map 93 C, 5.)

Balu Chaung; See Laimaw River.

Ban Chaung.—See Tavoy.

Bean River.—Tavoy. Mr. Crossley of the Southern and Boundary Burmese Wolfram Co., has located an 1,100 foot fall on this river, but no gaugings are available. (Map 95 J. 12, K. 9.)

Bernard Myo River.—This river, 9 miles north of Mogok, is said to have a minimum discharge (due to springs) of 20 to 40 cusecs, and a good drop, stated to be several thousand feet in a short distance. It runs into the Kin Chaung, a tributary of the Sweli, and is probably capable of 8,000 e.h.p. or more. Rock is gneiss and limestone. Rainfall between 100 and 50 inches, of which 96 per cent. falls between May and November. The catchment area is about 120 square miles. (Map 93 A 8.)

Bilin River.—South west of, and on road to, Papun; said to be worth examination. An isolated river, with seven months' rainfall of 100 to 150 inches over its catchment and 5 dry months. The drainage area above Yinon, (which may however be near sea level) is about 600 square miles. It runs nearly dry for 5 months, so storage would be essential. (Map 94 G, but mostly unsurveyed.)

Chaungmagyi. See Madaya R.

Che Chaung.—Yaw district. A promising gorge with a good perennial discharge is found 4 miles above Yeshin village, 45 miles from Pauk.

Chindwin River.—Tributary of Irrawaddy. Kanti Fall (presumably at the place of that name, latitude 25° 58′, longitude 95° 45′) is said to have a discharge of about 3,000 cusecs in March and a fall of 30 feet. It is in wild country, with rock soil, but is said to be the most promising site on the river. May be valued at a probable 10,000 e.h.p., but has not been examined. Mr. Barlow considered it well worth investigation. The catchment is very great, probably 5,000 square miles, with rainfall about 75 inches. (Map 83 O, but unsurveyed).

Heho River.—Beyond Kalaw on the road to Yawnghwe. There is here a very large and almost flat valley, mostly cultivated, evidently an old lake bed, spongy peat like soil, with outcrops of inferior peat. The area of this flat valley (a small part only of the catchment) may be about 20 square miles, but at its lower end, where the drainage escapes, there is a smaller flat of about a square mile (dimensions not determined) partly enclosed by spurs coming in from either side. At the south west end of the large valley a big spring comes through the limestone and feeds the nala that drains the area. The discharge was estimated to be 150 cusecs early in February, 1919, and was gauged at 103 cusecs on the 28th of that month. It was again gauged on 28th April and found to be 64 cusecs, which may safely be taken as near the absolute minimum. At the exit through the hills into Yawnghwe, from the smaller flat referred to above, there is a rapid series of cascades giving a drop of 672 feet in a horizontal distance of 4,000 feet, but it is believed that there is a further fall of 100 feet or more within easy distance, the survey having terminated at the foot of the fall. The nala flows into Imle Lake. The ground on either side of the fall is fairly

good and is suitable for a duct, and the pipe line would be reasonably short. A small regulating tank could be made at the head of the fall and a reservoir of large size above this could be scoured out hydraulically when power is available. Possibly levels may prove that a dam at the head of the fall would impound a considerable volume of water in the small flat valley without flooding the larger valley. The cross-section at the dam site is very favourable so far as it has been taken, showing that a height of 28 feet above water level could be obtained with a crest length of only 240 feet (much greater height is practicable), with rock on one bank and, almost certainly, near the surface on the other. As however there is a drop in this valley of only 14 feet in the 6,000 feet above the fall it is fairly certain that a dam of any size would flood valuable land in the larger valley. If however a power scheme were developed at this excellent waterfall the problem of large storage could be solved quite simply by utilizing a small proportion of the total power in driving large low-lift centrifugal pumps, to keep the upper valley clear, an earthen embankment being constructed at the neck across the smaller valley. Thus, suppose the main dam to be 30 feet high, giving a water level at the neck 16 feet above the stream level. Then the pumping through the embankment at this point would only require about one-thirtieth of the total power available, based on the relative main and pumping "heads." If the nala were liable to violent floods such a scheme might prove impracticable, but this is not the case. The total catchment area is perhaps 150 miles, with an annual rainfall of about 40 inches, of which 97 per cent. falls between April and November. The great flat spongy valley involves a very slow run-off, and considerable evaporation from its swamps, so that the stream (and examination confirms this) is comparatively even in its discharge. It may be hazarded to average not less than about 150 cusecs throughout the year. Before the amount of storage which can be obtained, and the steady flow which can thus be depended on, can be determined, further information is required regarding the actual rainfall and run-off and the capacity of dams of different height with their corresponding embankments. It is also necessary to survey both banks for the best location for a channel from the head of the fall to the point where the pipes would be carried down to the power station; to survey the most practicable pipe line in each case; and to determine from these which bank should be used and where the power station will be located.

The minimum flow will give some 3,800 e. h. p. continuously, which would allow a plant of about 8,000 e. h. p. on ordinary 12 hour working. At the lowest estimate storage coupled with the much greater normal discharge would give at least half as much again. The scheme appears to be a first class one of about 10,000 e. h. p., which would not be expensive to construct, and it should be fully investigated. There is, however, no likelihood of the power being required in the district unless an industry is founded on the power. The Kalaw railway will soon be extended up to the site, and there is considerable traffic awaiting it. The site was examined by Messrs. Barlow and Meares and subsequently discharges and a preliminary survey were carried out by Mr. F. A. Clift, Executive Engineer, Taungyi. (Map 93 D. 10,14.)

Heinza Chaung.—Tavoy. There are falls "of great height and volume" north-east of Yebyu.

Indawgyi Lake.—This has an area of some 40 square miles, and a low dam would impound an immense volume of water. There is a perennial flow from it down the Indaw Chaung, and regulation would be easy. The available fall is not known; nor is the catchment area and rainfall. (Map 92 C. 7,8.)

Irrawaddy River.—Reference has already been made to the British Water Power Committee's remarks on this catchment. Having seen their figures Mr. T. Hare, Executive Engineer, Public Works Department, drew up a scheme for harnessing the river at the defile by damming it below Sinbu. He proposed to divert the river by a channel to the east, *viâ* the Nainsang and Mole Rivers, a distance of 45 miles. The scheme would be both expensive and difficult to construct, with this diversion, a large flooded area with the submergence of many villages, new roads required, etc. The floods rise 60 to 90 feet in the defile so that it is improbable that with any reasonable dam a head of more than 50 feet could be obtained. The minimum discharge is not known. Above Myiti-

kina there is doubtless great power available, at a cost which is likely to be prohibitive.

Kainggyi Ye Ta Gon in the Tawnglet circle of Monglong sub-State, Hsipaw has been mentioned. (Map 93, B, 7)

Kaladan River.—Akyab. The upper reaches stated to have possibilities. The catchment area is over 3,000 square miles at Kaladan, where the Mi comes in, but the elevation there is unknown. Rainfall 100 inches, 97 per cent. falling in 8 months. (Map 84 B. C, and G. unsurveyed.)

Kalonta Gorge.—See Tavoy.

Kelaung River.—Mandalay district. Said to be worth reconnaissance near Wetwun.

Kin Chaung River, tributary of Shweli, near Mogok. Above the junction with Bernard Myo (q. v.) this has a good catchment of about 1,200 square miles, including the Bernard Myo and Konwet, and a good perennial discharge, with several places said to have a good drop also. Below the junction there is also a likely site. Where the Kin Chaung crosses the road the R. L. is about 500 feet whereas 3 miles further up it appears to be about 1,100 feet. Rainfall about 100 inches, 96 per cent. falling between May and November. (Map 93 B. 5.)

Konwet River (near Mogok) is believed to have a perennial flow of 20 cusecs and a drop of 2,000 feet in a few miles. From the map the site appears good, but the catchment is not known. If the streams at Mongmit make it up it is about 400 square miles, but this has already been included (rightly or wrongly) in the Kin Chaung. The river joins the Muik, (?) a tributary of the Shweli. Probably good for 3,000 e.h.p. Rainfall about 100 inches, of which 96 per cent. falls between May and November. (Map 93 A. near square 12.)

Kun Chaung, Toungoo. Said to have possibilities. Its tributary, the Sinmakadin has falls which are believed to be promising.

Kyan kpyu Chaung.—See Tavoy.

Laimaw River.—Or Balu Chaung enters Imle Lake near Indemze and is said to have a good discharge and many rapids about 7 to 10 miles from the south-west end of the Lake. Considered capable of 2,000 e.h.p. Rainfall 40 to 50 inches of which 97 per cent. falls between April and November. The catchment area appears to be about 370 square miles up to the valley, but the Atlas sheets show some of the streams apparently flowing both ways! For this reason many of the catchments may have been wrongly estimated. They can be checked by larger scale maps later on. (Map 93 D. 14,15.)

Lampar River.—Said to be perennial with a large fall.

Lenge Chaung, Meiktila, Div. Minimum discharge at Pweya Se was 2·75 cusecs on 29th April 1919.

Lenya River, below Mergui; said to have power sites. Rainfall about 160 inches, lasting from April to November, with a catchment at Lenya of some 700 square miles. (Map 96 I 15, 16.)

Madaya River, or Nam Pai, tributary of Irrawaddy. This has a minimum discharge in the hot weather of about 400 cusecs near Mandalay. Higher up, some 10 miles, the river is said to have a good slope, so power should be found. Near Mogok it is also said to have a good discharge and rapid fall. Rainfall between zones 40 and 100 inches, practically all falling between May and November. The catchment area at Gwe Kyaung is about 1,200 square miles, but the altitude there is not known. The minimum discharge in 1919 was 350 cusecs on the 19th May at the headworks of the Mandalay Canal. (Map 93 B.)

Magyi Chaung.—Tributary of Madaya, 45 miles from Mandalay; this and other similar streams near had a fair discharge (about 50 cusecs) in March and possibly several could be run together for a fall. No details. Site not identified. Elsewhere the Chaung Magyi is identified with the Madaya (*q. v.*)

Man River, tributary of Irrawaddy. This is said to have some possibilities below Ngape but is very little known. It is near the Mon River and has less discharge; and may even dry up at times. A discharge taken near Payagyi village, 12 miles above Aingma weir, showed 40 cusecs on April 7th 1919. A fall may be got by tunnelling through the watershed, it is believed. Very unhealthy till January and of doubtful value. Rainfall 50 inches or more over a catchment at Ngape of about 250 square miles, (Map 84 L 8 and 12.)

Mandalay District (see also Anisakan River). From the headworks of the Mandalay canal the Yetagon waterfall, flowing into the Madaya, can be seen some 6 miles off to the N. N. W.; 40 miles from Mandalay and 35 from Maymyo. There is a drop of 1,700 feet, and Mr. Scott, Executive Engineer, found a discharge on the 9th March 1919 of 14½ cusecs. The minimum, on 12th May, was 5 cusecs. The catchment is only about 8 square miles. Reservoir possibilities are poor, as the limestone is very fissured, but a site north of Yonbin village might carry 100 million cubic feet. The site appears good for 2,000 e.h.p. Rainfall about 40 inches, of which 97 per cent. falls between April and November. (Map 93-B 2, 3, 6, 7.)

Mandalay District.—There is said to be a perennial stream with a large fall some 35 miles north east of the town, not far from Mogok. No details, but probably refers to Madaya or Magyi Ch. (q. v.).

Manipur River, tributary of Myittha. Subject to high floods, and has a quick slope, but in very wild country and unlikely to offer much steady power, though stated to be worth 4,000 e.h.p. Rainfall 50 to 100 inches, over a catchment of some 4,000 square miles, including the considerable Loktak Lake, near Imphal. (Map 84 E. & F., unsurveyed.)

Menyan River.—This has not been identified, but is said to have a perennial discharge and a good fall 20 miles from the Irrawaddy.

Mindon Chaung (or Mu) River.—Tributary of Irrawaddy, Thayetmayo District. The upper reaches of this river are stated to be worth examination, and good for 2,000 e.h.p. The lower parts are navigable and useless for power. The rainfall varies from 40 inches up to 100 near the watershed, of which 95 per cent. falls between May and November. The catchment area above Mindon is about 600 square miles. Discharges are available from 1893. The minimum on record is 95 cusecs at the Shwebo Canal. (Map 85 I.)

Minpaw.—A 30,000 horse power scheme was mentioned, working on a 280 foot fall, but it has not been identified so far.

Mon River.—Tributary of Irrawaddy, said to be perhaps worth prospecting as discharge is generally good (seldom below 500 cusecs) and slope quick in upper reaches. Very little information available, as the region is inaccessible and unhealthy until January, but a possible 6,000 e.h.p. was suggested. From Kyion downwards, above the canal headworks, it is believed that excellent reservoir sites can be found to carry over the low water period, and from 2,000 to 10,000 e.h.p. can be obtained. A discharge taken at the end of April 1919, gave 279 cusecs above the Dwe junction and on the 5th May 450 cusecs at the canal headworks, Mezali, 40 miles lower down. Regular readings are taken here. Some of the tributary streams look favourable on the map, especially one which joins near Dwe. This tributary joins the river above Paiksok, and carried 48 cusecs at the end of April 1919. The *total* catchment here is about 800 square miles. Rainfall in upper reaches 50 to 75 inches. (Map 84 L 2, 3, 7).

Monghang River.—Southern Shan States. A natural limestone tunnel exists here with a fall of several hundred feet. It is about 150 miles south east of Taungyi, a cart road existing as far as Mongnai. River not identified, but probably on map 94 I.

Moulmein to Pegu.—The hills near the railway are said to offer possibilities by running through the watershed from reservoirs on the east to the coast side. The rock is good. Rainfall probably over 150 inches, mostly falling in May to October. Detailed examination of maps will be necessary. (Map 94 C G. H.)

Mu River.—See Mindon Chaung.

Myittha River.—Tributary of Chindwin. Near its junction with the Chindwin River this (which includes the Manipur River) is said to have a series of rapids and a large discharge, but it is of doubtful value except in upper reaches. Probably 3,000 e.h.p. could be obtained. The lower reaches are at times navigable. Rainfall 40 to 75 over very large catchment (of the order of 10,000 square miles), but concentrated into about 6 months (Map 84 I, mostly unsurveyed.)

Myitnge River.—Tributary of Irrawaddy. There are falls above Thebaw which could be increased, coupled with good perennial flow. This river is said to be "full of power sites." The discharge in March was about 10,000 cusecs

in the reaches near the Mandalay-Maymyo Road. Some 25 miles further up there is said to be a promising "hair-pin" bend. The floods rise about 30 feet and a dam would be most difficult to construct, but a tunnel across the bend appears simple. (This is similar to the Sutlej Scheme.) The tributaries of this river are worth gauging and examining, (See Nam Tu, Namma and Nam Laung below.) The rainfall over the whole catchment of some 8,000 square miles at the junction of the tributaries named is probably about 40 inches. Minimum discharge in 1919 was 6,360 cusecs on 16th May at Kimbet. (Map 93 B and F.)

Nandaungya Chaung; see Anisakan falls.

Nam Et River.—Tributary of the Nam Laung and the Myitnge, 60 miles east of Kyaukse, said to have 1,000 feet fall and a large discharge. By making a dam or tunnel the river, it is said, could be diverted across to the Zawgyi, through a hill, to give some 6,000 c. h. p. Rainfall about 40 inches of which 94% falls between May and November. The catchment area at latitude 21° 35′, which is probably near the place referred to, is about 1,000 sq. miles. (Map 93 C 10, 14 with G 1, 2).

Nam Kaw, falling into the Salween below Na Hang. (Map 93 J, 11.)

Namkwe Lake, north of Yamethin. There is a project here but no details are known. The Executive Engineer, Meiktila Division, proposes to examine it.

Nam Lan River.—Northern Shan States. Said to be worth reconnaissance between Namtu and Mongtung.

Nam Laung River.—Tributary of Myitnge. There is said to be a natural bridge and a 15-foot drop about 12 miles above the junction with the Nam Tu, but the prospects of power do not seem good. The Nam Et flows in above this (q. v.). Rainfall about 40 inches. The catchment at the junction mentioned is however about 3,000 sq. miles. (Map 93 F 4 and 8).

Namma River.—This joins the Namtu (q. v.) below Mansan Falls, and some 12 miles from the junction there is said to be a site with a fall of 200 feet and a minimum flow of about 600 cusecs, equivalent to 11,000 c. h. p. There is also a possibility of making a large reservoir a little distance above the natural bridge that gives the drop in this river. The rock however is limestone and may be fissured. A further site 20 miles due west of Hsipaw was mentioned. Coal (poor quality) is found near this river and there is also iron ore. Rainfall probably 40 inches. The catchment area at Namma is about 400 sq. miles. (Map 93 F 10 and 14 and J 2.) The Nam Hawm or Namhsawn tributary on map 93 J, 5, above the junction with the Namma, is also mentioned.

Nampai River.—See Madaya River.

Namparga River.—(Tributary of Chindwin River). Said to have a fair discharge with quick slopes. The rock is largely sandstone with some shale. Not identified but stated to be good for 2,000 c. h. p.

Nam Pawn River.—Tributary of Salween. Navigable up to latitude 19°, but has a large perennial discharge and probably has rapids in upper reaches. There are falls between Hsataung and Karenni, but not of great height. Rainfall 40 to 50 inches. The catchment area above latitude 20° is some 1,600 sq. miles. (Map 93 G. H.)

Nam Tang (or Teng) River.—This is a tributary of the Salween and 70 miles east or north-east of Taungyi it is said to have large falls at about 97° 45′ by 20° 20′ to 20° 55′. There is a "good discharge" and the road from Taungyi passes near by. Rainfall 40 to 50 inches of which 97% falls between April and November. The catchment area above latitude 20° is about 2,500 sq. miles. (Map 93 H 11, 15).

Nam Tay River.—Tributary of Salween. Said to have good discharge and high falls. No details. Site not identified. Possibly the Nam Tang (q. v.).

Nam Tu River.—Tributary of Myitngye. Already being developed at the Man San Falls (see Table 4). There are many rapids all along this river, which has a large perennial discharge, but it is unlikely that any other equally favourable site exists. Immediately below Nam Tu the low water discharge is estimated as 15,000 cusecs and a fair head may be obtainable. There is also a possible site 12 or 15 miles above the railway bridge over the river, accessible from Hsipaw. Near Hsipaw where the Nampu (?) Chaung joins the Namtu there are said to be good possibilities and power may be wanted. At Makyeng some 8½ miles above Namtu town, it is said that 1,500 h. p. can

be developed, but the falls are mostly small and would be expensive to combine. Rainfall about 40 inches with a catchment area, at the junction with the Namtu, of about 5,000 sq. miles. (Map 93 B, E and F).

Nyaungho Stream.—Thaledan Forest Reserve. Said to have possibilities 28 miles from Padaung or 40 from the Irrawaddy west bank, opposite Prome. Discharge not great in the hot weather, but a drop of 1,000 feet or more available.

Pang River.—Tributary of Salween, Southern Shan States. In about 6 miles, at a point 2 miles south of the Taungyi-Kengtung road, there is a fall of some 600 feet in a series of cascades. The stream is of considerable volume. (Map 93 H).

Panlaung River.—Tributary of Myitnge, above Myittha, Kyaukse, is said to be well worth prospecting, as there is a natural reservoir site of some 5 acres extent; the rock however is mostly limestone, and fissured. Discharges of 400 cusecs and a 900-foot fall were mentioned. Position not identified, but probably good for 5,000 c. h. p. or more. It is believed to have been surveyed already either by Government or the Burma Railways, Limited. The catchment cannot be traced on the Atlas sheets, but includes that of the Zawgyi (q. v.) and is probably over 4,000 sq. miles at Kyaukse. Rainfall 30 to 40 inches. Discharges have been taken from 1909 onwards. The average flow between December and May varied fairly evenly between 1,100 and 400 cusecs. A flow of 500 cusecs can generally be depended upon. (Map 93 C).

Panlang River.—Tributary of Sittang; also said to be worth examination. It is apparently near the previous entry, but the site has not been identified as yet. (Map 93 C?).

Papun-Dagwin road.—Near Yedagon hill stream has a discharge of about 20 cusecs in February, and may have a site giving 1,000 feet head.

Pathechaung River.—Near Toungoo. May have a little power, sufficient for local needs (200 c. h. p.?) But there are no reservoir sites and dry weather discharge is small. The river however is constantly mentioned as worth investigation. Thandaung beyond here has a rainfall of 200 to 250 inches, between May and November, but practically none in other months, and the catchment is quite small. (Map 94 A 12).

Paungdaw Chaung.—See Tavoy.

Payagale Ch. Pegu Division. Minimum discharge at mile 12-6 was ½ cusec on 3rd April 1919.

Pin River.—Tributary of Irrawaddy, flowing from Popa Mount, an old and isolated volcano (4,980 feet) seen from the Irrawaddy from Pakokko to Yenangyaung. The catchment area at Magyigon is about 40 sq. miles only; elevation here unknown. There are numerous springs on the hill side which it is believed could be collected to give a good discharge at a fair altitude above the flat plain. Rainfall 30 to 50 inches of which 96% falls between May and November. (Map 84 O 4, 8; P 2, 6).

Pinkan River.—This is perhaps the same as the Pin; it has "a perennial discharge and a good fall 20 miles by cart from the Irrawaddy."

Pyu River.—Toungoo. Said to have possibilities.

Pyinpongyi Ch. Pegu Division. Minimum discharge 0·6 cusec on 3rd April 1919, at mile 18-4.

Salin River.—Tributary of Irrawaddy. This is said to be of no use except for the tributary which runs from Kodakham towards Laungshe, which is worth reconnaissance. There is no definite information, but it is stated to be worth 1,000 c. h. p. Mount Victoria (10,085 feet) appears to feed this and the rainfall is in the 50 to 100 inches zones. The catchment area of the tributary in question is about 400 sq. miles. A discharge taken in the main stream near Minyin village, 20 miles above the headworks of the Myaungmadaw Canal, in the dry season of 1919, showed 4 cusecs only, with an additional ½ cusec from the Mwe. (Map 84 K 4 and L 5).

Saingdin Creek.—Akyab District. There is a mainfall of 47 feet and others making up 66 feet below Buthidaung and 8 miles from the Mayu River, all in a length of 1,000 feet. Minimum discharge about 1,000 cusecs and maximum 100,000.

Salween River.—The Hatgyi Rapids about 100 miles south east of Taungyi and 100 miles north of Moulmein, some 40 miles above entry of the Yunzalin

River, and below the mouth of the Thaungin R., are believed to be capable of great development ; the possibility of locking the river and making it navigable for boats for several hundred miles further up was also raised. A fall of 70 to 300 feet is believed to be obtainable (reports are conflicting), and the minimum discharge is stated to be over 1,000 cusecs. Another report says there is a triple fall of 20 feet in 300 feet length, with a discharge generally of a million cusecs —presumably this is in the rains. The flood waters however rise about 90 feet. Lime is obtainable. There is a cart road to Mongnai, and pack transport must be employed beyond. May be considered worth at least 6,000 e. h. p., but would be very expensive to develop. The catchment area is enormous and covers the whole gamut of rainfall ; and there are said to be more many rapids higher up. Above the mouth of the Yunzalin there are said to be many sites, especially 8 or 10 miles above Kammanaung, which is accessible by boat and elephant. Here a canal a few miles long, which the banks would allow to be constructed, would give a moderate head. (Map 94 G, square not known, but probably unsurveyed).

Sawchaung.—Yaw dist. The gorge 4 miles above Saw and 75 miles from Seikpyu can, it is said, be dammed to a height of 80 or 100 feet. There is a good flow in the dry weather.

Shweli River.—Tributary of Irrawaddy. Said to have a discharge of 4,000 cusecs in April, with a drop of 1,000 feet in 5 miles, (highest fall at one spot 34 feet) 20 miles below the large swamp or lake near Selan (R. L. 2,400 feet). The lake land is too richly cultivated and valuable to be dammed. There is granite rock in the district, and a good reservoir site exists higher up the river. May be worth from 300,000 e.h.p. upwards. Rainfall 50 to 60 inches, over a catchment at this place of 2,500 or more sq. miles. (Map 93 E 6, 9 and 13.)

The upper reaches below Namkhan and the Kyanktake rapids are also mentioned as well at the Nam Chit falls on a tributary, said to be 300 feet high.

Sin Bo Sin Ma falls ; See Tavoy.

Sittang River.—There is said to be a good power site on the head waters (?) of this river north of Pyinmana near Yezin village and near Taungnyo. Further north, 20 miles due east of Yamethin, there is said to be a fall of about 1,200 feet, with a minimum discharge of about 50 cusecs, which can be supplemented by storage with considerable bunds. The possibility of tunnelling through to another catchment was mentioned at this site, in which case the water would be useful for irrigation. The formation is limestone, but high mud banks have been used successfully for storage in olden days. The site is probably worth 5,000 e. h. p. Rainfall 40 to 50 inches nearly all between May and November. Catchment area not determinable from Atlas sheets. (Map 94 A 1, 5 ; 93 D 3, 4).

The tributaries of this river on R. bank are also said to be worth examination, having good perennial discharges up to 100 cusecs in some cases. (Same maps).

Tabak Hla River.—Where the Lwema joins this stream, 2 miles east of Namlang, there is a rocky gorge with a drop of about 150 feet, a good perennial discharge, and a possible reservoir site. Rainfall and catchment area not known. (Map 92 G 12 ?).

Talaingya Chaung ; see Tavoy.

Tandin Falls.—North Arakan. There is an ample discharge, used for timber flotation, and a fall of 60 feet. The passing down of the timber is not a matter of difficulty, and the river is believed well worth examination.

Taping River.—This joins the Nam Ti which runs into the left bank of Irrawaddy near Bhamo. About 31 miles up the river from the junction, near the road suspension bridge, where the catchment area is about 450 or 500 sq. miles, there is believed to be a cold weather discharge of 500 cusecs (minimum not known) and a drop of 500 feet in 5 miles. The site is worth examination, and may be worth 10,000 e. h. p. or more. The Tunhong Gorge beyond Kalechet has also been mentioned. Rainfall not known. (Map 92 H 11, 14; latter unsurveyed).

Taungdwin Chaung.—Mingin, Myittha Division. This is stated to be worth reconnaissance, though somewhat remote. Site not identified.

Tavoy District.—One power site has been developed, see Table 2. It is believed that many more, including good reservoir sites, are to be found ; but the country has been little prospected for power. Rainfall 150 to 200 inches of which 96 % falls between May and October. Mr. Raikes reports that gaugings will be taken in the following ;

Paungdaw Chaung, which has a fall of 600 feet at one point.
Ban Chaung (130 cusecs, 29th March 1919.)
Kalonta gorge (19 cusecs, 19th April 1919).
Kyankpyu Chaung falls.
Sin Bo Sin Ma falls.
Talaing-Ya Chaung.

No falls have been determined as yet, but the first on the list is said to be the most favourable. (Maps 95 J & K).

Teng River.—Southern Shan States. (*Nam Teng* ?). Near the Pang (q. v.). This feeder of the Salween is said to have a large volume and a fall of 365 feet some 2 marches from the Tang falls (Map 93 H ?).

Thaukyegat River. Tributary of Sittang, 11 miles from Toungoo. This river has a very large catchment area and before entering the plains is said to have a large discharge, while falls of about 250 feet in 7 miles can be obtained near here, where the catchment area is over 400 sq. miles. It probably falls very low in the driest seasons. On the northern or main branch a fair reservoir appears possible, holding perhaps 1,000 million cubic feet, from which a short channel would run to the power station. The run-off is said to be fair but not high. Most of the smaller streams have a trickle of water and there are many springs. The southern branch is not likely to be of use unless its discharge can be led round by a channel into the northern branch near the junction. The latter appears good for 6,000 to 12,000 e.h.p. from information received, but further examination is required. Rainfall between 75 and 100 inches, of which 96 % falls between May and October. (Map 94 A 11, 12, 16 ; B 9, 13).

Tonbo River.—Mandalay. Attention has been called to the upper reaches of this stream.

Ye River.—near Pagyi (98° X 15° 20′) has about 150 to 200 inches of rain in the elevated catchment of over 400 sq. miles. (Map 95 I 3, 4).

Yezin Ch., Meiktila Division. Minimum discharge 3·3 cusecs near Yezin on 28th April 1919.

Yetagon Falls.—See Mandalay.

Yunzalin River.—This is said to have a rapid fall of over 3,000 feet to near Papun, but is very inaccessible. Where the road from Papun to Kawluck leaves the river the discharge is said to be about 10,000 cusecs and there is a fall of 1,000 feet in 3 or 4 miles. This site is accessible by elephant from Papun and appears very promising. There are others lower down also.

Zamayi River.—Pegu District. There is a waterfall in forest compartment 91 and the river is believed worth prospecting.

Zami River, running to Moulmein. The higher reaches are said to merit investigation as power may be required for pulping work, already proposed there. (Site not identified).

Zawgyi River.—Tributary of Panlaung and Myitnge. There is a small waterfall of about 10 feet some 4 miles north-east of Lawk Sawk, showing a good discharge in April, which is fairly maintained. There are said to be many other falls, but little is known. A possible site was also mentioned near Myitson, about 20 miles from Kyaukse. From the hills to the plains there is a fall of some 4,000 feet in 20 miles. The water of this river is said to be exceptionally fine for crops. Rainfall probably between 30 and 40 inches. The catchment above Kyaukse is about 2,500 sq. miles. Gaugings have been taken by the Irrigation Department from 1900 onwards, but until 1909 the low readings were unreliable. From 1910 to 1918 the average flow between December and April varied between 515 and 2,200 cusecs with a mean of about 900. Very heavy floods have occasionally occurred. The drop of the bed is generally said to be quite gradual. (Map 93 C 15,16).

Zingyaik River.—Thaton district. The river is dry for many months, but the waterfall is believed to be worth investigation in case there are reservoir sites above. This is a mining and also a salt district, and power is wanted.

APPENDIX X.

List of Sites in the Central Provinces and Berar.

Aran River.—At Masni, in Magrul Taluk, there is said to be a good site for impounding 5,000 million cubic feet of water with a 90-foot bund 2,600 feet long, having 330 sq. miles of catchment. The submerged land is forest waste land mostly. There is "a good site for utilizing the water with a high fall," which is very indefinite as the layered map shows that the whole district indicated lies between 1,000 and 1,500 feet, so that not more than a 200 foot fall (low medium) is likely. The catchment area at Sangri, probably below the site referred to, is about 300 sq. miles. Investigation is required. Rainfall 30 to 35 inches, mostly concentrated in 5 months, and 85 % between June and September. (Map 55 H 7,11).

Baihar Plateau, Balaghat.—A reconnaissance was made in the hot weather of 1919 and none of the streams had more than a trickle, though villagers stated that the flow continued through the cold weather. Some of the streams appear in the list.

Ban River.—Tributary of Purna, near Wari on the border of the Jalgaon and Akot Taluks. This flows from the Gawilgarh hills, Satpura range, and is said to have a vertical fall of 60 to 70 feet which can be increased. The catchment area is 130 sq. miles, to the west of Narnalla. The stream is "practically" perennial and reservoir sites are said to exist. The rainfall, averaging about 30 inches, is said to be good in these hills even in a year when the monsoon fails in the plains below, but it falls to the extent of about 90 % in the 5 months June to October, and 85 % in June to September, so very large storage would be required especially with a view to the necessary carry-over for bad years. (Map 55 C 12,16.)

Bearma River.—Tributary of Ken. A favourable reservoir site with a catchment area of 4,126 sq. miles is reported at Khumergar, Damoh, below the junction with the Sunai (Sonar?) where a flood discharge of 235,000 cusecs has been recorded. The site has not been identified at present. Rainfall about 45 inches, of which 43 inches fall in the monsoon between June and September. (Map 55 M.)

Bina River.—Near Rahatgarh (Saugor). The catchment area is 500 sq. miles and the slope is said to be fairly rapid; about 50 feet a mile (?). Reservoir sites have been located above and below here, and are worth investigation. Rainfall about 40 inches, of which 93 % falls between June and September. Estimated by Mr. Batchelor to be worth some 5,000 e.h.p. or more at each of two sites; but this requires further examination. (Map 55 I 5,6).

Chandra Bhaga.—Close to the Sarpin (q. v.) and the same remarks apply. (Map 55 G 7,11.)

Chargad River.—Tributary of Wardha. A large reservoir could, it is said, be constructed at Udkheir, 9 miles south-west of Morsi, with a catchment area of about 80 sq. miles. Rainfall 35 to 40 inches, nearly all in June to September. No information as to falls. (Map 55 G 15,16).

Chikalda Plateau.—(Melghat). Mr. Batchelor believes that some 2,000 e. h. p. can be obtained here from a reservoir commanding a head of 1,800 feet. The site should be examined further. Catchment not specified. Rainfall 35 to 60 inches; mean at Chikalda itself 67 inches of which 60 inches fall between June and September. (Map 55 G 7.)

Chornai River.—Uprora (Bilaspur). There is said to be a reservoir site with a catchment of 150 sq. miles, and some perennial flow, and a fall of 100 feet is indicated. Estimated by Mr. Batchelor to be worth 8,000 e. h. p. but has not been examined as yet. Rainfall 60 inches, of which 82 % falls between June and September.—(Map 64 J 10.)

Darekasa Waterfall.—Gondia Tehsil. Situated in hilly country near the station of that name on the main line of the Bengal Nagpur Railway. It dries up by the end of the cold weather, so will be useless unless storage can be found. (Map 64 C 11 or 12).

Deo River.—Balaghat district. This rises on the Baihar plateau and flows into the Waingunga, and is said to be worth investigation above Bhanpur,

where the catchment is 120 sq. miles or more. Being near the Nahara and Uskal rivers the conditions are likely to be similar. (Map 64 C 5,6,9.)

Erai River.—Tributary of Wardha, 12 miles north of Chanda. Reservoir sites are indicated, without details. The area does not look particularly promising, though the catchment is about 300 sq. miles, and the rainfall 40 to 50 inches between June and September. There is a known fall of 20 feet on the Mul hills. (Map 55 P. 4, 8.)

Ghisari River.—Near Dhansura, is stated to have a waterfall of several hundred feet, though the stream dwindles down to a few cusecs in the hot weather. Reservoir sites may however be found. (Site not identified).

Hasdo River,—where it leaves the hills above Chhuri and Korba. Reservoir sites suggested; no details, but there is apparently a rapid fall where the plains are entered. The catchment area is about 2,800 sq. miles at Garaghat, where the 1,000 foot contour crosses, and the rainfall averages 60 inches of which 80 % falls between June and September. (Map 64 J 9, 10.)

Indrawati River.—Chatisgarh State. There is a waterfall of 90 to 100 feet at Chitrakot, and the flow is always substantial. In May 1906 760 cusecs were gauged. The rainfall over the large catchment of about 4,500 sq. miles at the falls is 60 to 75 inches, mostly falling between June and September. On the 29th May, 1919, the discharge was 443 cusecs. There is a possibility of constructing a very large reservoir immediately up stream of the fall, where the country is very flat. Reconnaissance indicated that this might carry 50,000 million cubic feet with a dam of reasonable cost, but the land acquisition would be expensive as much of the area is cultivated. The site appears worth 4,000 e.h.p. *without* storage and perhaps 12,000 to 15,000 e.h.p. if the storage turns out feasible to the extent named. It is worth full investigation. (Map 65 E 12,16.)

Kanhan River.—An irrigation scheme was prepared involving a reservoir on this river (which the Pench joins higher up) a few miles north of Nagpur, but it fell through. The site may be worth reconsideration for power purposes in combination with irrigation from the tail waters. No details are at present known, except that the site is near the junction with the Waingunga, above the village of Ambhora, and 8 miles south of Bhandara, where any large fall is unlikely. Rainfall over catchment 35 to 40 inches between June and September. (Map 55 O 12.) The catchment at the 2,000 foot contour is 178 sq. miles, increased, before the junction with the Pench, to about 1,200 sq. miles. Four other points on this river between Khapa and the above were also referred to. (Map 55 K 15; O 3,8).

Madu River.—Tributary of Wardha. It is stated that reservoirs (of unspecified size) can be constructed north of Destara, Morsi Taluq, having a catchment of 204 sq. miles, but no information is given as to falls. Site not identified but probably on map 55 G 15. Rainfall about 35 inches, mostly in June to September.

Melghat Area.—The possibilities are said to be promising in the Melghat area, where there would be a demand for power from the Tapti and Sipri Rivers and smaller streams mentioned in this list. The rainfall is from 35 to 40 inches up to 60 on the Gawilgarh Hills near Chikalda (q. v.), which fall rapidly from over 3,000 feet to about 1,500 feet. The McKenzie falls are said to be several hundred feet high with a perennial flow; but the site has not been identified.

Mhas River.—A site is named between Waigaon and Hingna, Nelgaon, Buldana, for a small tank of 10 million cubic feet, which is unlikely to be of much use over 9 dry months. It is stated however that the Mun and Panigunga rivers could also be diverted into this reservoir, thus increasing the catchment from 90 to 450 miles, with a rainfall of about 30 inches concentrated in 5 months, and almost in 3 months. The latter streams are "practically perennial." (Map 55 D, square not identified yet).

Moga River. 12 miles north-east of Ellichpur. It is stated that a reservoir draining 88 square miles may be constructed north of Pala, with "a number of falls *higher up.*" This reservoir is presumably intended to impound the tail waters, as it is useless for power; but without storage there will probably be a dry bed for many months. (Map 55-G 11).

Munyari (?) north-west of Bilaspur. Information was received of an abandoned irrigation reservoir scheme here, which it was stated might be worth examination for power purposes. (Map 64-J 7 ?).

Murna or Morna River. At Shaikla, 16 miles south of Akola, a reservoir of 80 square miles can, it is said, be constructed by a bund one mile long and 70 feet high. Whether a rainfall averaging about 30 inches over a catchment area of about 110 square miles (taken from the millionth map only) will fill this reservoir and give nearly 7 months' dry weather supply is a matter for further consideration. The river is "practically perennial." (Map. 55-D 15 and II 3).

Nahara River.—Balaghat district. This comes down from the Ghat a few miles east of Charegaon Station, ending in a considerable waterfall (Jhang Gogra fall). A reservoir site was found near the village of Sale, but the 4 inch Forest maps may serve to locate others, as the upper reaches are not well known. With a 5 mile channel from the site mentioned a fall of some 500 feet would be obtainable. The catchment area is about 120 square miles there and the average yield about 12,000 million cubic feet. Rainfall 60 inches, mostly in June to September. The site, allowing for a large carry-over for bad years, is reckoned worth some 9,000 e. h. p. (Map 64-B 4, 8 and C 1).

Nawegaon Tank.—This is situated in a basin surrounded by hills in Sakoli Tehsil, Bhandara District, with a catchment of 23 square miles, and a water spread of 5 square miles. In June 1919 the discharge was about 5 cusecs. It is not known what fall is available. The site is a mile from Dewalgaon on the Gondia-Nagbhir branch of the Bengal Nagpur Railway. (Map 64 D 1).

Nerbudda River.—Discharges have been taken during the dry season of 1919, but have not come to hand as yet. The river is known to have possibilities but they have been little examined except at the falls at Marble Rocks near Jubbulpore; and no details of this scheme have come in. It was proposed however to manufacture cyanamide. (Map 55 M 16).

Ibid.—The Dharighat fall in Nimar District has also been put forward. The actual fall is 50 feet, but it can probably be increased to 100 feet or more, and the flow is "large". This site is in dense forest, 24 miles by road from Bir station on the Great Indian Peninsula Railway. The rock is hard Vindyan sandstone. (Map 55 B 7).

Ibid.—The Baroda Darbar also calls attention to the Khodiar Mati falls on the Nerbudda in Dhari Taluka, which may be the same as above: also to the Mokhadi falls, which have not been identified.

Pench River.—A definite site is indicated near Bhiwagarh, 22 miles directly north of Nagpur, where the catchment is about 1,700 square miles. Other sites are indicated on the river, which requires further examination. The catchment area is 527 square miles where the 2,000 foot contour is met. The discharge between Seoni and Chhindwara was practically *nil* in May 1919. (Map 55 O; 1, 2, 3, 4, 5, 8).

Mr. Batchelor's Silewani Ghat scheme also brings in this river.

Penganga River.—There is a fall on this perennial river, which forms the boundary between Yeotmal District and Hyderabad, known locally as the Susar Kund. No details are available. The site has not been identified, but is on Map 56, E or I.

Purna River.—The remarks on the Moga River apply here. The falls are *above* the reservoir.

Sarpin River.—At Wajar, 8 miles north of Ellichpur, Amraoti. A fall of 2,000 feet is said to exist in 10 miles; the catchment area however is given as 44 square miles only, and "with impounding reservoirs along the course of the stream very cheap energy can be obtained." The conditions appear to be the very reverse, but the site should be examined. Rainfall about 35 inches, mostly falling in 4 months. (Map 55 G 7, 11).

Shahnur River.—West of Ellichpur (Amraoti). A reservoir site is indicated by Mr. Batchelor between Tekra and Ambaparti, with a catchment of 12 square miles and a possible fall of 600 feet. A further site between Raipur and Moragarh has been mentioned. Rainfall about 35 inches, mostly between June and September. (Map 55-G 7 and 8).

Silewani Ghat. Mr. E. Batchelor, I.C.S., prepared and published a number of "paper" schemes - such as indeed are most of those in this section of the present Report—dealing with the Chhindwara area. There is, in the pamphlets issued, a great volume of assumption and no very clear description of the schemes themselves but at the same time attention has been drawn to an area which is well worth technical investigation. Mr. Batchelor's estimate of an available 70,000 kW or say 94,000 e.h.p. must be taken with great reserve. One site of those mentioned was visited by Mr. Barlow who recorded his opinion, as follows:—

"The proposals for Umra Nala tanks are wrong; the catchment area is too small. Run-off will be poor, rainfall is not high, area flooded is A 1 land but probably cheap and the line of the canal from the reservoir to the edge of the ghat runs through undulating country where rock is near the surface. The site is certainly near the ghat, and the drop in the ghat is good; but it is not sudden and a long pipe would be necessary. The Nala is joined by another larger Nala a little way on the far side of the *pacca* road and the Railway, and a proper reconnaissance is required to find a suitable storage site near the Ghats, with a good drop. Nagpur already requires 5,000 h. p. and this will increase if power can be provided cheaply. The project (*i.e.* the whole series of projects) is therefore one of the first that should be investigated. "Again, Mr. Barlow notes "His ideas are good but his figures are unreliable and useless. Some of his proposals are undoubtedly worth further consideration, but no reliance must be placed on his details." Examination of the maps of the district shows that possible reservoir sites certainly exist; the question of their employment and cost should be further examined.

Briefly the following is an outline of the chain of projects, which can only with difficulty be traced from the printed account. The main power station, one mile North of Khapa, elevation 1,200 feet, on the Kanhan River (Map 55 K 13, S. W. corner), is to be supplied by a long pipe line down the Ghat from Silewani Tola at 2,150 feet. The system is to be fed by a canal from a service reservoir on the Umra Nala, estimated to have a draw-off capacity of 600 million cubic feet, of which the dam is to be one mile North-East of Mau. A second dam immediately above this, up to the 2,200 feet contour, and an Upper Umra Nala reservoir one mile North-East of Palakher feed this. Yet another dam for the Chin Naia reservoir is placed one mile West of Umaria Dalel running up to the 2,200 feet contour, to feed the service reservoir by a canal. On the head of 950 feet gross Mr. Batchelor estimated this group to be capable of giving 1,400 e. h. p. at the high cost of Rs. 1,500 per e. h. p. (say Rs. 2,000 per k. w.), on his assumption of a 30 per cent load factor.

Further North is the Rohna reservoir site, one mile North of Rohna on Map 55 J 16, running up to 2,250 feet, and estimated to contain 3,000 million cubic feet. Mr. Batchelor proposes to canal this water to the Chin Nala reservoir, a distance of 16 miles, so after allowing for the slope of the canal a good deal of this water would not be of any use.

North of this again, a nine mile canal (including a three mile tunnel) would discharge the waters of the proposed Upper Pench reservoir *viâ* the Kulebehra Nala into the Royna reservoir. The site of the dam across the Pench River is two miles North of Chhinda, at the top of Map 55 J 16, and it is proposed to carry it up to R. L. 2,450 feet. The site is certainly very favourable on the map, and a short dam is estimated by Mr. Batchelor to impound 12,000 million cubic feet. Minor power stations are also proposed below this lake.

Further dams are proposed on the Pench River one mile West of Palatwara up to 2,250 feet (Map 55 J 16), and on the Gunor one mile North-East of Thesagora on the same Map up to 2,350 feet. These, however, though possibly of use for irrigation, would appear to be too low down for feeding the power system.

At first sight it would seem that if the Upper Pench site is good, and if its waters can be led at any reasonable cost to the edge of the Ghat, it would be better to concentrate on this and to omit all the smaller reservoirs except the regulating one, and all the minor power stations.

If Mr. Batchelor's estimates are at all near the truth, the cost of the Upper Pench reservoir and the regulating reservoirs at the Umra Nala, together with the necessary canals, would be in the region of 110 lakhs. The

storage, if correct, would on a 900 feet net head give some 22,500 kilowatt years, allowing of a plant of 45,000 kilowatts on a 50 per cent load factor, making a cost of some Rs. 250 per kilowatt for the hydraulic works, exclusive of the pipe line and power house. This, if attainable, would be a reasonable figure.

Son River.—North east of Langi, above Bijagarh. Indicated, but without details. Reconnaissance required. (Map 64-C 9, 10, 13, 14).

Tan River.—Pendra, Bilaspur. A reservoir site is indicated at an elevation of about 2,000 feet, with a rapid fall of 700 feet, where this river comes into the plains near Marai. The normal rainfall is 50 to 60 inches, concentrated into the months of June to September. The catchment area however is very small, some 15 square miles, and large carry-over would be required. The site may be worth 1,000 e.h.p. or more. (Map 64 F 9, 10, 13, 14).

Tapti River.—This rises in the Aravalli Hills, which it leaves some 25 miles east of Burhampur. The catchment area above here is about 2,000 sq. miles, with a rainfall of about 40 inches and there is a perennial flow. A site for a dam has been indicated but is apparently situated where there would be little or no further fall. The river at Betul was found dry early in June 1919, though it runs until the beginning of the hot weather. A possible site for storage was found, with a series of drops aggregating 100 feet. As the area is favourable further reconnaissance is desirable. (Map 55 C-7, 11, 14, and G 2).

Tawa River.—Said to be worth investigating where it enters the plains at Bagra, near Itarsi, Great Indian Peninsula Railway. The layered atlas sheets indicate that at the junction with the Denwa tributary there is a narrow neck between spurs. The rainfall is 50 to 70 inches in the upper parts of the catchment, mostly falling in June to September. (Map 55, F. 14).

Umra Nala; see Silewani Ghat *supra*. (Map 55 K 13).

Uskal River.—Balaghat District. This is stated to be perennial and to be capable of a fall of 1,000 feet or more, near the village of Udwa, Balaghat junction, presumably below the junction with the Nahara (q. v.) but not so far located on the 1 inch map. The locality has greatly mineral possibilities, and power is certainly likely to be wanted in future. It is stated that some 4,000 continuous e. h. p. at least can be got from the site, and by further raising the proposed dam 17 feet the capacity of the tank can be doubled. A local report on the site exists, and it is still under investigation. The catchment area above the junction with the Nahara is about 130 sq. miles. Rainfall normal about 60 inches during the June to September monsoon. (Map 64 B 4, 8).

Waingunga River.—Small falls are indicated, but no details of any value as yet. Judging from its tributaries the river should be worth further reconnaissance. The catchment area above the 2,000 foot contour is 275 sq. miles; at the 1,000-foot contour it is about 1,800 sq. miles. Rainfall 50 to 60 inches, mostly between June and September. See entry under the Kanhan River also. (Map 64 B. 3, 4 and C. 1).

Wardha River.—Small falls are said to exist near Pulgaon and Mr. Batchelor believes that 1,000 e. h. p. is available. No details are available, but the catchment area is over 2,000 miles here. Rainfall 35 to 40 inches, mostly between June and September. (Map 55 L. 5 and 6).

Canal Falls, Central Provinces.

The Chief Engineer, Irrigation Branch, considers that there is good scope for utilizing the canal falls for pumping to uncommanded areas, especially from the Mahanadi canal, where large areas of well drained *bhata* soils lie out of command. This soil is particularly suitable for growing long-stapled cotton, as recommended by the Cotton Committee. The canal falls are not likely to be of any use for general purposes as they only run a comparatively small number of days in the year. Most of the irrigation is done during the Kharif; rabi irrigation is purely subsidiary. There are 62 canal falls, running from 90 to 120 days.

APPENDIX XI.

List of Sites in Madras.

Aliyar River.—Anamalai Hills (q. v.). There is said to be 2,000 feet of fall, of which 500 feet could easily be utilized, in this river some 40 miles from Coimbatore and 16 from Pollachi. The discharge is believed to vary from about 800 down to 6 cusecs. Further observations will be made. The catchment area is small, but the rainfall varies from 40 to 75 inches over it, well distributed from April to November. Probably worth 2,000 e. h. p. or more. (Map 58 B. 15 and F. 3).

Anamalai Hills.—Messrs. Siemens are interested in the Kayanapardal Falls, Sholujar (Suruli ?) River, near Coimbatore. No details are available. See also Aliyar River. (Map 58 B. and F.).

Bhavani River.—The falls near Thondai, 13 miles above Metupalliam, and 22 miles from Coimbatore are said to be about 50 feet. The catchment above them is about 400 sq. miles. The discharge is believed to vary from over 3,000 down to 40 cusecs. Observations are being made of the dry weather discharge in 1919. The rainfall contours probably give too high a precipitation for this catchment, but there are no stations in it. It may be anywhere between 20 and 75 inches. December to March are dry months. (Map 58 A. 16).

Ibid.—Malabar District. A fall of 2,500 feet in 3 miles is shown on the upper Bhavani, 45 miles from Coimbatore and 21 from Ootacamund. A water level recorder will be installed as gauging cannot be undertaken at this out of the way spot. The catchment area must be very small here, but the above distances meet outside the Bhavani catchment altogether. (Map 58 A. 12).

Cauvery River.—Apart from the existing development (see Table 1) there have been proposals for utilizing the Goat's Leap Fall, the Mekadatu Falls (q. v.), and the Hogenkal Falls (q. v.). The Goat's Leap Fall is 26 miles below Sivasamundram, and no details are available.

Chalakudi River.—Cochin. This has been investigated by Mr. Forbes, Chief Electrical Engineer, Mysore. He states that the minimum flow is 50 cusecs and storage of 1,000 million cubic feet is proposed. The site is estimated to be good for 25,000 e. h. p. on 577 feet head. (Map 58 B. 11).

Chandravauki River.—Guntur District. The Ettipotata waterfall is near Macherla, and 16 miles from Gurzala. No details are known and the site has not been identified as yet, but the river is presumably one of those flowing into the Kistna from the north. These all appear from the layered map to pass through fairly narrow gorges within 10 miles of the big river, and reservoir sites may exist above. The Superintending Engineer is examining the site and will take dry weather discharges. Rainfall about 30 inches, of which 92% falls between June and November. Catchment area not determined. (Map 56 P.).

Cochin State.—There are believed to be possibilities of considerable magnitude in this State, but no details have been made public. Some 24,000 e. h. p. can, it is understood, be developed, presumably from the Chalakudi River (q. v.).

Coonoor and Karteri Rivers.—When the Coonoor-Ootacamund section of this hill railway was being built in 1905, the Electrical Adviser to the Government of India drew up a project, at the instance of the Railway Board, for its electrification. The site chosen for power development was on these two rivers, near Runymede, some 3 miles from Coonoor and 12 from Ootacamund. The project was limited to what was then required, and details are given in Table 4. A far greater head than the 1,000 feet proposed, probably up to 3,500 feet, could however be obtained. The minimum discharge in 1905 was 4·3 cusecs for the Coonoor branch and 12 cusecs for the combined streams. Large storage is possible. Further investigation is proceeding. The Karteri River is already employed in its upper reaches for the Government Cordite Factory; see Table 2. The rainfall over the catchment area of some 60 or 70 sq. miles is particularly well distributed. It averages about 60 inches, catching both the south-west and north-east monsoons, and from April to

November the monthly averages are reasonably constant. The worst months are January to March, but they receive about 10 per cent. of the total in average years, or some 2 inches per month. (Map 58 A. 15).

Gundar Valley.—Near Kodaikanal. Attention has been drawn to this valley. The catchment area is very small, about 8 square miles, but the rainfall of 60 inches is well distributed throughout the whole year; even January and February each receive an average of nearly 2 inches. The perennial flow is good and a fall of about 1,000 feet is said to exist. There are also said to be good reservoir sites. (Map 58 F. 7, 8, 11, 12).

Hogenkal Falls.—Cauvery River, Salem and Coimbatore. The utilization of these falls (also called Smoking Rocks Falls) on the River Cauvery, 66 miles above Erode, has long been discussed especially in connection with the Salem iron ore district 40 miles distant, where electrical reduction has been contemplated. Some survey work has been done at the dam site, where the rock is said to be a brittle granite. A head of 46 to 85 feet is available, according to whether Metur reservoir is or is not constructed. The flow of water depends on unsettled irrigation projects, but is likely to be of the order of 550 cusecs minimum, so that some 2,500 e. h. p. at least is available at the site. The maximum flow is about 250,000 cusecs. The power available would be increased to well over 3,500 e. h. p. if certain other projects materialize. The cost has been estimated as about Rs. 570 per h. p. installed or Rs. 760 per kW. The water rights of the river are somewhat complicated as between Madras and Mysore. A survey has been made and cross-sections of the river taken above and below the falls. A site for a low dam is being investigated. (Map 57 H. 12 or 58 E. 9).

Karteri River.—See Coonoor River; also table 2 "Cordite Factory."

Kolakambe water fall.—Nilgiris. This is a neighbour of the Karteri River and has a drop of about 600 feet, but by means of a short tunnel a fall of 1,000 feet could be obtained. The waters of the Karteri could probably be diverted into this stream below the existing power house of the Government Cordite Factory (table 1). The minimum flow is believed to be about 10 cusecs. With a short high dam it is believed that 3,000 e. h. p. might be obtained. (Map 58 A. 11, 12).

Kundah River.—A project for utilizing this most promising river in the Nilgiris, 9 miles from Ootacamund, was sketched out by the Hon'ble Mr. Murray, then Chief Engineer, P. W. D., Madras. It appears well worth further investigation. The catchment area at the Kundah bridge is 65 sq. miles and the minimum discharge recorded in 1918 was 31 cusecs, but by comparison with neighbouring catchment it is believed that the true minimum in a very dry year, such as 1914, would be about 20 cusecs; gaugings are proceeding. There are two good reservoir sites, one in the main river a mile above the junction with the Emerald Valley stream and one in that valley itself, where the minimum flow is estimated to be 4½ cusecs. This latter site has not been fully examined. The mean rainfall is about 80 inches and is extremely well distributed; a run-off of 60 inches is estimated from known data, giving some 1,600 million cubic feet available for storage in the Kundah river site, with an estimated minimum flow of 5·6 cusecs at that point. The site allows some 828 million cubic feet to be stored with a dam of 120 feet. The fall in the neighbourhood is about 3,000 feet of which 2,000 feet are in 2 miles, but it has not been determined whether this could be utilized. The scheme however appears likely to yield some 20,000 e.h.p. or more and is worth thorough investigation. The minimum flow in 1917 was 30½ cusecs and in 1919 24 cusecs; no readings were taken in 1918. (Map 58 A 11, 12.)

Malabar District.—Said to have great possibilities, with high rainfall and jungle products, such as bamboo for pulp, which may require power. The average rainfall is about 120 inches and is fairly well distributed over April to November, though 70 per cent. of the total fall occurs during the 3 months June to August.

Machkand or Silern River.—This appears from the Atlas sheets and the ¼ inch maps to have great possibilities if levels are favourable, but practically none are given. A fall of 540 feet with a discharge of 104 cusecs in the driest part of May, 1919, has since been reported. The site has not been identified but is on Map 65 J.

Mekadatu Rapids. Cauvery River.—These are 28 miles above Hogenkal falls (q.v.) and 21 miles below Sivasamundram (see Table 1, Cauvery falls). The distance to Salem is 67 miles. The flow is the same as that at Hogenkal falls and the drop is 175 feet. The frontier between British and Mysorean territory runs down the centre of the river, and negotiations are proceeding between Madras and Mysore as to the utilization of the fall. An estimate has been framed by the Chief Electrical Engineer, Mysore. At least 8,500 e.h.p. is continuously available on the 550 cusec minimum. (Map 57, H 8 or 12.)

Narpurya River.—Nilgiris. This is stated to be worth examination at Cherambadi Village, in the Wynaad, reached *vid* Gudalur, Devala and Pandalur. The Glenrock Tea Estate is near by. (Map 58 A 7).

Periyar Project.—The history of the proposal to utilize the water of the Great Periyar Lake in Travancore for power purposes would fill a volume and stretch back a generation, and it is sufficient to say that negotiations are still proceeding between Government and Mr. Garrett, a retired Chief Engineer of the Madras Irrigation Department. There is an available fall of about 1,000 feet and a minimum supply of 250 cusecs for 240 consecutive days has been the basis of negotiation. This is equivalent to some 54,000 e.h.p. (Table 4). There is little doubt that, as a rule, power of this order could be generated for a longer period in most years; but as matters stand, it cannot be guaranteed. The construction of a supplementary reservoir above the lake, in the Cardamon Hills, Travancore, would enable 150 cusecs to be given continuously, and this might indirectly benefit industrial India (including this progressive State) greatly, as the manufacture of fertilizers is proposed. For reasons which cannot be discussed here the supplementary project is held up, but it is highly important that a settlement should be arrived at. A suggestion may, however, be hazarded as to the project as it stands. The draw-off level is fixed by the location of the tunnel which carries the supply through the water-shed; and the lowering of this tunnel a few feet, so as to increase the possible draw-off, would be a costly matter. If, however, a power plant is put up, utilizing the full 1,000 feet head, it would be a comparatively simple matter to utilize a fraction of the power to pump additional water from the lake, below the present draw-off to the tunnel level, a suitable intake chamber being constructed for the purpose. Thus, if the total lift were 5 feet not much more than one two-hundredth of the power would be sacrificed and a much longer working period would be possible. (Map 58, G. 2, 3.)

Pykara River.—A project to utilize this river (See Table 4) for the supply of the Ootacamund District (15 miles from the town) was drawn up by Mr. H. P. Gibbs and has been the subject of negotiations between him and the Government of Madras. The lowest gauging recorded on the river at the power site was 9½ cusecs in 1914; gaugings have been resumed since and have varied from 15⅓ cusecs minimum in 1917 to 19 minimum in 1918. Two falls aggregating practically 900 feet could be combined, but it is believed that 3,000 feet could be obtained by tunnelling through the watershed to the catchment on the north. A storage site exists above the upper fall, but the capacity is not known. It is believed that the scheme is good for at least 2,000 e.h.p. or more continuously. The mean rainfall is about 76 inches and both monsoons affect the catchment area to some extent; from January to March however the average precipitation is very low. The catchment area has not yet been determined. (Map 58, A 10.)

Sandy Nullah.—Five miles from Ootacamund. This small scheme with a minimum flow of 1 cusec and a fall of 1,000 feet is being investigated for local employment; see Table 4.

Silern River: see Machkand.

Silent Valley.—The District Forest Officer, South Malabar, states that a short dam 200 feet high would form a reservoir 6 miles long, though not of great width. The position is 1½ miles up stream (name of river not given) from the point where the river crosses the forest boundary. The rainfall is at least 150 inches and the catchment "large." The fall available is not stated, but there is a "considerable drop" into the plains of Malabar, South of Mannaghat. The dry season lasts from the middle of January till the end of April. (Map 58 A 8).

Singamputti Scheme.—Madura District. This was mentioned, but the site has not been identified.

Siramalai Hills.—Mr. H. Perry has suggested that a power scheme for the Madura District can be formulated in these hills, situated 20 miles from the town in the Ammayanayakanur Zemindari. The rainfall map shows a mean between 30 and 35 inches in the surrounding plains, but the hills probably receive more; Mr. Perry's estimate, obtained from a Planter, is 65 inches; but there are no true records in the hills. The catchment area proposed is only 8 square miles, and a considerable number of artificial reservoirs is proposed; the fall available is stated to be 1,500 feet. The power available is estimated by Mr. Perry at "6,500 h. p. *per minute*," and the words italicized show that caution must be exercised in accepting his conclusions; see Appendix IV. The project requires to be examined by an expert, and may prove less expensive and more reliable than would appear at first sight; various enquiries were made as to its practicability by persons interested in local industries. (Map 58 J 4).

Siruvani River.—Tributary of Bhavani. A project, first mooted so long ago as 1879, has recently been investigated for utilizing this stream for combined water supply and power to Coimbatore, which is 25 miles distant. By damming up the valley so as to form a lake, and piercing the ridge with a tunnel, there would be an available fall of some 1,200 or 1,300 feet; some of the tail water would then be piped to the town for water supply. The minimum flow of the stream is small ($4\frac{1}{2}$ cusecs) as the catchment area is only $6\frac{3}{4}$ square miles, but as it receives both the south-east and north-west monsoons, with an annual rainfall of 75 inches or more, it is merely a question of storage. From December to March there is not much rain. The proposed dam would hold up from 280 to 450 million cubic feet according to height, from 120 to 140 feet; and with the fairly frequent rainfall replenishment it is believed that the site is good for about 2,500 to 5,000 e. h. p. continuously. (Table 5). The tail waters can be used for irrigation. Investigation is still proceeding. It is understood however that expert geological opinion condemns the dam foundation, and if this is so the scheme cannot materialize. The neighbouring Kundah River scheme is more promising, though the Siruvani can still be used for water supply. (Map 58 A 12, 16).

Suruli River.—See Anamalai Hills.

Tambrapani River.—The Paponasam falls, 22 miles from Tinnevelly and 54 from Tuticorin, are 250 feet high. The river is already utilized by Messrs. Harvey Brothers for their mills at Ambasamundram. Gaugings have been made in connection with an irrigation reservoir above the falls and work will proceed. (Map 58 H 6, partly unsurveyed).

Canal Falls, Madras.

The following falls, of which the exact positions are recorded but not printed here, are capable of utilization for power on a small scale. Nos. 1 to 12 are on Map 94 and the rest on Map 95. It is proposed to use No. 17 for pumping from the Kistna River to irrigate 10,000 acres. The remainder are not required either for sub-soil pumping or for pumping to uncommanded areas. The power aggregates about 3,300 e.h.p.

Serial No.	Canal.	Position.	Fall in feet.	Minimum flow except at closure.	Working period.
	Godavari Eastern Delta.				
1	Cocanada Canal . .	Medapadu lock weir .	10·0	373	11 months.
2	„ „ .	Tossipudy Lock . .	6·75	268	„
3	„ „ . .	Chintapally Lock . .	8·5	108	„
4	Bank „ . .	Kulla Lock . . .	8·5	101	„
5	Coringa „ . .	Vella Lock . . .	8·25	91	„
	Godavari Central Delta.				
6	Gannavaram Canal . .	Gopalpur Lock . .	4·80	425	11 months.
7	„ „ .	Mondepulanka Lock .	5·58	287	„
8	Bank „ . .	Wadapalem Lock . .	5·25	414	„
9	Amalapur „ . .	Palivela Lock . .	4·16	407	„
	Godavari Western Delta.				
10	Bank Canal . . .	Siddhantam Lock . .	9 to 12 ft.	100	11 months.
	Kistna Eastern Delta.				
11	Ryves Canal . . .	Komatigunta weir . .	6·84	1350	9½ to 10 months.
12	Bandar „ . .	Kankipad Lock . .	4·25	481	„
13	„ „ . . .	Veeranki Lock . .	10·41	224	„
14	Bantumilli „ . . .	Cowtaram Lock . .	5·60	316	„
	Kistna Western Delta.				
15	Bank Canal . .	Kollur Lock . . .	5·54	330	9½ to 10 months.
16	Commanur „ . .	Kollimerla Lock . .	5·60	324	„
17	Head of Commanur Canal	Duggirala Lock . .	7	200	...

APPENDIX XII.

Sites in North-West Frontier Province.

Indus River.—This is not considered likely to be capable of development, at any rate economic development, in the Himalayan area; the proposed Sukkur barrage (Bombay Presidency) may or may not be able to supply power. It is early to speak of this until the project materializes, but the possibility of high level pumping to canals, should it be required, may be borne in mind.

Kunhar River.—This joins the Jhelum not far from the Abbottabad-Kashmir road and had many rapids with a large perennial flow. As however the district is within easy transmission reach of the Kashmir Darbar's power station at Mohora on the Jhelum (table 2), where much surplus power is already installed, it is unlikely that any other large scheme will be required for the present. (Map 43. F 7).

Sinan River, trib. of Indus.—This flows in from north of Mansehra, and at the time of the Boer War a small plant was erected on one of its tributaries to supply the prisoner's camp. It was subsequently dismantled. It is probable however that sites exist in the main stream, which has *not* been prospected. (Map 43, F 3).

Canal falls in N. W. F. P.

Upper Swat Canal.—Soon after leaving the headworks this runs through the Malakhand tunnel and then, on exit, down a steep river bed, which is pitched. At Dargai the right and left bank canals take off. The discharge of the canal is 2,200 down to 1,000 cusecs, and the drop available below the tunnel is about 230 feet, giving a minimum power of 20,000 c. h. p. Mr. Sangster, who was in charge of the works, and Mr. Walton, his assistant, read papers on the subject before the Simla Engineering Conference; and Captain (now Lt.-Colonel) Battye proposed the utilization of the falls for the manufacture of nitrates, in a paper read before the Punjab Engineering Congress. The district however is a wild one. Constant power could be obtained by tailing into the river below the power house instead of into the canal as proposed by Mr. Sangster. The canal has to be closed for 10 days every alternate year to provide local irrigation in the rains on the banks lower down the river. Riparian rights necessitate this. Otherwise the canal could probably be run constantly.

Upper Swat Canal.— Branches. By utilizing the existing falls these have considerable power available; there are frequently groups which will permit of 30 to 50 feet drop with a minimum discharge of several hundred cusecs during about 286 days in the year. Unless required for irrigation pumping however there is not likely to be much demand for power.

Lower Swat Canal.—There are no falls suitable for power here, but near the head works power is now generated for the works by dropping the water about 50 feet down into the river area, where there are small canals that require feeding. The site could be utilized later. There is also another small scheme near the tail of one of the distributaries, for developing power for pumping water for a new grass farm. Elsewhere no pumping is required in this district.

Cabul River Canal.—A scheme has been considered for running water from one branch to another, near Peshawar, giving a 50 foot drop.

APPENDIX XIII.

List of Sites, Punjab.

Baspa River, trib. of Sutlej. At Raturing gorge this pours over a series of cataracts below Sangla, with a drop of about 500 feet in half a mile. It is believed to be a good site, though remote. (Map 53 I, 7.)

Beas River.—This has not, so far as is known, been prospected for power. Between its rise at the Rohtang Pass in Kulu and the plains there are however continual rapids, during which the descent amounts to several thousand feet. Whether there is any concentration of falls sufficient to allow of economic development is not known. Several of the larger snow fed tributaries in Kulu, especially the Parbatti and the two rivers flowing in at Largi, have also great potential power; but they are used for extensive timber transport up till the monsoon, so it would perhaps be impossible to divert the water from the stream without interfering with forestry. The catchment area is 5,700 sq. miles and the average rainfall over it is 62·5 inches. The maximun flood at Naushera is 325,000 cusecs and the minimum recorded discharge 2,600. (Map 53 A 1, 5, 9, 13, 14 and B 2).

Chenab River. (Kashmir).—A project has been proposed for utilizing this river at Riasi, where 30,000 c. h. p. can, it is said, be developed. The catchment area is 12,000 sq. miles, of which half is in the exterior Himalayas, and the average rainfall is 41·7 and 28·7 in the exterior and interior divisions. The maximum observed flood carried some 600,000 cusecs and the minimum recorded discharge is 3,884 at Marala. (Map 43 K 16).

Giri River.—The upper reaches of this perennial river were prospected about 1900 for power for Simla, but the Nauti Khad was found preferable. There are probably good sites for power lower down, but they are not recorded. The rainfall is from 50 to 75 inches, and is well distributed except for October to December, which are dry months. Much of the winter rain falls as snow in the upper areas, thus tending to equalize the discharges. The catchment area is about 600 sq. miles at the junction a few miles from Solon. (Map 53 F 6,10).

Haro River, near Hasan Abdul, Attock. Enquiries have been made regarding this river and the Jablat (or Chablat) in the same district, and discharges were asked for. There is said to be a fall of 50 feet and a good perennial discharge. Rainfall 25 to 40 inches. (Map 43 C. 5, 9, 13).

Indus River.—(See also entry under Bombay). The catchment areas above Kalabagh amount to 50,400 sq. miles in the exterior Himalayas and 63,000 in the interior range, with average rainfalls of about 26·6 and 7·6 inches respectively. The maximum recorded flood discharge at Kalabagh is 1,000,000 cusecs and the lowest observed flow 18,870. The bed here is narrow and if a 100 foot dam could be constructed the *minimum* power would be about 170,000 c. h. p. Below the bed widens out greatly, so the flood afflux would be small.

Jablat River.—See Haro River.

Jumna River.—(See also entry under the United Provinces). The catchment area above Tajawala is 4,400 sq. miles with an average rainfall of 73 inches. The maximum recorded flood carried about 273,000 cusecs and the lowest observed flow was 2,195 at that place.

Jhelum River, (Kashmir).—Already partly developed at Mohora (Table 2) but further power can certainly be obtained. The flume line of the existing plant is large enough for 4 times the power now installed. (Map 43 J 4). Captain (now Lieut.-Colonel) Battye, R. E., in a paper read before the Punjab Engineering Congress, 1914, suggested using this river for power at Rasul, at the head of the Lower Jhelum Canal. A flow of 4,500 cusecs and a head of 80 feet were stated to be obtainable, giving 33,000 c. h. p. (See Table 2). The catchment areas in the exterior and interior Himalayas are 7,000 and 8,000 sq. miles respectively, with average rainfalls of 39·5 and 46·2 inches. The maximum flood at Rasul carried about 500,000 cusecs and the minimum recorded discharge is 4,500 cusecs.

Kishenganga River, tributary of Jhelum (Kashmir).—No information is available, but the catchment area is certainly over 2,000 sq. miles at the junction with the main river, and it is snow fed. (Map 43 F 11, 14, 15).

Kunhar River, tributary of Jhelum.—No information is available, but the catchment area is about 1,000 sq. miles at the main junction, and the river is snow fed. (Map 43 F 6, 7, 9, 10).

Mogri River.—Rampur Bashahr State. The Chief Wazir of this State believes that a fall of 600 feet or more could be obtained in a mile or two of channel in this river, which is snow fed and has a dry weather discharge sufficient to drive about 10 of the local water mills —or say 30 to 40 cusecs. The stream is probably worth 2000 e.h.p. or more. (Map 53, E 11, 15).

Punch River, tributary of Jhelum, (Kashmir).—This appears to be worth examination near Kotli where the catchment is about 1,400 sq. miles; but no information exists regarding the river. It will be snow fed during at least the early part of the hot weather, as it rises in the Gulmarg snows. (Map 43 G 14, 15).

Ravi River.—This has not been prospected in the hills, but certainly has considerable possibilities. Where the Upper Bari Doab Canal takes off near Madhupur a *gross* fall of 109 feet can be obtained in 4·6 miles; 140 feet in 7½ miles; 175 feet in 9¼ miles; and 200 feet in 13 miles. Mr. Milne in a paper read before the Punjab Engineering Congress, 1919, states that the minimum recorded discharge there is 1,300 cusecs, which would give a continuous 12,000 e.h.p. on the smallest and most practicable combination of these many falls. The excess water not required for the canal could be surplussed back to the river. The project has been estimated to cost Rs. 530 per e. h. p. or Rs. 716 per kilowatt installed. See entry in table 5. The normal supply is nearer 5,000 cusecs. A cross-section is available but is not printed. The catchment area of the river is 2,500 sq. miles with an average rainfall of about 93 inches. The maximum flood discharge is about 200,000 cusecs and the minimum recorded flow 1,303 cusecs at Madhupur. (Map 43 P. 11, 14, 15 with 52 D 2).

Sutlej River; Bhakra Dam project.—The proposal to use the great power of the Sutlej where it enters the plains near Kirthpur, north of Rupar, at the head of the Sirhind Canal, is not dependant on, nor does it in any way interfere with, the project for storing some 112,000 million cubic feet of water behind this 395 foot dam. The proposals given in Mr. F. Milne's paper, read before the Punjab Engineering Congress at Lahore in April 1919, involve tunnelling through the spur round which the Sutlej makes a great loop at Oel and Anandpur; a fall of some 430 feet or 330 feet effective can be obtained in this way, and the minimum discharge of 2,700 cusecs (usually not below 4,000) which must in any case be allowed to pass down the river could be utilized to give some 81,000 e. h. p. continuously. The lake would extend above the headworks, but its storage would not be drawn on beyond the minimum flow coming in. The cost is estimated to be Rs. 313 per kilowatt installed. The only differences that the dam project makes in the hydro-electric is that, if the former is built, the tunnel will be under the pressure of a considerable head of water; whereas, if the dam is not built, a diverting weir must be built across the river at the tunnel entrance. It is probably that below the dam also some 10,000 e. h. p. could be obtained if the main scheme is blocked by the fear of interference with irrigation. This site was first suggested by Messrs. Crompton & Co. in the early nineties. The reaches further upstream have doubtless great possibilities, but at a much higher cost. The catchment areas of the river amount to 5,000 and 16,000 sq. miles in the exterior and interior Himalayas with an average rainfall of about 44 inches in the former. The maximum flood discharge is about 300,000 cusecs and the minimum recorded flow 2,818 at Rupar. (Map 53 A 7, 8, 11, 12).

For the construction of the dam, and the tunnel also, power to the extent of about 3,000 h. p. will in any case be required; and this can be obtained from a site 4 miles from Nangal, on the same loop and below the dam site. Here a minimum of about 15,000 e. h. p. can be obtained under a comparatively low head of about 30 feet, unaffected by the flood rise. The cost, including transmission to the works, is estimated to be about 10 lakhs for the power actually required, but it would seem preferable to so arrange that the whole power can be developed. If the demand later on justifies it, and the tunnel has been built (which would certainly be an advantage in constructing the dam) then the larger project could subsequently be matured. Certainly several thousand h. p. could at once be used for the Kalka-Simla Railway and other requirements within easy reach.

Sutlej River—At Khatolu gorge, 2½ miles from Sarahan on the Hindustan-Tibet road, there are cataracts for ¾ of a mile with a single drop of 30 feet included. During the monsoon however the rise of the river practically obscures the falls, so it would only be possible to utilize it with a considerable dam for giving a head. The minimum perennial discharge will be of the order of 1,500 to 2,000 cusecs and the site appears promising, though remote. (Map 53 E, 14, 15).

Canal Falls, Punjab.

Note.—Discharges given are mostly the *normal full discharges*. Minima are being collected and will be available later. Serial numbers refer to a map on record in the Survey. Falls less than 8 feet not given.

Serial.	Name of channel.	R. D.	Particulars.	Head feet.	Normal full discharge.	Minimum discharge.
	UPPER JHELUM CANAL.					
1	Main Line	240,000	Fall	50	3,030 See note.	...
2	Do.	418,000	Fall (combined)	20	...	1,000 See Note.
3	Gujrat Branch	6·0	Fall	8	2,033	...
4	Do.	1,350	Do.	8	1,866	...
5	Do.	2,000	Do.	8	1,850	...
	LOWER JHELUM CANAL.					
1	Northern Bank	342,080	Fall	3	294	...
2	Do.	343,080	Fall } can be combined {	3	294	...
3	Do.	343,580	Do. } can be combined {	100	294	...
4	Do.	344,080	Fall	5	294	...
5	Sulki Branch	13,526	Do.	6	357	...
6	Do.	14,000	Do.	5·5	341	...
	UPPER CHENAB CANAL.					
1	Main Line, lower	715,000	Fall and bridge	8·5	9,070	...
2	Do.	221,000	Do.	10·5	7,889	...
	LOWER CHENAB CANAL.					
1	Bhawana Branch	7,500	Fall	9·2	423	...
2	Khewra Major Dy.	8,000	Do.	8·7	314	...
3	Burala Branch	164,000	Do.	8·2	350	...
4	Upper Gugera Branch.	219,000	Do.	8·5	...	850 See Note at end.
	UPPER BARI DOAB CANAL.					
1	Salampur feeder	6,486	Rapids No. 3 and bridge	8·3	1,895	See Note at end.
2	Do.	33,845	Rapids No. 11 and bridge	9·3	1,824	
3	Main Line	13,300	Rapids No. 2	8·0	4,796	
4	Do.	22,500	Rapids No. 6	8·5	4,782	
5	Do.	24,500	Rapids No. 7 and bridge	8·0	4,779	
6	Do.	28,500	Rapids No. 9	8·5	4,773	
7	Do.	31,500	Rapids No. 11	8·5	4,769	
8	Faridnagar feeder	21,829	Rapids No. 8	9·2	1,774	
9	Do.	27,697	Rapids No. 10 and bridge	8·6	1,764	

UPPER BARI DOAB CANAL—*contd.*

Serial.	Name of channel.	R. D.	Particulars.	Head feet.	Normal full discharge.	Minimum discharge.
10	Main Line	54,500	Rapids No. 16 and bridge	8·5	4,695	
11	Do.	60,000	Rapids No. 18	8·5	4,695	
12	Do.	92,142	Tughal rapid and bridge	8·0	6,292	
13	Do.	101,072	Dhambai bridge and fall	8·5	6,300	
14	Do.	114,100	Nanunangal bridge and fall.	10·0	6,330	
15	Main Branch, upper.	42,849	Dhariwal bridge and fall	11·0	4,270	
16	Do.	49,768	Kunjer bridge and fall	9·0	4,200	
17	Do.	123,500	Aliwal regr. and fall	8·0	2,631	
18	Lahore Branch	25,000	Sanchur bridge and fall	10·0	1,080	
19	Do.	96,000	Raneywal bridge and fall	8·6	872	
20	Subraon Branch	34,860	Tughel Walad bridge and fall.	8·4	790	
	LOWER BARI DOAB CANAL.					
1	Main Line	329,058	Fall and bridge	8	4,291	See Note at end.
2	Do.	493,759	Do.	8	3,774	
	SIRHIND CANAL.					
1	Abohar Branch	23,000	Khanpur	8	2,506	
2	Do.	47,000	Chupki	8	2,888	
3	Do.	69,500	Ballowal	8	2,820	
4	Do.	105,000	Akalgarh	8·1	2,755	
5	Do.	128,000	... ..	8·2	2,657	
6	Do.	213,000	Doodhar	10·0	2,396	
7	Do.	254,000	Gholia	8·2	1,957	
8	Do.	289,000	Channowal	8·0	1,717	
9	Do.	332,000	Samalsar	8·0	1,562	
10	Sultej Nar.	98,000	Baraghar	9·9	400	
11	Do.	110,500	Malha	10·0	400	
12	Bhatunda Branch	32,250	Khatra	8	2,029	
13	Do.	58,900	Jaghera	7·6	2,011	
14	Do.	87,500	Kanganwala	10·1	1,982	
15	Do.	128,000	Lohgarh	8	1,770	
16	Do.	185,000	Chambhai	10	1,561	
17	Do.	277,900	Ballohi	8·6	1,039	
18	Do.	307,000	Sadhana	7·7	1,010	
19	Kotta Branch	15,000	Dalowal	9·4	1,427	
20	Do.	56,650	Solar	8	1,414	
21	Do.	61,566	Banbhora	8	1,400	
22	Do.	122,175	Sogra	8·1	1,006	
23	Do,	185,000	Harigarh	8	847	
24	Do.	215,000	Sahoki	8·9	604	

SIRHIND CANAL—*contd.*

Serial.	Name of channel.	R. D.	Particulars.	Head feet.	Normal full discharge	Minimum discharge.
25	Kotta Branch	269,000	Ralla	8·5	517	
26	Ghaggar Branch	23,000	Thus	11·1	719	
27	Do.	55,000	Nidampur	8·5	676	
28	Do	135,000	Sular	8·0	311	
	WESTERN JUMNA CANAL.					
1	Sirsa Branch	168,000	Fatehpur	8·8	1,241	

Of the above it has been suggested by the Chief Engineer that the 50 foot fall on the Upper Jhelum Canal, serial 1, at R. D. 240,000, could be employed usefully at Khewra Salt Mines and Dandot Collieries, but the closure would be a drawback. This may, however, be reduced when the Woolar Lake Barrage in Kashmir has been built. Sir Louis Dane also suggested the employment of this power for irrigation pumping to the tract between the North Western Railway and the Upper Jhelum Canal, where the closure would not matter, but the question of the sufficiency of the supply for the rabi crop would have to be considered. The power available on normal discharge is nearly 14,000 e. h. p. but the minimum and period of closure have not come to hand.

The 20 foot fall on the same canal (serial 2) at R. D. 418,000 could be used at Gujrat and Wazirabad, where some industries exist. The power available on minimum discharge (subject to short closures) is 1,800 e. h. p.

The falls on the upper reaches of the Upper Bari Doab Canal have been dealt with above in connection with the Ravi River. Serial 4 on the Lower Chenab Canal was at one time proposed to be utilized for the "Buchiana Lift Project" of irrigation; it is found however, that the area can probably be commanded by gravitation flow.

There are the following areas of high land within reach of the power and water of the Lower Bari Doab Canal, which could be used for irrigation pumping, *viz.*, Renala, 50,000 acres; Okara, 1,300 acres; Montgomery, 1,750 acres. The closure would not matter for this.

Apart from the power ascertained in these notes on canal falls, those not specially mentioned would yield the following amounts on the discharges given, which are mostly *normal and not minimum discharges*, viz.:—

Upper Jhelum Canal		4,000	e. h. p.
Lower „ „		3,300	„
Upper Chenab „		14,500	„
Lower „ „		800	„
Upper Bari Doab „	(58,000 total) say	46,000	„
Lower „ „		5,800	„
Sirhind „		32,800	„
Western Jumna „		1,000	„
	TOTAL	108,200	„

The power in any particular instance may here be found by $\text{e. h. p.} = \frac{\text{cusecs} \times \text{fall in feet.}}{12}$

APPENDIX XIV.

Sites in the United Provinces.

Alaknanda.—(See also Bhagirathi River).—This river, also called the Vishnuganga, has a catchment area of some 4,500 square miles and drops 5,000 feet in 16 miles between Badrinath and Vishnuprayag. The gorge $2\frac{1}{2}$ miles above Rudraprayag would be difficult to develop and is very out of the way; but the river is snow fed and could undoubtedly be developed at a cost. It is reported that the limestone cliffs of the gorge are 150 feet above the bed of the river at this place, where it takes a sharp bend. An old channel cuts a chord across this bend, with the pilgrim route to Badrinath parallel to it. The suggestion has been made that the old bed could be cut down to the present water level and sluice gates constructed on it; the river could then be diverted while a dam is built across the gorge. Presumably a second dam of the same height would be necessary across the cutting. Arrangements would be required for passing timber over. A light railway to Karanprayag is under consideration. (Map 53 J 15-16 or N 3).

Bakher Nadi.—Tributary of Belan, Mirzapur.—There is a reservoir site here designed to hold 1,400 million cubic feet of water for irrigation purposes; but as the catchment area is 318 square miles with a good run-off and a rainfall of about 40 inches it is believed that 8,000 million cubic feet or more could be reckoned on with a higher dam. Some 87 per cent. of the rain falls between June and September. The Sirsi fall near by has a drop of 90 feet. The project makes an admirable combined irrigation and power scheme, as the tail waters could be stored lower down and yet above the canal. The site appears likely to yield at least 2,000 e.h.p. continuously, and probably much more. It is worth further investigation. (Map 63 L 9).

Baur River.—Naini Tal District.—The minimum recorded discharge at Dechauri is 9 cusecs and the stream is small and unpromising. (Map 53 O 7).

Belan Nadi.—Mirzapur.—There is a possible reservoir site (unsurveyed), believed capable of storing 5,000 million cubic feet, above the Mukha fall of 80 to 100 feet, 6 miles west of Ghorawal. It has so far not been examined as the cost of the submerged villages and land would be high, but it offers considerable possibilities for power (1,500 e.h.p. or more) and irrigation combined. The catchment area is about 250 square miles with a rainfall of about 40 inches, which practically all falls between June and September. (Map 63 L 9, 10).

Bhagirathi River.—Tributary of Ganges.—At the junction with the Alaknanda, at Devaprayag, there are rapids with a perennial snow-fed discharge. Reconnaissance is desirable, as the catchment is nearly 4,000 square miles. The President of the Council of Regency, Tehri-Garwhal State, has examined this river and its tributaries beyond Barahat, and calls particular attention to the Assi, which joins the main river 2 miles above that place. This is a perennial stream, largely snow fed, and has a fall of some 1,275 feet in 8 miles in its lower reaches, which are at an altitude of 6,000—7,000 feet. The estimated discharge between the 14th and 20th May 1919, was 400 cusecs. The site is 40 miles from Dehra Dun. (Map 53 J, 5, 6, 12).

Chandrapabha River.—Benares State.—There is a small storage site to hold some 300 million cub. feet which was surveyed but not proceeded with. A 200 foot fall is said to exist near Baraur. Site not identified, but probably north of the Son River. The power possibilities appear small, though in combination with irrigation it might be developed. A request to examine the site has been received through Government. The rainfall is about 40 inches of which about 31 inches fall between June and September. (Map 63 P).

Dabka River.—Naini Tal District.—The minimum recorded discharge is 10 cusecs at Kota, and the river only offers small prospects of power apparently. No information as to falls. (Map 53 O 3).

Ganges River.—(See also Bhagirathi River).—It has been recommended that levels should be taken from Rikhishesh up to Phul Chatti or beyond; the latter region is believed to offer possibilities, but the harnessing of such a river is likely to be very expensive. The site has not been identified at present. Being snow fed from the main Himalayan range there is of course enormous

potential power in the river, and it is within the borders of British India, though mostly unsurveyed.

Garai River.—Mirzapur.—For irrigation reasons this is said to be not worth consideration, though a fall of 180 feet exists near the present dam.

Gaula River.—Naini Tal District.—The minimum recorded discharge at Kathgodam is 82 cusecs while there are generally at least 100 cusecs through the dry season. The hills fall rapidly from the Bhim Tal District. It is worth further prospecting. Discharges are being taken. (Map 53 O 11).

Gauna Lake.—Garwhal.—This was formed by the great landslip of 1893 and burst in 1894, but the lake is still very large (3 times the size of Naini Tal Lake) and it might be possible to raise a dam there. The Birchi Ganga flows thence to the Alaknanda. (Site not identified).

Ghagar Nadi.—Mirzapur.—The water is all required for irrigation, so the power cannot be utilized unless falls exist above the headworks, as to which there is no information at present.

Jagei Lake.—Garhwal.—Formed similarly to the Gauna Lake (q.v.) and the same remarks apply. Snow fed. The Biera Ganga flows from it to the Kaliganga. (Site not identified).

Jumna River.—The scheme of the United Provinces Power Association (Major-General Beresford Lovett) mentioned in Table 5, was a double one. The sites are at Jalanta and Binahar respectively. At the former site a double loop was to be utilized by making two short tunnels through the spur, a canal joining up the tunnels, and giving a fall from R. L. 2,362 to 2,194 or say 168 feet gross. The latter is a single loop, involving a 2 mile tunnel, giving a fall from R. L. 1,953 to 1,698 or 255 feet. The existing concession is partly in Tehri State. Minimum discharge about 750 cusecs; snow fed from a very large area. The promotors of this scheme reckoned, after full investigation, that they could obtain 26,000 e. h. p. at Binahar and 12,000 e. h. p. at Jalanta at about one-third of the cost of the larger scheme. It is a matter for regret that for various reasons these promising schemes had to be postponed; it is to be hoped that they are not abandoned. (Map 53 F 14).

Kalaunia Nadi.—This is reported as unlikely to be of any use. It is to the west of the Sarda.

Kaliganga River, Garhwal.—(See also Jagei Lake).—It has been suggested that a large reservoir could be made near Launsari. The stream joins the Kail and the Pindar. (Site not identified).

Kanhar River, tributary of Sone, right bank conditions similar to Rer River (q. v.) and worth investigating. (Map 63 P. 3, 7, 8).

Karanauti, Khajuri, Dahwa and Jargo Nadis, Mirzapur District.—These small nalas rise in the lower scarp of the Vindyas and flow north to the Ganges. There are small storage sites and falls of from 50 feet upwards, but in view of the better sites in the district they are at present not worth more than record. Some power however can doubtless be developed, and might be useful to the neighbouring quarries. Rainfall about 40 inches, nearly all between June and September. (Map 63 K 12).

Karamnasa River, Benares State.—At Nangarh, 40 miles south of Benares, there is a reservoir site investigated by the Irrigation Department and found capable of storing 3,500 million cubic feet at a cost of 12 lakhs; as an irrigation project it was abandoned. A smaller site holding 700 million cubic feet was also located on the Gurwat tributary, 4 miles below Nangarh. Near here there is said to be a fall of 240 feet and another of 100 feet, on the way down to Chakia, where the reservoir of the Benares State Canal is situated; possibly they can be combined. The value to the State of the tail waters of the proposed large reservoir, in keeping the existing irrigation reservoir always supplied, is obvious. The site seems likely to afford at least 4,000 e. h. p. continuously within 40 miles of Benares, probably far more, and is well worth further examination. Details of the sites are available in the Chief Engineer's office. A request to examine the site has been received through Government on behalf of the Benares Darbar, and enquiries have been made by Messrs. Martin & Co. The rainfall is about 40 inches of which 31 inches fall between June and September. (Map 63 P. 5).

Ken River, tributary of Jumna.—At Paind village, Panna State, below junction with Sunai (Sonar ?) there is a favourable reservoir site with a catch-

ment area of 5,700 square miles and a recorded flood discharge of 325,000 cusecs. The site has not been identified. (Map 54 P).

Khoh River, Garhwal.—This falls very low but does not dry up. About 4 miles above Dogadda (on the cart road to Lansdowne) a promontory almost closes the ravine. It was proposed some years ago to make a dam here to generate power for a ropeway between Lansdowne and Dogadda, but the project was dropped in 1914. Site not identified. (Map 53 K 9, 10?).

Kosi River, Naini Tal District.—The minimum recorded discharge at Ramnagar is 152 cusecs, and the dry weather flow is generally over 200 here; there are no gaugings higher up, where falls can certainly be developed. The river is not fed from the perpetual snows, but rises in high altitudes in the Almora district, with a rainfall of 50 to 100 inches. November and December only have averages below an inch, though July to September gets most of the rain. The river merits further investigation and is being gauged. Near Hawalbagh it is reported that damming would be feasible and power obtainable. (Map 53,O).

Mussoorie.—In addition to the existing development for Mussoorie and Dehra the Kamptee Falls on the Ringel Gad were mentioned and are to be examined. The catchment is only about 4 square miles. The discharge in 1919 fell to 4·8 cusecs as there was considerable irrigation higher up. A fall of 896 feet can be obtained with a flume of 1,850 feet, and a regulating tank can be built. The minimum discharge of the Bhatta, which supplies Mussoorie (see Table 2) was 8 cusecs in 1919. The Rispana stream had a minimum discharge of 3·8 cusecs in 1919 and a fall down to Mukrat of 720 feet with a pipe line of 4,100 feet. The Aghlar stream is more considerable; it lies between Mussoorie and the range to the north. The discharge below Tonata at the junction of the Khakrana was 5½ cusecs; at the Bhilaru junction 41 cusecs; between Kempti and Bhilaru streams 68 cusecs; and at Kempti junction 41 cusecs. The average fall is 150 feet per mile for 6 miles. The country is difficult and transport of machinery would be costly, but this river seems the best for the Mussoorie-Dehra extensions. (Map 53 J 3 ?).

Naini Tal Lake.—The old proposal to utilize this lake for the supply of the hill station is again under consideration of Government. A head of 1,000 to 1,350 feet can be obtained. It is proposed to instal 600 kilowatts (450 working and one spare set) at a cost of 4 lakhs. The storage area, if a dam is built, will be considerable; but the mud flats when the water is low may prove objectionable. (Map 53 O 7).

Nandhaur River, Naini Tal District.—The minimum recorded discharge is 18 cusecs at Chorgallia canal headworks, while the average is considerably higher throughout the dry months, from 22 to 60 cusecs. Falls have not been located and the catchment is small. Rainfall 50 to 100 inches, well distributed. (Map 53 O 12, 16).

Nayar River, tributary of Ganges.—There is a waterfall in the Eastern branch of this river near the Baijran-Kainur Road, 40 miles north-east of Lansdowne (Garhwal). No details are known, but the rainfall in the large upper catchment is about 75 inches. A plan exists, fully worked out, for making an irrigation channel to take out of the Eastern Nayar, a little above its junction with the Western Nayar, to run by a siphon under the latter and then proceed along the Main Nayar to Banghat and Bilkhet. It is said to be possible to adopt a similar project for power purposes at Bilkhet where there is a broad piece of flat land and terraces with a fall of 50 feet. (Map 53 J 16; K 9, 13; N 4).

Paisuni River.—Near Markundi station there is a fall of 150 feet. The river dries up entirely, but the catchment is 175 square miles with a rainfall of 40 inches between June and September. Storage sites may be found. (Map 63 C 16; D 9, 13).

Pindar River.—This snow fed river carries a large volume of water from a very large catchment, and is said to be worth prospecting. It runs into the Alaknanda. (Map 53 N).

Ramgunga River.—This rises in the Garhwal district. At Tarag Tal, in the west Almora Forest Division, a landslip in former times blocked the valley of a tributary and formed a lake; the embankment however is far from watertight. Below here there is believed to be a fall of 600 feet or more in 1½ miles.

The site is worth reconnaissance, but is remote. Catchment area of tributary not known. Rainfall 50 to 75 inches. This is probably either the Gauna Lake (q. v.) or the Jagei Lake (q. v.) but the accounts received do not make it clear. (Map 53 O 1, 2, 5, 6.)

Rer River.—Tributary of Sone, right bank. (Rihand River in Atlas?).—A perennial stream, once estimated as carrying 200 cusecs in May, and therefore probably having a considerable hot weather discharge. Runs in gorges with alternate pools and rapids, but little known. Almost certainly has power, and requires prospecting. Rainfall 40 to 50 inches of which 93 per cent. falls between June and October. (Map 63 L. 15, 16 and P. 3, 4).

Saraswatiganga River, Garhwal.—Two miles north of Badrinath this river drops 300 feet where it passes through a narrow cleft, spanned by a boulder over which the Tibetan trade route passes. The river is snow fed and has a large hot weather discharge, but as the altitude is 11,000 feet it is unlikely to be of any use. (Map 53 N 5.)

Sardah and Sarju Rivers. Naini Tal District. Details of gaugings are available in the Chief Engineer's office, the river having been completely surveyed for further canal projects. The river is snow fed and the water is used for the Rohilkhand Canals; but falls can almost certainly be developed above the head works, though they may prove to be out of British India, in the kingdom of Nepal, of which the river appears to be the boundary. The upper reaches of the Sardah are called the Sarju, and it is believed that power could be obtained near Bageswar and Rameswar, for the projected ropeways in the Almora District. On the right bank, which is in British territory, the Ledhia, Sarju, Gori, Dharma and Kuti flow in. Of these the Sarju is partly snow fed and has many rapids, and its feeder streams may possibly prove of value also for forestry. The Gori is also snow fed, and should be an excellent source of power, but it is very remote. The Dharma and Kuti also rise in glaciers but are even more out of the way. (Map 62 C 2, 3, 4, 7, 8.)

Tons River.—Lonipur in Rewah State is mentioned, the river having a catchment area of 3,100 square miles in Baghelkhand and a flood discharge of 400,000 cusecs. Site not identified. Higher up, at Poorwa, there is a fall of 100 feet, but here the catchment is reduced to 2,010 square miles. Further up still, at Chachai, 3 miles from Poorwa, there is stated to be a fall of 300 feet; but the dry weather discharge is small and a reservoir site has not been located. The rainfall is about 44 inches of which 41 inches fall between June and September (Map 63 D or H.)

Tons River. Dehra Dun. A site is mentioned near Kalsi, where this joins the Jumna (Map 53 F. 10 or 14).

Note (i)—A full report on the general features of Garhwal and its many streams has been received from the Commissioner, Kumaon Division. The more promising have been entered above, but the list will be useful to the officer examining the district.

Note (ii).—There is doubtless great power in the Nepalese rivers Karnali (or Kauriala), Sarju, Rapti, Madi, Budyar, Trisulganga and its tributaries, Sun Kosi and its tributaries. No data are however available regarding any of these rivers.

Canal Falls, United Provinces.

UPPER GANGES CANAL.

Anupshahr branch—

Anikas falls.—Minimum 150 cusecs for 155 days. Fall 5 feet.
Bhagwantpur falls.—Minimum 150 cusecs for 155 days. Fall 8 feet.
Makri falls.—Minimum 220 cusecs for 160 days. Fall 8½ feet.
Jakhera falls.—Minimum 230 cusecs for 160 days. Fall 4 feet.
Dehai falls.—Minimum 250 cusecs for 160 days. Fall 12 feet.
Parichatgarh falls and regulator.—Minimum 325 cusecs for 170 days. Fall 8½ feet.
Dhakauli falls.—Minimum 300 cusecs, but 400 cusecs for 180 days. Fall 7½ feet.
Akbarpur falls.—Minimum 300 cusecs, but 400 for 180 days. Fall 8·8 feet.
Churiali falls.—Minimum 300 cusecs, but 500 for 190 days. Fall 7 feet.

NOTE.—The normal flow during most of the year is much greater.

Aligarh Division.

Machua falls.—Minimum 600 cusecs for 8 months. Fall 6¼ feet.
Somera falls.—Minimum 600 cusecs, but 800 for 8 months. Fall 8 feet.
Patra falls.—Minimum 600 cusecs, but 1,100 for 8 months. Fall 8 feet.

Bulandshahr Division.

Walipura falls.—Minimum 600 cusecs, but 1,300 for 9 months. Fall 5 feet.
Sananta falls.—Minimum 600 cusecs, but 1,500 for 9 months. Fall 1¾ feet.
Dehra falls.—Minimum 600 cusecs, but 1,700 for 9 months. Fall 7 feet.
Dasna falls.—Minimum 600 cusecs, but 2,500 for 9 months. Fall 8 to 9 feet, increasing with low supply. Will give nearly 2,000 c. h. p. for 9 months.

Meerut Division.

Bhola falls.—Minimum 600 cusecs, but 2,700 for 9 months. Fall 12 feet. Will give nearly 3,000 c. h. p. for 9 months. It is anticipated that this fall will be utilized in the near future for the supply of Meerut, but only 750 kilowatts (giving 500 kW with a spare set) are to be installed at a cost of about Rs. 5,00,000. The project is now under consideration of the Local Government. The inlet channel will carry 600 cusecs. 8 miles from Meerut.

Salawa falls.—Minimum 600 cusecs, but 2,900 for 9 months. Fall 12 feet. Will give 3,000 c. h. p. for 9 months.

Chitaura falls.—Minimum 600 cusecs, but 3,000 for 9 months. Fall 10 feet. Will give some 2,700 c. h. p. for 9 months. Near Muzaffernagar.

Jauli falls.—Minimum 600 cusecs, but 3,500 for 9 months. Fall 10 feet. Will give about 3,200 c. h. p. for 9 months. Near Muzaffernagar.

Northern Division.

Nirgajni falls.—Minimum 600 cusecs, but 3,600 for 9 months. Fall 12 feet. Will give about 4,000 c. h. p. for 9 months. Near Muzaffernagar.

Mohammedpur falls.—Minimum 600 cusecs but 3,750 for 9 months. Fall 12·2 feet. Will give over 4,000 c. h. p. for 9 months.

Asafnagar falls.—Minimum 600 cusecs, but 3,800 for 9 months. Fall 10·7 feet. Will give 3,700 c. h. p. for 9 months. Near Roorkhee.

Pathri falls.—Minimum 600 cusecs, but 4,500 for 10 months. Fall 10 feet. Will give 4,100 c. h. p. for 10 months. Midway between Roorkhee and Hardwar.

Salempur and Bahadurabad falls.—Already combined and utilized in part. Minimum 600 cusecs, but 4,500 for 10 months. Combined fall 17 feet. Can be developed for nearly 7,000 c. h. p. for 10 months.

Ranipur falls.—Minimum 600 cusecs, but 4,500 for 10 months. Fall 9 feet. Will give over 3,600 c. h. p. for 10 months.

Eastern Jumna Canal Upper Division.*

Belka bridge fall.—Minimum 350 cusecs, but 740 for 9 months. Fall 14½ feet.
Dialpur fall.—Same discharge; fall 5·8 feet.
Nogla bridge fall.—Minimum 350 cusecs, but 666 for 9 months. Fall 7 feet.
Babail fall.— Ditto.
Randoul fall.—Same discharge; fall 8·4 feet.
Ghuna and Sarkari falls.—Same discharge; might be combined to give 10½ feet fall.
Hilapur bridge fall.—Minimum 350 cusecs, but 498 for 9 months. Fall 6½ feet.
Megchaper fall.—Same discharge; fall 4·4 feet.
Reri fall.—Same discharge; fall 3 feet.
Malri bridge fall.—Same discharge; fall 4½ feet.
Salampur fall.—Minimum 250 cusecs; fall 5·6 feet.

* All the above have larger discharges as a rule, from 1,000 to 1,770 cusecs.

LOWER GANGES CANAL.

Bundelkhand Tract.

Information not yet received.

On the minimum discharges the following power is available (in small units) from these canals; on normal discharge for some 9 months 2 or 3 times the amount could be obtained, *viz.*:—

UPPER GANGES CANAL.

Anupshahr Branch	1,600 c. h. p.
Aligarh Branch	1,200 „
Bulandshahr Branch	1,400 „
Meerut Branch	2,400 „
Northern Division	2,900 „
EASTERN JUMNA CANAL	2,400 „
TOTAL	11,900 c. h. p.

The power in any particular instance may here be found by c. h. p. $= \frac{\text{cusecs} \times \text{fall in feet}}{12}$.

Narbada R.—Gaugings were taken at Khiranighat, near Jubbulpore, during March, April and May 1919. The catchment area there is 6,500 sq. miles. The maximum flood discharge recorded up to date is 2,395 cusecs on 20th March 1919. The mean discharges were as follows :—

March 13th to 15th	519 cusecs	Minimum 412 cusecs.
„ 16th to 31st	933 „	
April 1st to 15th	405 „	„ 173 „
„ 16th to 30th	254 „	
May 1st to 15th	239 „	„ 145 „
„ 16th to 26th	215 „	

Total flow in period 2,791 million cubic feet.

The *Kapadhana Falls* below Amarkantak are about 100 feet.

Nimgahan.—At altitude 2,709 feet there is a perennial stream with a drop of 1,000 feet in a short distance.

Penganga R.—Kinwat Forest Reserve, Berar. The Sahasrakund fall near Bittargaon (Map 56 I 3) is 120 feet. A further possible site is indicated on sheet 56 I 5, in the Kelapur Forest Reserve.

Rakshadah Fall.—This is on the border of the Lurmi Range and Mandla District, near Berar Pani. Said to have a drop of 1,300 feet in a mile.

Madras.

Kolab R.—At Bargra near Jeypore; (Map 65 J 9). There is a site for power here, reached by a footpath of about 4 miles from the Jeypore ghat, at mile 58-0 on the road. Three falls exist of some 150 to 180 feet in the aggregate, but by utilizing a reservoir site higher up a fall of 800 feet may be obtainable. A sketch has been forwarded, but gaugings have not so far been reported. It is worth further examination as the tail waters could be used for irrigation on the Jeypore Plateau.

Machkand R.—The Duduma waterfall near latitude 18° 31½′, longitude 82° 31½′ (or 82° 28′ as shown on Atlas sheet 65. J on the ¼″ scale) has been measured and found to be of 510 feet. A float gauging made at the beginning of May, said to be at the driest time showed 104 cusecs with a coefficient of 0·5. The site is reached from Bugura, 22 miles off, by a footpath. A large reservoir site exists just above the falls, and it is probable that there are many others higher up still. No details are given as to capacity, but the site is certainly good for 5,000 c. h. p. or more. Vizagapatam, where the harbour works will require power, is 80 miles distant.

SGPI—S14—3 HESI—23-8-1919—5000.

ADDENDA TO LIST OF SITES.

Received after going to Press.

Assam.

Cachar.—In the North Cachar Hills, near Subong Tea Estate, it is stated that a valley could be dammed to form a lake in the Abong River. Other similar sites are mentioned near Loobah and Soonamganj; while the Kiang River is said to be worth investigation.

Bengal.

Tista River.—From the Tista Bridge upwards the fall is as follows:—

0 to 2⅝ miles	15 feet per mile.
2⅝ to 12⅝ „	18 „ „ „
12⅝ to 21⅝ „	32 „ „ „
21⅝ to 39⅝ „	43 „ „ „
39⅝ to 47⅞ „	255 „ „ „
47⅞ to 52⅛ „	228 „ „ „
52⅛ to 61⅝ „	413 „ „ „

Cold weather discharge not less than 1,250 cusecs in North Sikkim.

Bombay.

Bedti R.—Magod falls, near Yellapur (Map 48 J 9). The falls on the branch from the South, 4 miles above the junction, are 328 feet. Falls on the main river 3 miles above the junction are indicated, but not their height.

Ghatapraba R.—At Gokak (q. v.). There are said to be possibilities of extensions, if a new dam is built at Daddi (4″ topo. sheet 242 S. E. 4), and the rapids at Katabali (4″ topo. sheet 274 S. W. 1) are also mentioned.

Kanbargi; 3 miles North of Belgaum. A combined power and irrigation scheme is suggested, a drop of 400 feet being feasible.

Markandaya R.—There is a good waterfall on 4″ topo. sheet 274 N. E. 3.

Nagargali.—There is a perennial stream with a waterfall between Duggeli and Kirpoli, on 4″ topo. sheet 277 N. W. 4.

Sonda Nala.—Near Ibihalli, Sirsi Taluka. The falls are over 300 feet high. (Map 48 J 13; 14).

Burma.

Lilu Ch., tributary of Mon, near Paungseik.—A fall of 100 feet with perennial flow reported. Shwegyin Division.

Maisakhaing Ch. near Kyankpon.—Two falls of 50 and 75 feet reported, with perennial flow. Also, higher up, two falls of 40 and 100 feet known to the Karens as the Donwe and Kyaukoh Falls.

Pada Ch., near Khedo.—A fall of 100 feet reported with perennial flow. Shwegyin Division.

Central Provinces.

Gogra R.—There are rapids near Sohagpur.

Hasdo R.—A large perennial flow over rapids of 20 feet is found 10 miles North of the Railway.

TWENTY-FIFTH ANNUAL REPORT

OF THE

SANITARY COMMISSIONER

FOR

MADRAS,

1888.

WITH

APPENDIX

CONTAINING

VITAL STATISTICS OF THE GENERAL POPULATION.

MADRAS:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

[Price, *Rs.* 1-12-0.] 1889.

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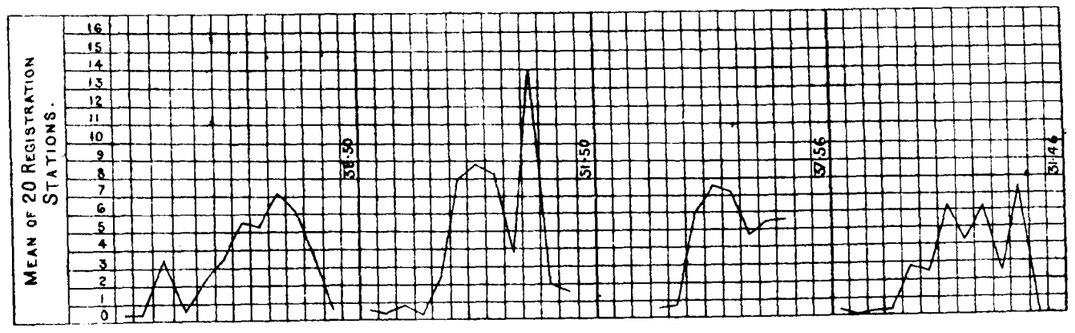
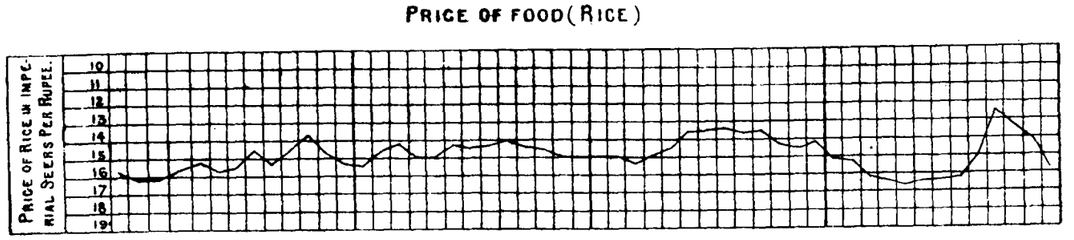
Godavari

Districts	Years.	Average of 10 years.											1886.												1887.												1888											
	Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct	Nov	Dec	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total

Rainfall

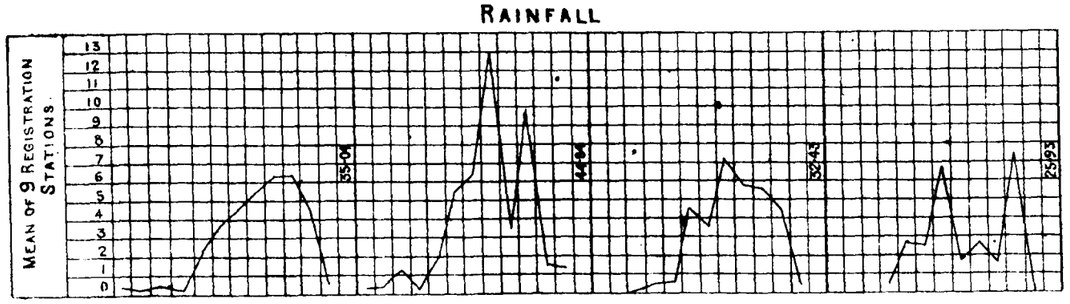


Price of food (Rice)



Kistna

Rainfall



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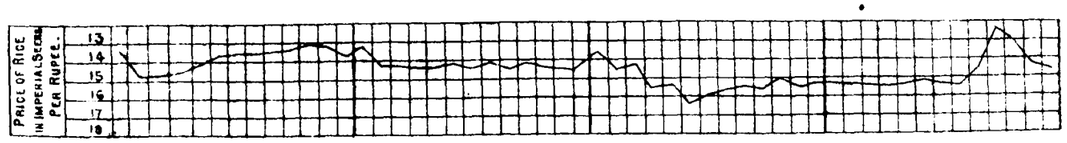


Photo-Zincographed in Central Survey Office, Madras.
1889

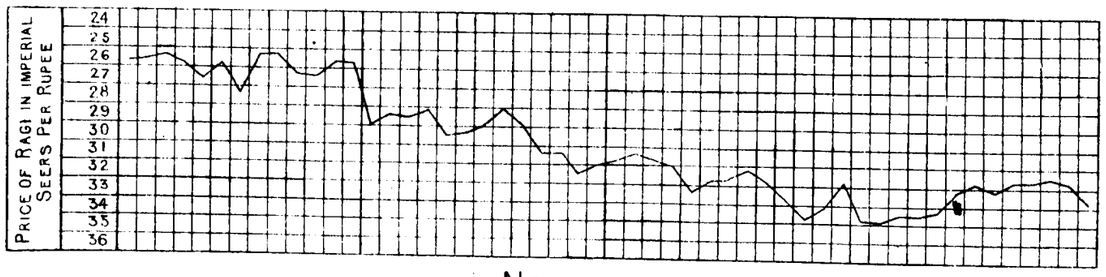
Diagram Showing the Rainfall and Price of food (Ragi) in the districts of North Arcot and Nellore for 3 years ending 1888 Compared with the Average of 10 years.

North Arcot

Districts	Years	Average of 10 years											1886												1887												1888											
	Months	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

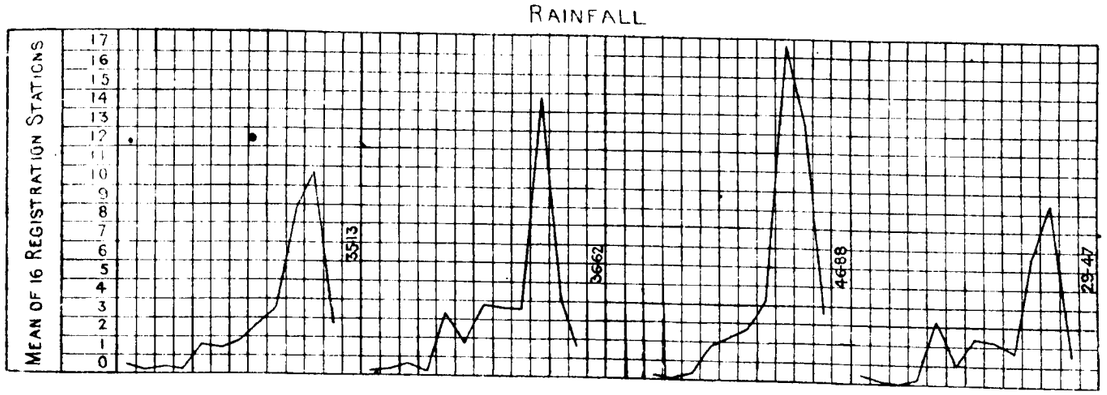
Rainfall

Price of food (Ragi)



Nellore

Rainfall



Price of food (Ragi)

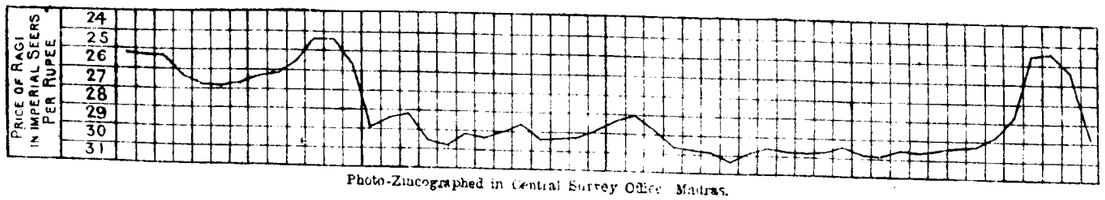


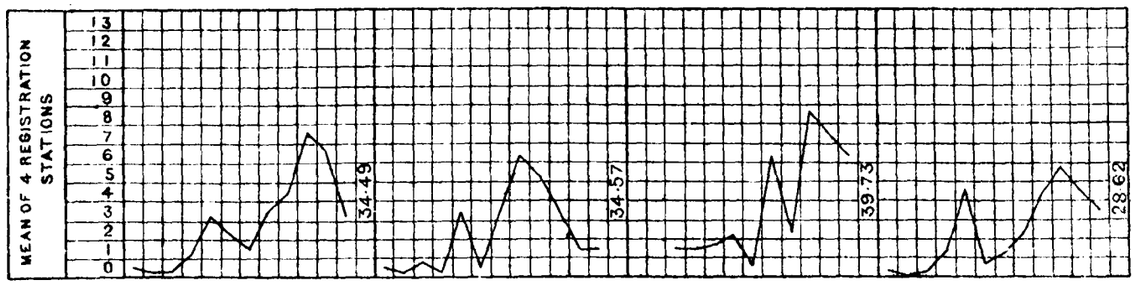
Photo-Zincographed in Central Survey Office Madras.
1889

DIAGRAM SHOWING THE RAINFALL AND PRICE OF FOOD (CUMBU) IN THE DISTRICT OF TRICHINOPOLY AND (RICE) IN THE DISTRICT OF TANJORE FOR 3 YEARS ENDING 1888 COMPARED WITH AVERAGE OF 10 YEARS

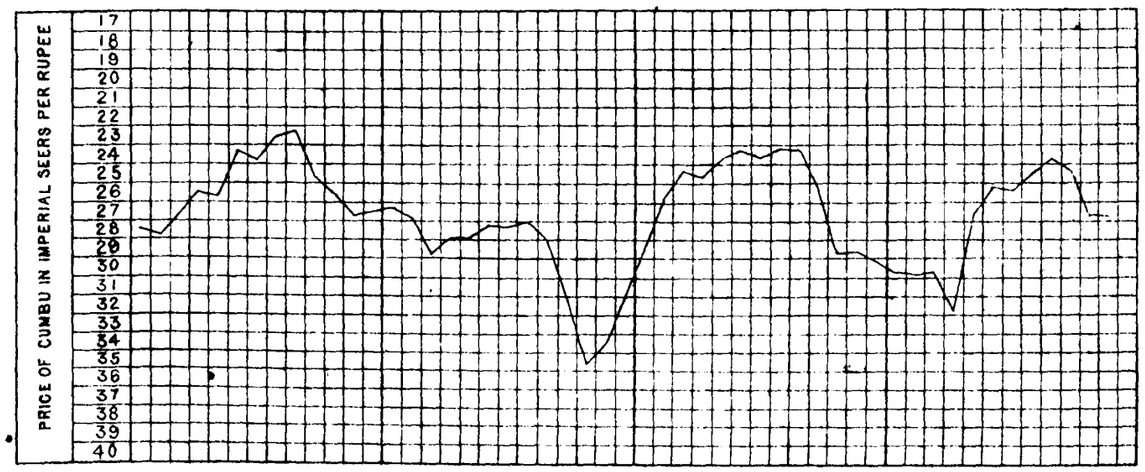
TRICHINOPOLY

DISTRICTS	YEARS	AVERAGE OF 10 YEARS												1886												1887												1888											
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL



PRICE OF FOOD (CUMBU)



TANJORE

RAINFALL

PRICE OF FOOD (RICE)

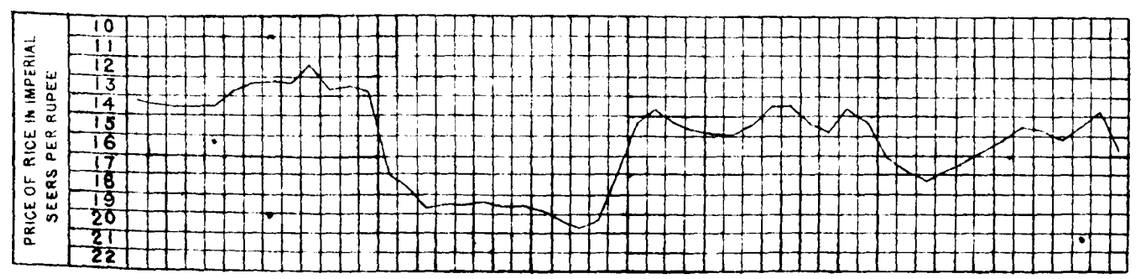


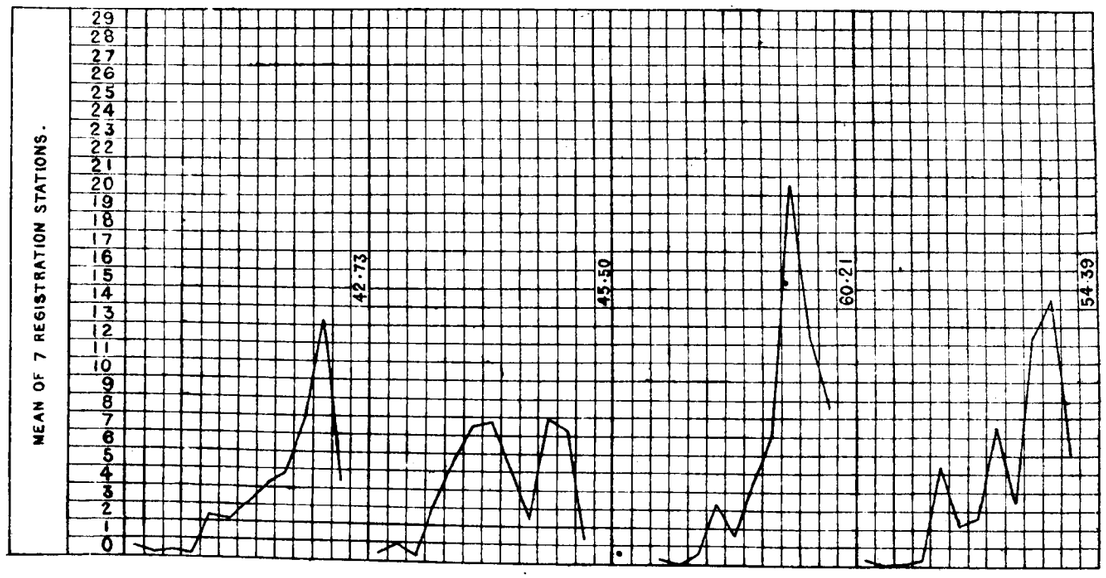
Photo-Zincographed in Central Survey Office, Madras.

Diagram Showing the Rainfall and Price of food (Rice) in the districts of Chingleput and Madras for 3 years ending 1888 Compared with average of 10 years

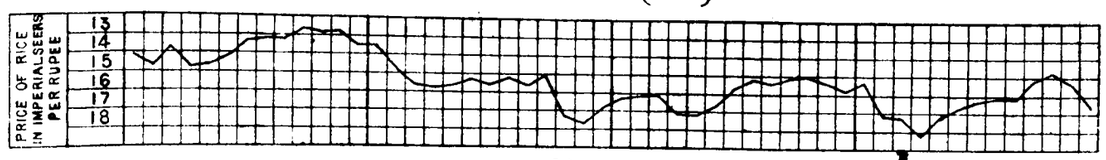
Chingleput.

Districts	Years	Average of 10 years												1886												1887												1888											
	Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total

Rainfall

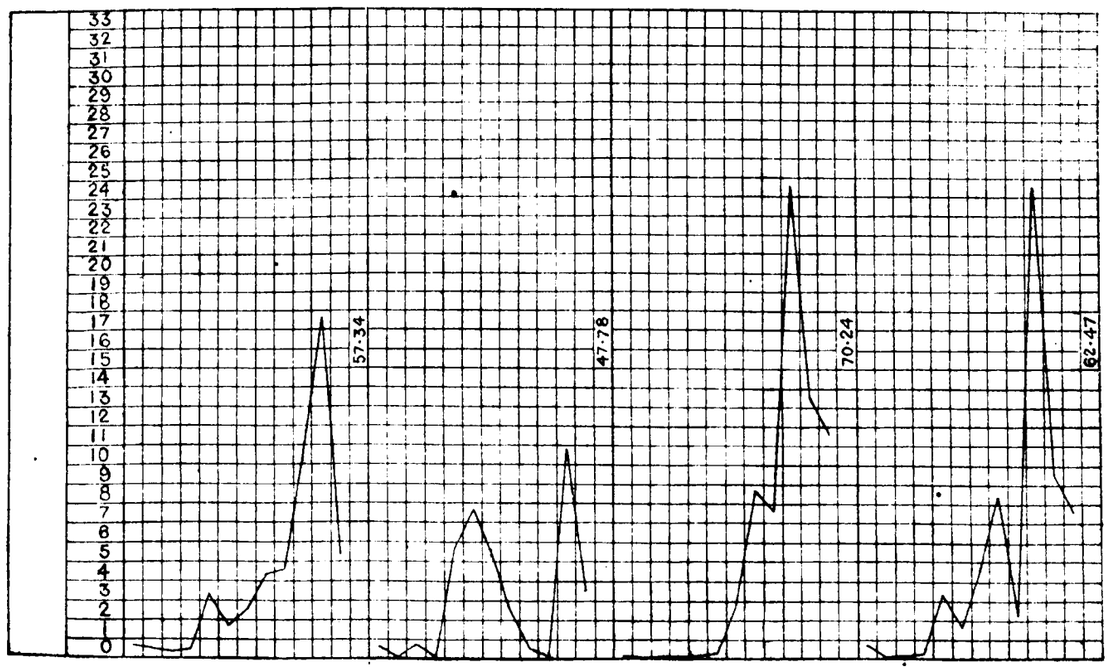


Price of food (Rice)



Madras

Rainfall



Price of food (Rice)

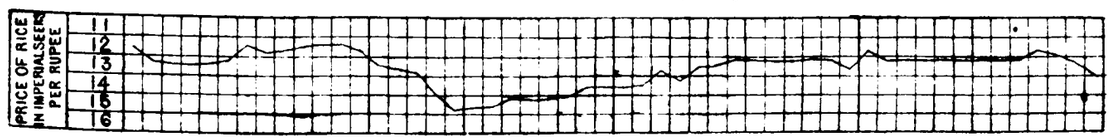
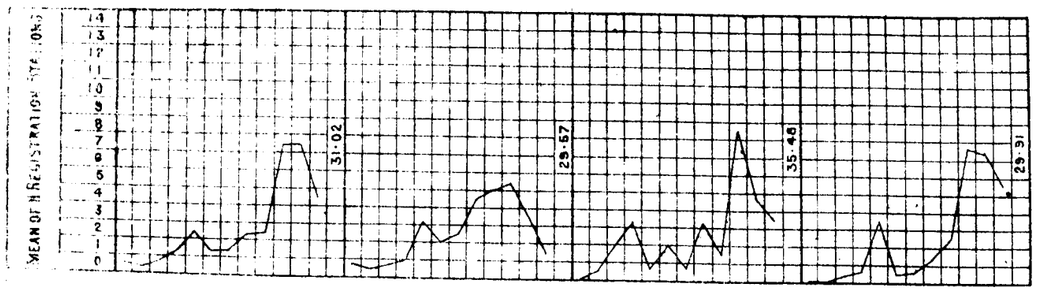


DIAGRAM SHOWING THE RAINFALL & PRICE OF FOOD (RAGI) IN THE DISTRICT OF MADURA & (CUMBU) IN THE DISTRICT OF TINNEVELLY 3 YEARS ENDING 1888, COMPARED WITH AVERAGE OF 10 YEARS.

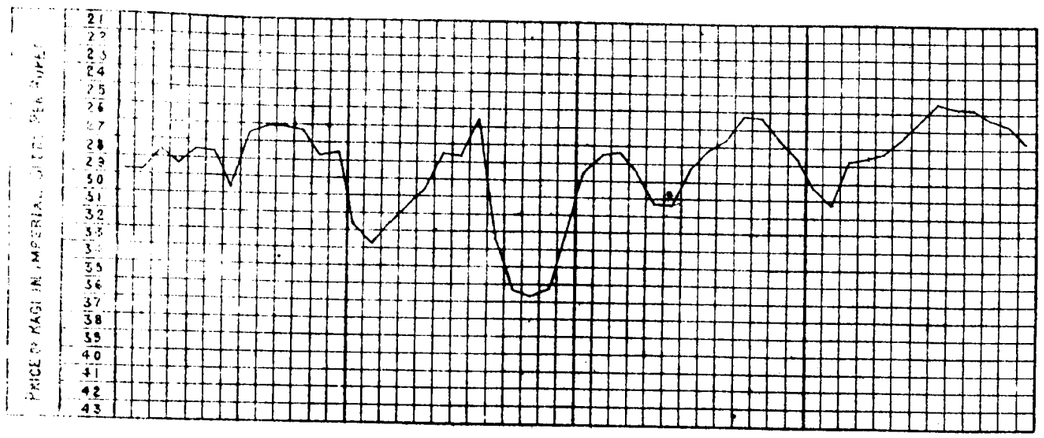
MADURA.

DISTRICTS	YEARS	AVERAGE OF 10 YEARS												1886												1887												1888											
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL

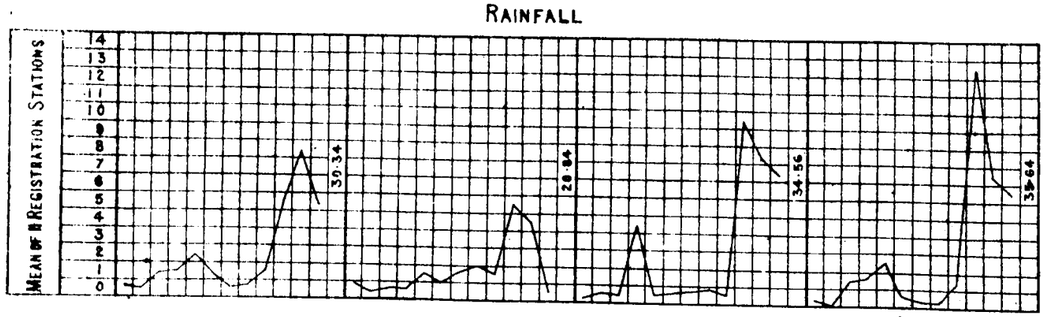


PRICE OF FOOD (RAGI)



TINNEVELLY.

RAINFALL



PRICE OF FOOD (CUMBU)

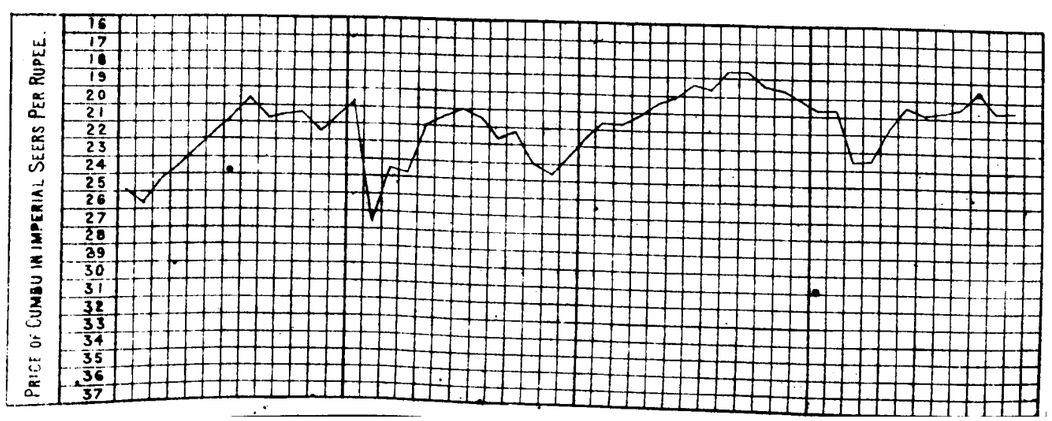


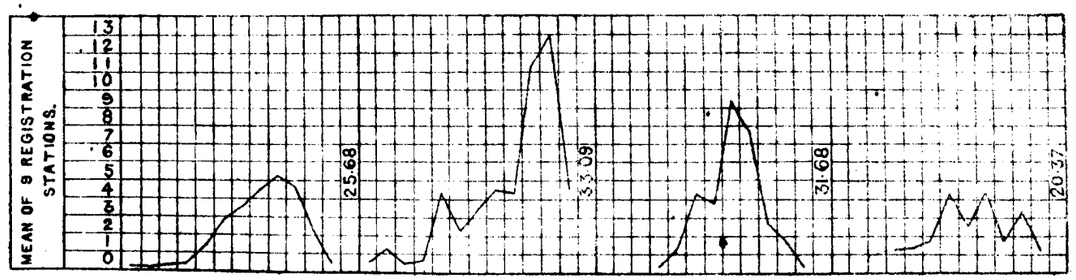
DIAGRAM SHOWING THE RAINFALL & PRICE OF FOOD (CUMBU) IN THE DISTRICTS OF KURNOOL & BELLARY

FOR 3 YEARS ENDING 1888 COMPARED WITH AVERAGE OF 10 YEARS

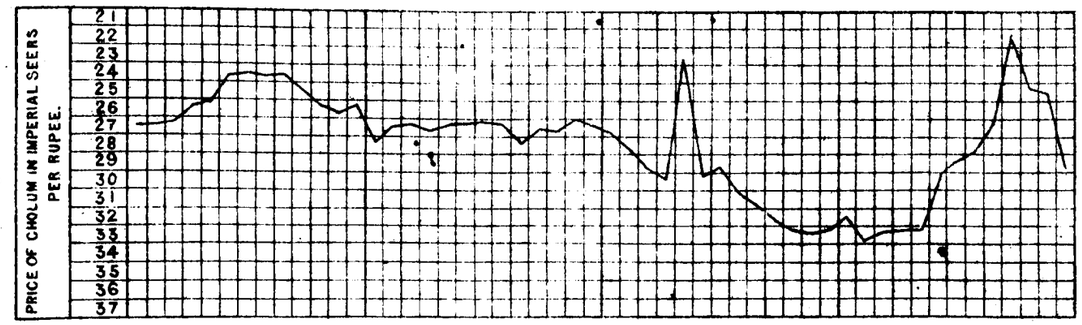
KURNOOL.

DISTRICTS	YEARS	AVERAGE OF 10 YEARS.												1886												1887												1888											
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN	JUL	AUG.	SEP.	OCT	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN	JUL	AUG.	SEP.	OCT	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN	JUL	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL

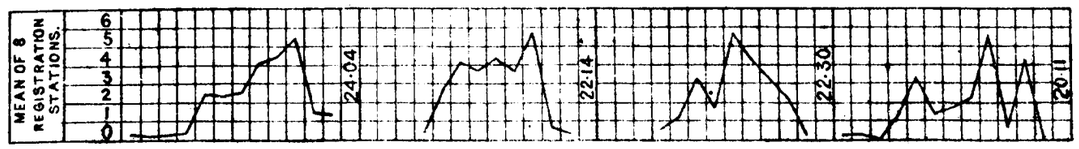


PRICE OF FOOD (CHOLUM)



BELLARY.

RAINFALL



PRICE OF FOOD (CHOLUM)

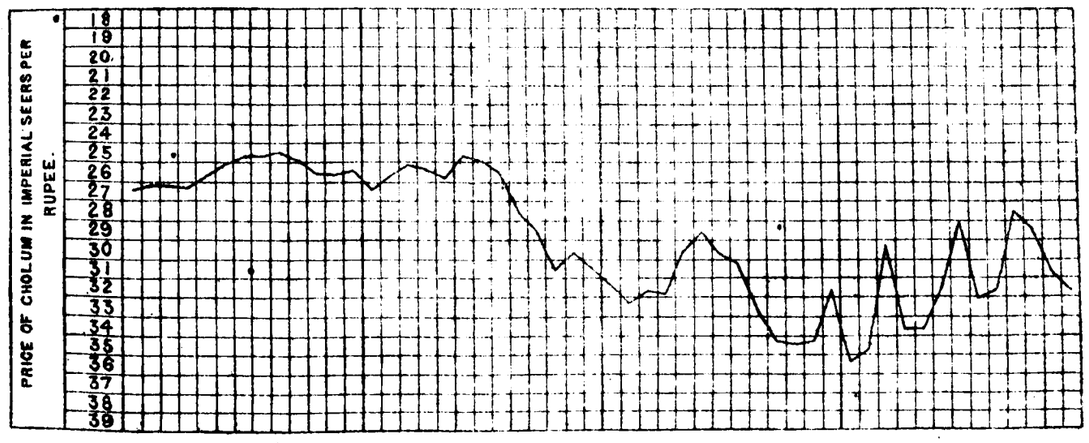


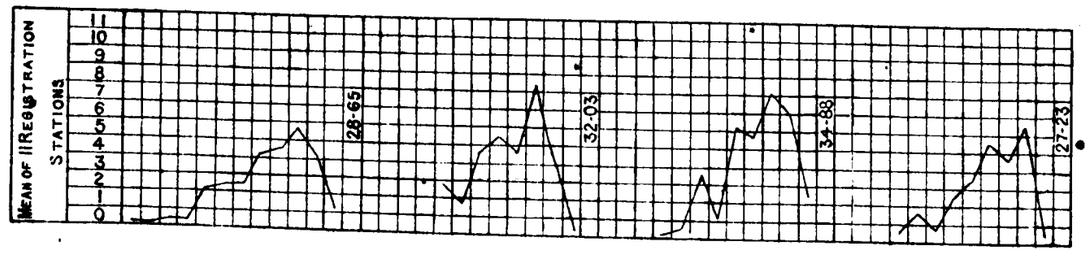
Photo-Zincographed in Central Survey Office, Madras.
1889

DIAGRAM SHOWING THE RAINFALL AND PRICE OF FOOD (CHOLUM) IN THE DISTRICTS OF CUDDAPAH AND ANANTAPUR FOR 3 YEARS ENDING 1888 COMPARED WITH AVERAGE OF 10 YEARS

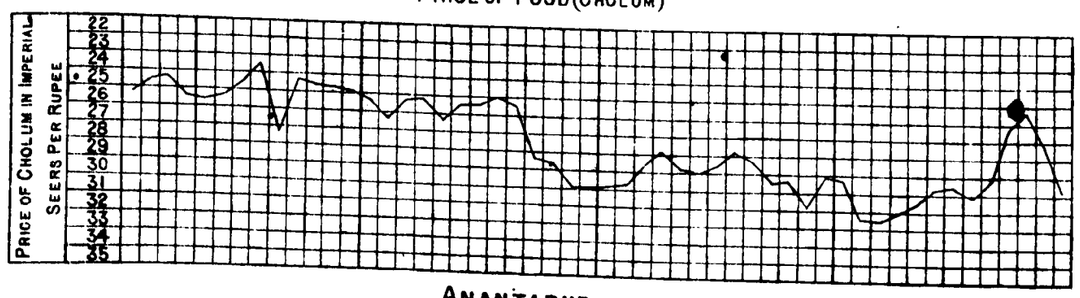
CUDDAPAH

DISTRICTS	YEARS	AVERAGE OF 10 YEARS										1886										1887										1888									
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL

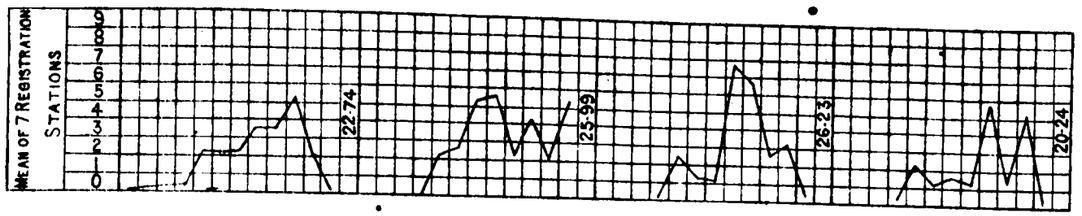


PRICE OF FOOD (CHOLUM)



ANANTAPUR

RAINFALL



PRICE OF FOOD (CHOLUM)

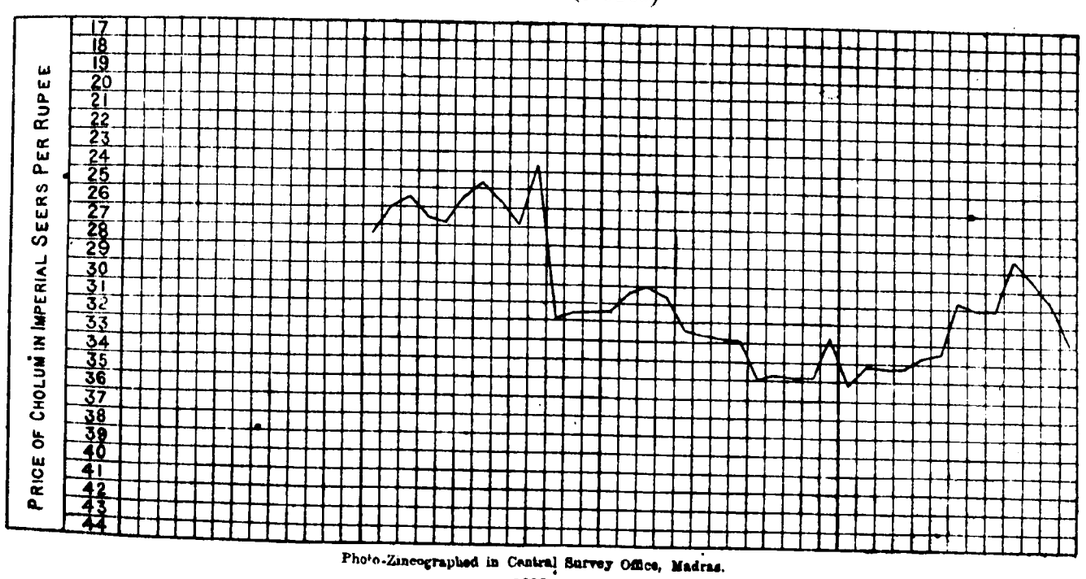


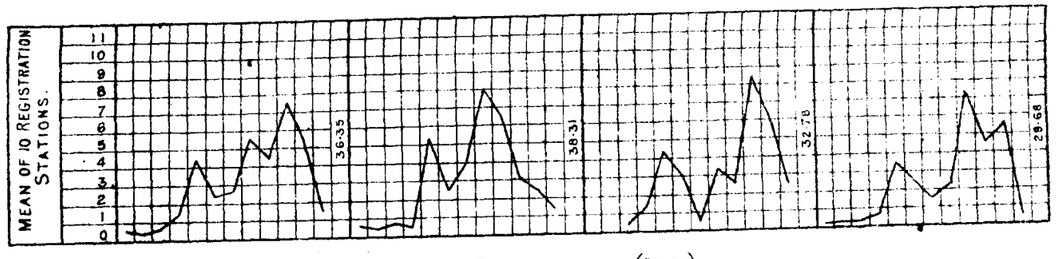
Photo-Zincographed in Central Survey Office, Madras.
1889

DIAGRAM SHOWING THE RAINFALL AND PRICE OF FOOD (RAGI) IN THE DISTRICT OF SALEM AND CUMBU IN THE DISTRICT OF SOUTH ARCOT. 3 YEARS ENDING 1888, COMPARED WITH AVERAGE OF 10 YEARS.

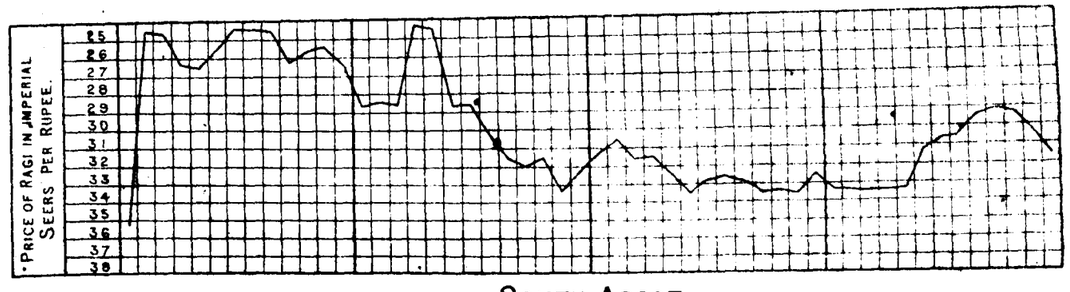
SALEM.

DISTRICTS	YEARS	AVERAGE OF 10 YEARS.												1886												1887												1888.											
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB	MAR	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL

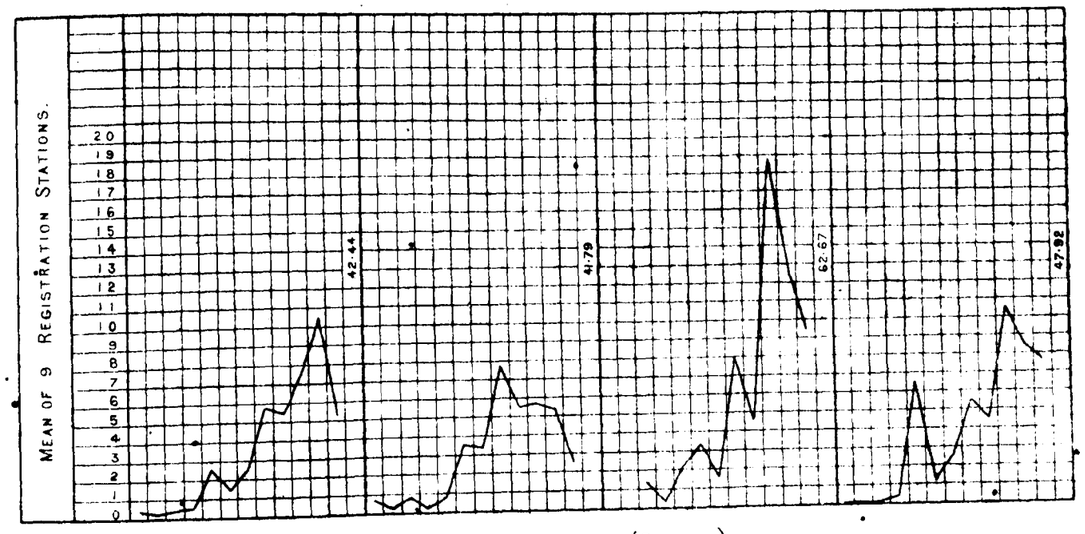


PRICE OF FOOD (RAGI)



SOUTH ARCOT.

RAINFALL



PRICE OF FOOD (CUMBU)

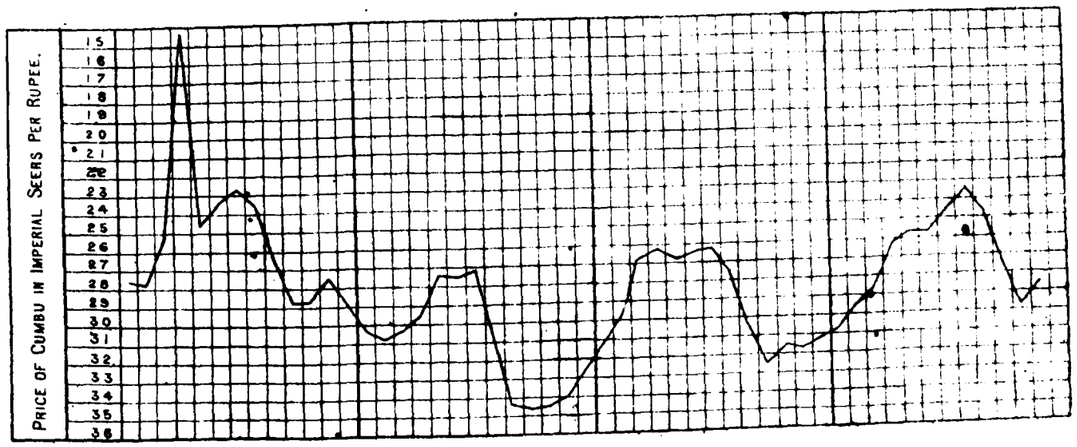
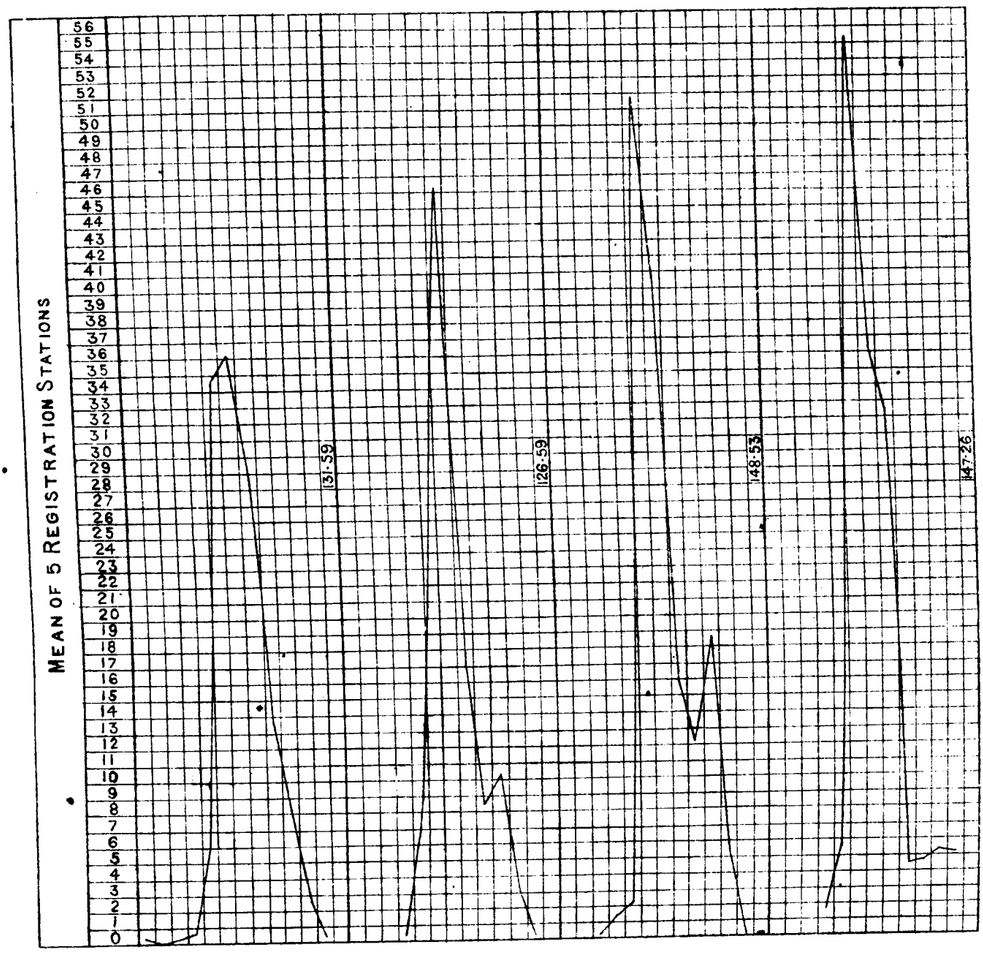


Diagram Showing the Rainfall and Price of Food (Rice) in the Districts of South Canara and Malabar for 3 Years ending 1887 Compared with Average of 10 Years

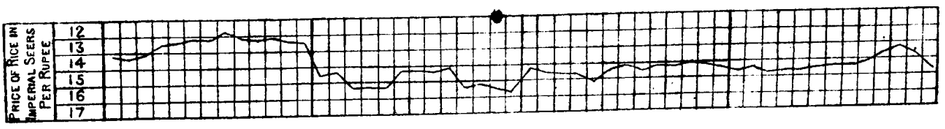
South Canara

Districts	Years	Average of 10 years												1886												1887												1888											
	Months	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	JAN.	FEB.	MAR.	APR.	MAY	JUN	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

Rainfall



Price of Food (Rice)



Malabar

Rainfall

Price of Food (Rice)

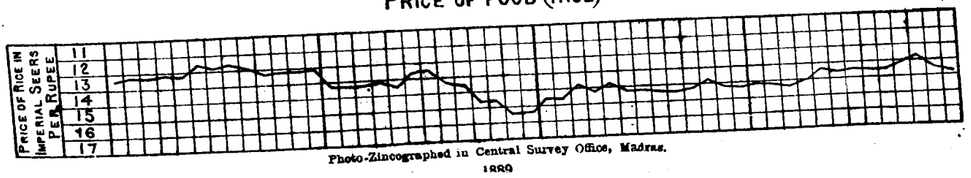


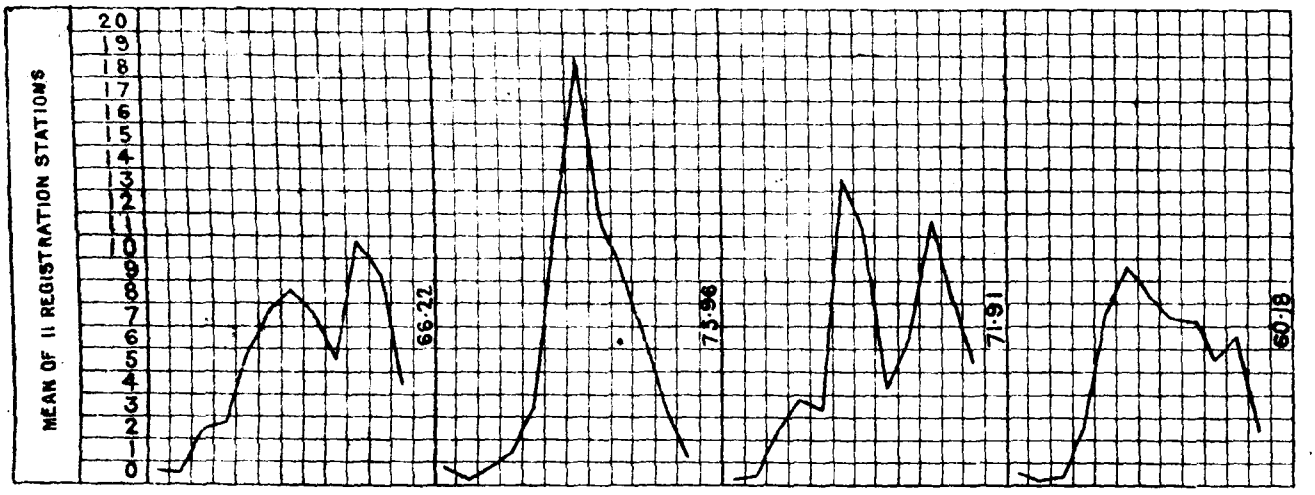
Photo-Zincographed in Central Survey Office, Madras.
1889

DIAGRAM SHOWING THE RAINFALL & PRICE OF FOOD (RICE) IN THE DISTRICT OF NILGIRIS & (CUMBU) IN THE DISTRICT OF COIMBATORE FOR 3 YEARS ENDING 1888, COMPARED WITH AVERAGE OF 10 YEARS

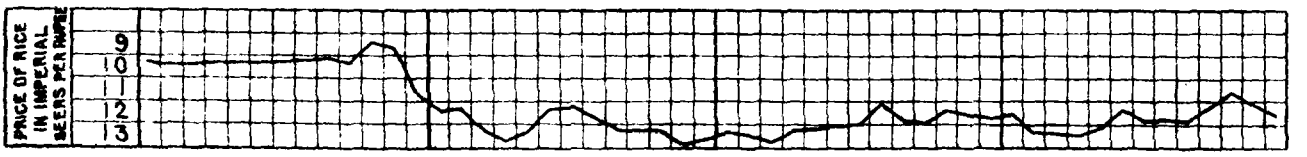
NILGIRIS

DISTRICTS	YEARS	AVERAGE OF 10 YEARS												1886												1887												1888											
	MONTHS	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL

RAINFALL

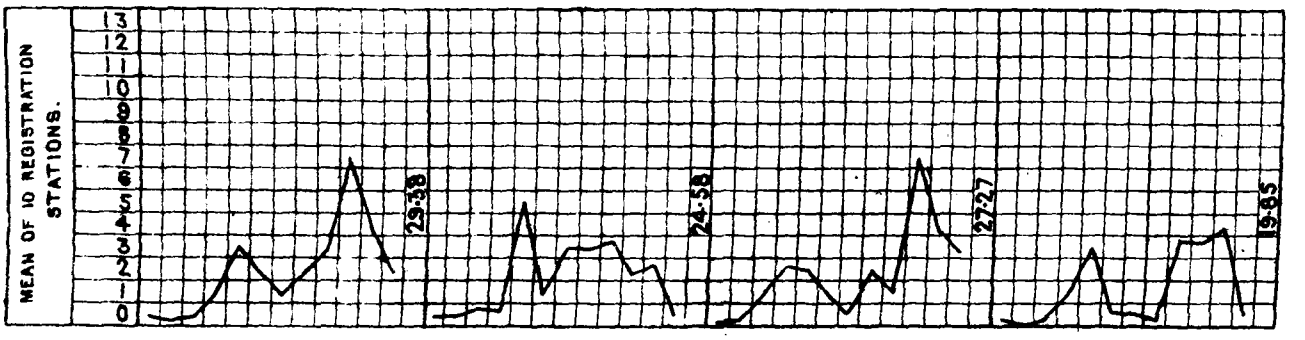


PRICE OF FOOD (RICE)



COIMBATORE

RAINFALL



PRICE OF FOOD (CUMBU)

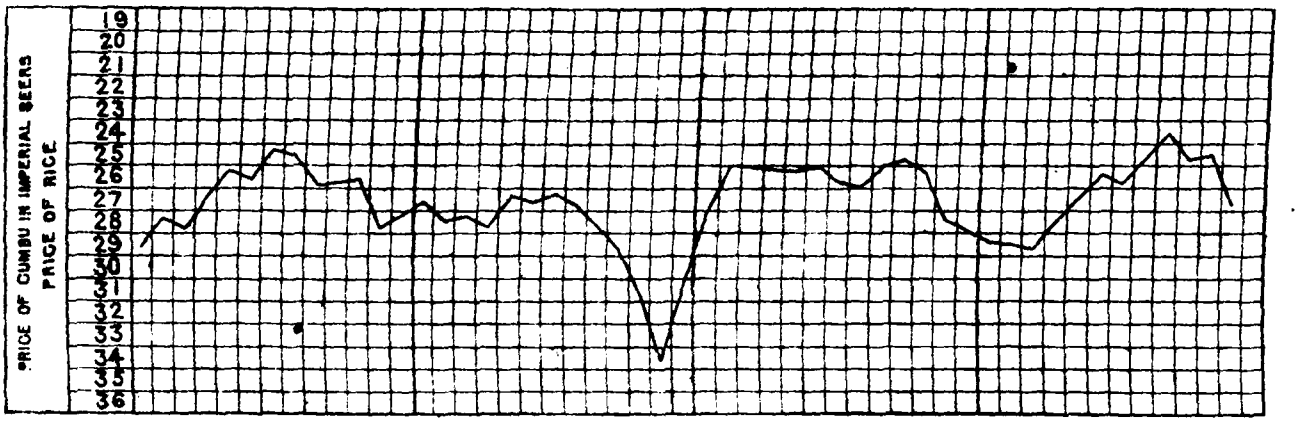


Photo-Zincographed in Central Survey Office, Madras.
1889

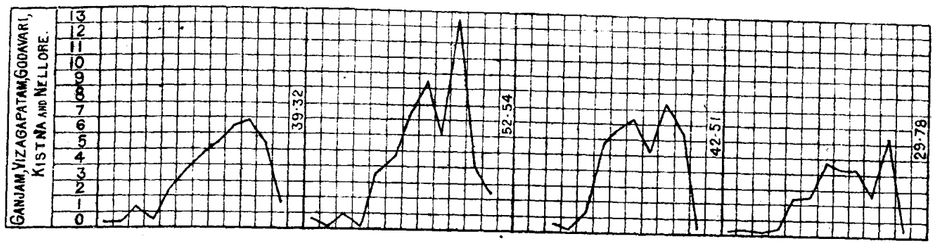
Table contrasting the Monthly Rainfall in the Madras Presidency during 1886, 1887 *and* 1888, *with the average of previous ten years ending* 1885, *exclusive of* 1876.

Districts.		Number of places of observation.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Total.	
			Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.
Anantapur	Average of 9 years.	11	0·06	0·2	0·09	0·2	0·24	0·5	0·23	0·6	2·49	3·7	2·29	4·5	2·26	4·9	3·65	6·9	3·77	6·3	5·33	8·0	2·08	4·1	0·25	0·8	22·74	40·7
	1886		...	...	...	...	...	...	0·16	0·6	2·05	4·3	2·31	4·8	5·08	8·7	6·60	7·1	2·08	5·3	4·94	6·5	2·21	1·6	0·56	1·5	25·99	40·4
	1887		...	...	...	...	...	...	0·08	0·5	2·50	3·7	1·55	4·5	1·16	4·0	7·76	9·3	6·87	7·2	2·79	5·8	3·04	4·9	0·48	1·6	26·23	41·5
	1888		...	...	...	...	...	...	1·39	1·7	2·10	2·6	1·12	1·6	1·74	4·8	1·33	3·9	5·98	8·6	1·43	2·0	5·12	5·1	0·03	0·1	20·24	30·4
Bellary ...	Average of 9 years.	11	0·08	0·1	0·02	0·1	0·16	0·5	0·55	1·7	2·41	4·5	2·34	5·7	2·77	7·5	4·00	8·7	4·50	8·2	5·44	8·6	1·51	2·7	0·26	0·5	24·04	48·8
	1886		...	...	...	...	...	...	0·19	0·5	2·30	5·1	4·08	7·4	2·74	9·6	3·16	6·5	2·95	6·5	5·60	7·0	0·87	1·7	0·25	1·1	22·14	45·4
	1887		...	...	...	...	...	...	0·78	2·2	1·02	2·3	3·45	7·0	1·40	6·6	5·88	9·3	4·31	8·5	3·13	6·3	2·16	4·1	0·17	0·8	22·30	47·1
	1888		0·06	0·1	0·08	0·2	...	...	1·09	1·9	3·05	4·8	1·26	3·9	1·83	8·3	2·42	5·9	5·49	9·9	0·81	2·5	4·02	6·4	...	...	20·11	43·9
Canara ...	Average of 10 years	9	0·12	0·3	...	...	0·06	0·2	0·84	2·3	6·00	7·7	34·83	26·8	36·03	29·0	28·86	26·8	13·50	21·3	8·10	13·6	2·66	5·3	0·59	1·4	131·59	134·7
	1886		...	...	...	...	...	...	0·21	0·7	7·43	13·1	32·62	27·3	46·91	28·7	17·03	26·7	8·62	18·0	10·46	18·8	3·68	3·1	0·23	0·7	126·59	137·1
	1887		...	...	...	...	0·06	0·6	1·62	4·1	2·09	4·7	51·89	27·3	40·14	28·5	16·15	23·8	12·35	15·8	18·61	14·4	5·58	9·3	0·04	0·4	148·53	130·9
	1888		0·04	0·2	...	...	...	...	1·98	4·0	5·97	10·5	55·33	28·2	36·24	30·1	32·68	30·6	4·77	12·8	4·81	9·9	5·32	8·0	0·12	0·7	147·26	135·0
Chingleput.	Average of 10 years	10	0·64	1·3	0·14	0·1	0·23	0·3	0·16	0·2	2·12	1·9	2·06	4·4	3·00	6·4	4·15	9·5	4·83	6·8	7·92	9·6	13·02	11·1	4·46	4·9	42·73	56·5
	1886		0·19	0·4	...	...	0·77	0·9	...	...	5·52	5·4	7·47	9·8	7·63	8·2	5·50	8·4	2·40	5·9	8·04	12·1	7·00	8·4	1·98	4·4	45·60	63·9
	1887		...	...	...	...	0·23	0·7	...	...	0·66	0·9	3·34	6·1	1·88	5·3	4·84	8·3	7·08	8·2	20·75	11·8	12·54	14·1	8·89	9·4	60·21	64·8
	1888		0·14	0·5	...	...	...	...	0·13	0·4	5·19	3·8	2·04	3·8	2·85	6·7	7·81	10·0	3·50	5·9	12·26	13·0	14·47	12·4	6·00	4·5	54·39	61·0
Coimbatore.	Average of 10 years	16	0·21	0·5	0·03	0·1	0·55	1·8	1·30	2·5	3·56	6·7	2·38	4·6	1·52	5·0	2·35	5·4	3·18	5·1	7·46	11·2	4·47	8·0	2·37	5·6	29·38	56·5
	1886		0·02	0·2	...	...	0·34	0·4	0·49	1·2	6·53	9·4	1·16	3·4	3·36	6·4	3·45	7·6	3·87	8·7	2·22	5·0	2·77	4·8	0·37	1·5	24·58	48·6
	1887		0·04	0·1	0·25	0·2	1·19	1·8	2·86	3·3	2·57	4·9	1·40	4·6	0·60	2·5	2·43	3·9	1·48	3·1	7·25	11·6	4·12	8·3	3·08	6·1	27·27	50·4
	1888		0·02	0·2	...	0·1	0·21	0·5	1·74	3·5	3·43	6·5	0·95	3·1	0·49	2·1	0·47	1·8	3·99	6·8	3·90	7·3	4·03	8·6	0·62	2·1	19·85	42·6
Cuddapah ...	Average of 10 years	14	0·07	0·2	0·07	0·2	0·35	0·6	0·37	0·7	2·07	3·3	2·58	4·8	2·61	4·7	4·28	7·9	4·71	7·3	5·59	8·0	4·79	5·7	1·16	1·6	28·65	45·0
	1886		...	...	...	...	0·26	0·4	...	..	3·01	5·1	1·47	4·1	4·43	8·2	5·73	6·9	4·66	5·4	8·29	8·5	3·39	2·8	0·79	1·3	32·03	42·7
	1887		...	...	...	...	...	...	0·06	0·1	0·80	1·7	3·16	5·7	1·21	3·2	6·26	8·9	5·89	6·6	8·01	10·8	7·07	11·5	2·42	4·6	34·88	53·1
	1888		...	...	...	...	...	...	0·75	1·4	1·70	2·9	0·85	2·9	2·66	6·6	3·44	5·6	5·66	8·1	4·69	6·1	6·80	7·5	0·68	1·3	27·23	42·4
Ganjam ...	Average of 10 years	19	0·21	0·5	0·53	1·0	0·63	1·4	0·87	2·2	3·18	5·2	4·84	7·4	6·52	11·3	7·32	11·8	8·12	11·4	6·54	7·5	4·23	3·8	2·32	1·8	45·31	65·3
	1886		0·10	0·3	0·03	0·2	1·40	4·1	0·16	0·5	3·38	6·3	4·64	9·2	8·47	14·7	10·13	15·9	11·12	15·2	15·68	18·6	5·88	6·9	4·52	3·1	65·51	95·0
	1887		0·04	0·3	...	...	0·89	2·2	0·50	1·3	1·82	3·6	6·00	8·3	8·65	13·4	9·42	14·3	5·22	9·2	7·01	8·3	7·01	8·3	...	...	46·56	69·2
	1888		0·29	1·2	0·67	1·9	0·12	0·4	0·25	1·0	0·37	1·5	2·33	6·0	3·28	6·9	7·42	11·2	4·48	8·0	1·96	3·2	5·83	8·3	0·09	0·3	27·09	49·9
Godávari ...	Average of 10 years	21	0·18	0·2	0·19	0·3	3·27	0·4	0·29	0·4	2·10	3·8	3·91	5·5	5·33	8·2	5·30	7·7	7·09	8·4	6·10	6·7	3·98	3·2	0·76	0·5	38·50	45·3
	1886		...	...	...	...	1·03	1·3	...	...	2·68	3·8	8·07	8·2	8·99	12·0	8·40	8·8	3·86	4·8	15·04	15·2	2·20	3·1	1·23	2·6	51·50	59·8
	1887		...	...	...	...	...	..	0·46	0·8	0·95	1·7	6·03	5·0	7·63	9·3	7·21	10·9	4·57	6·5	5·39	7·6	5·32	4·6	...	...	37·56	46·4
	1888		0·03	0·1	...	...	0·02	0·1	0·22	0·8	2·82	4·0	2·57	5·0	6·09	8·2	4·12	8·2	6·06	6·4	2·35	2·8	7·18	6·5	...	...	31·46	42·1

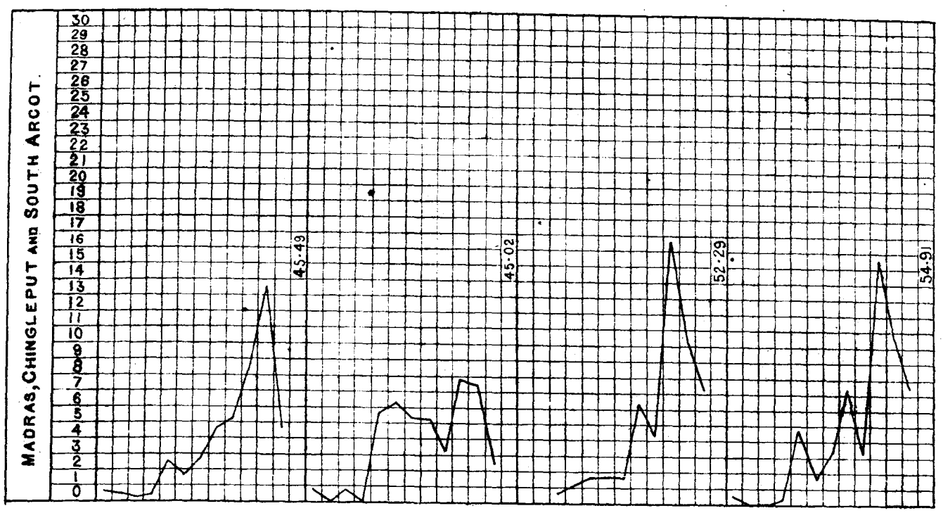
Diagram Showing the Rainfall in Different Groups of Districts (Northern, Eastern, South Eastern, Central and Western) of the Madras Presidency during 1888 Compared with Previous Years.

Districts	Inches of Rain	Average of 10 years												1886												1887												1888											
		Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total

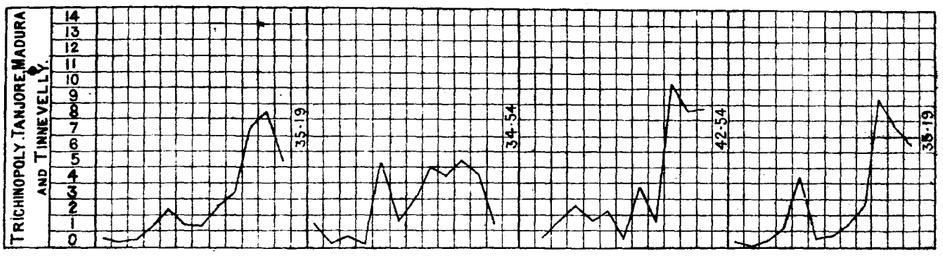
Northern.



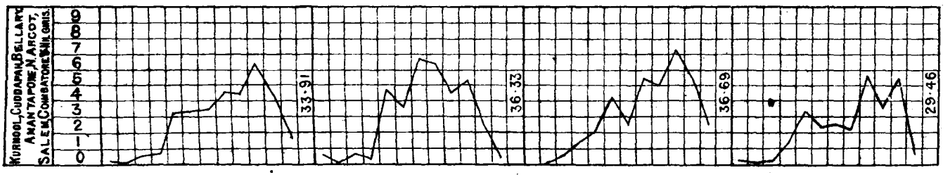
Eastern.



South Eastern.



Central.



Western.

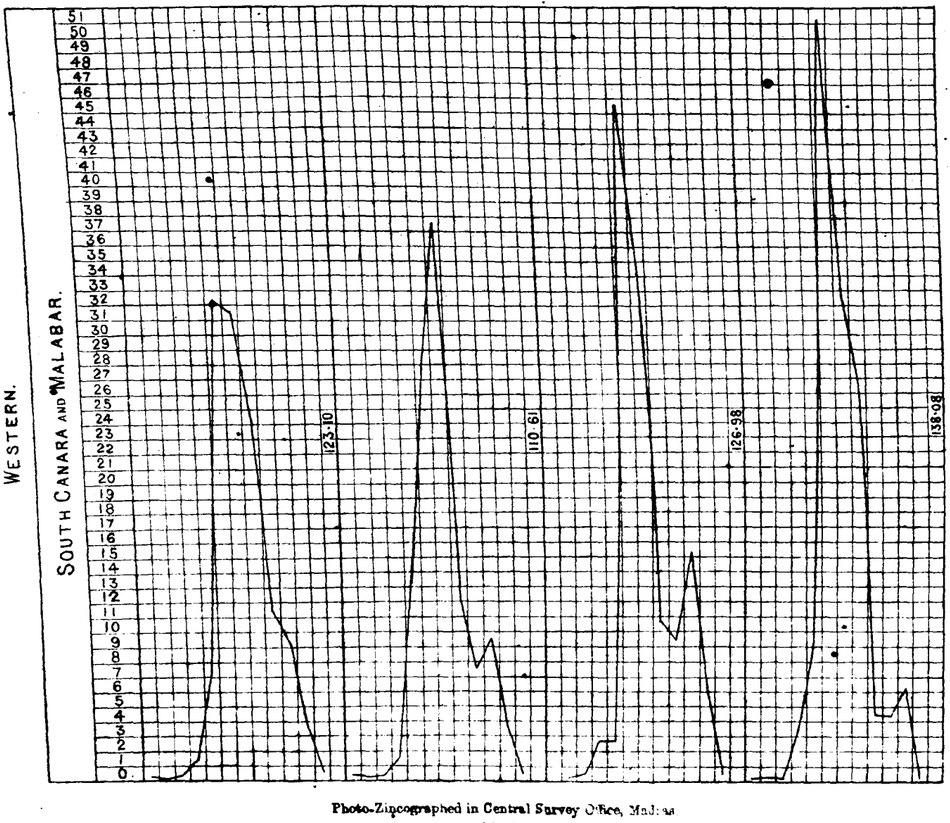
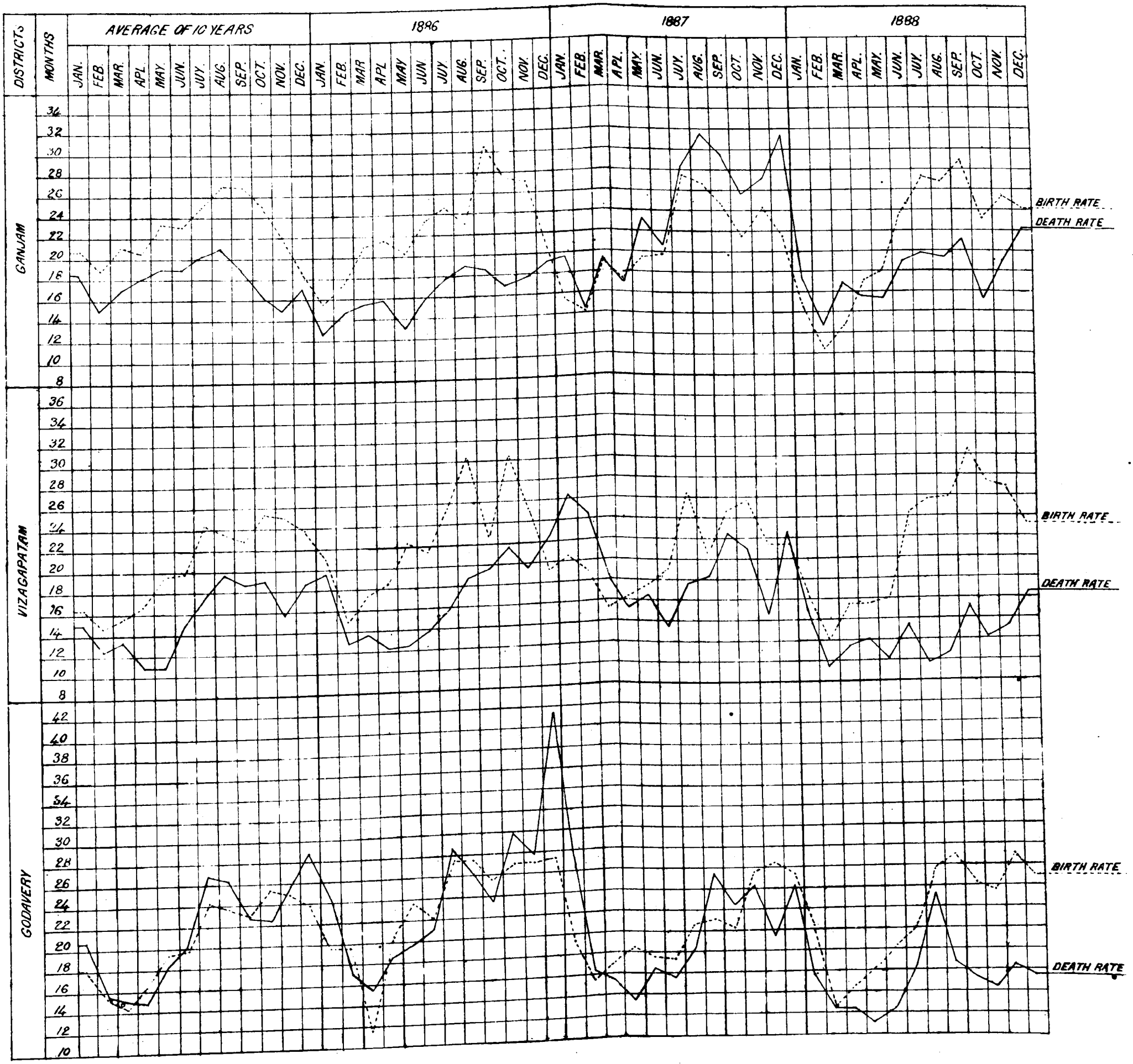


Photo-Zincographed in Central Survey Office, Madras
1889

Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years



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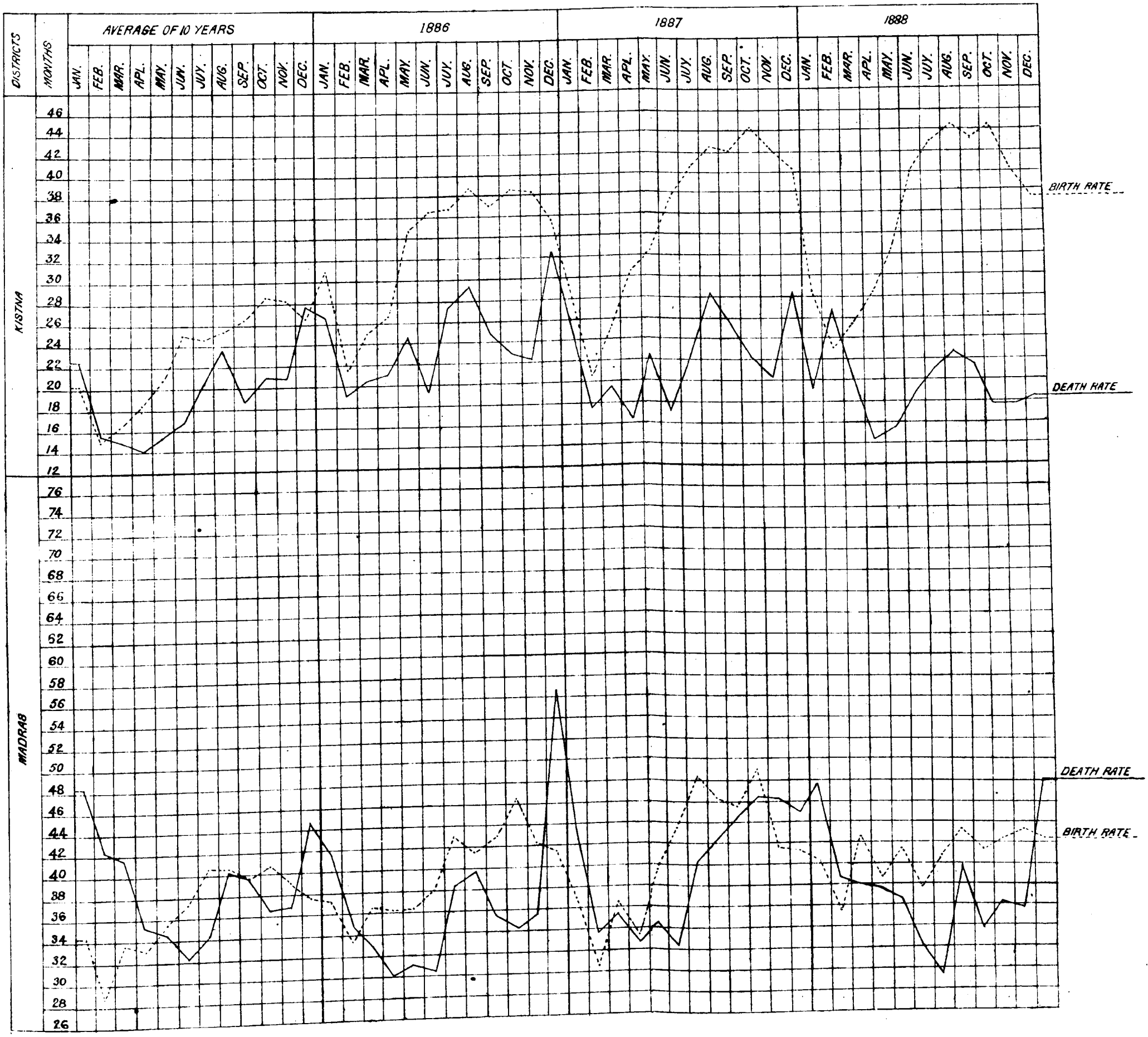
– 1889.

Table contrasting the Monthly Rainfall in the Madras Presidency during 1886, 1887 *and* 1888, *with the average of previous ten years ending* 1885, *exclusive of* 1876—continued.

Districts.		Number of places of observation.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Total.	
			Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.
Kistna	Average of 10 years	11	0·20	0·5	0·10	0·2	0·58	0·8	0·27	0·5	2·14	3·1	3·93	6·9	4·52	9·1	5·82	9·9	6·07	9·7	6·30	8·3	4·52	4·4	0·59	0·9	35·04	54·3
	1886		...	...	...	...	1·16	1·6	...	...	2·15	4·3	5·17	7·4	6·43	10·6	13·02	13·2	3·69	6·6	9·72	14·9	1·52	2·6	1·98	3·3	44·84	64·5
	1887		...	...	...	...	0·01	0·1	0·07	0·2	0·35	1·4	5·42	6·2	3·80	8·7	7·32	11·7	5·85	7·6	5·56	9·5	4·02	6·5	0·03	0·2	32·43	52·1
	1888		...	...	...	...	...	...	0·49	0·7	2·89	3·2	2·74	5·2	6·82	9·2	1·62	5·0	2·60	5·5	1·55	3·5	7·22	8·9	...	...	25·93	41·2
Kurnool	Average of 10 years	13	0·04	0·1	0·04	0·1	0·30	0·5	0·33	0·8	1·58	2·8	2·99	5·9	3·53	8·1	4·48	9·4	5·03	8·9	4·79	7·7	2·15	3·6	0·42	0·7	25·68	48·6
	1886		...	...	...	...	0·26	0·6	20·18	...	1·72	4·1	3·36	8·7	6·25	14·2	6·97	10·5	2·36	5·1	10·96	10·1	0·79	1·6	0·42	1·8	33·09	56·7
	1887		...	...	...	...	...	...	...	0·7	1·20	1·8	4·62	7·2	3·97	9·0	9·32	12·2	7·80	9·8	2·56	5·9	1·77	5·3	0·26	0·6	31·68	52·5
	1888		...	...	...	...	...	...	1·05	1·9	1·15	2·5	1·88	4·5	4·07	10·2	2·59	5·3	4·40	6·4	1·85	2·9	3·37	6·9	0·01	0·2	20·37	40·8
Madras	Average of 10 years	1	0·72	2·4	0·54	0·3	0·25	0·8	0·38	0·7	3·36	2·6	1·80	8·8	2·77	12·3	4·23	14·4	4·54	12·0	10·06	14·4	17·54	15·5	5·15	9·1	51·34	93·3
	1886		0·52	1·0	...	...	0·36	4·0	...	...	5·78	9·0	7·67	17·0	5·61	14·0	2·57	15·0	0·85	7·0	10·09	20·0	11·08	13·0	3·25	9·0	47·78	109·0
	1887		1·01	1·0	...	...	0·30	2·0	...	...	0·06	2·0	0·63	9·0	2·99	11·0	8·67	10·0	7·70	13·0	24·36	18·0	13·57	19·0	11·95	15·0	70·24	100·0
	1888		0·72	4·0	...	...	...	...	0·13	1·0	3·17	2·0	1·93	8·0	4·63	18·0	8·09	16·0	2·31	12·0	24·27	17·0	9·53	21·0	7·09	7·0	62·47	106;0
Madura	Average of 10 years	20	0·52	1·1	0·39	0·4	0·73	1·3	1·31	2·2	2·37	3·8	1·04	2·4	1·16	2·4	2·05	4·3	2·38	4·5	7·31	10·5	7·30	10·4	4·46	5·7	31·02	49·0
	1886		0·92	1·8	0·07	0·3	0·66	1·3	1·04	1·5	3·21	5·9	1·94	4·9	2·73	5·6	4·55	7·1	5·04	8·1	5·23	8·0	3·20	5·2	0·98	2·5	29·57	52·2
	1887		...	...	0·44	0·5	2·00	1·9	3·51	4·0	0·90	2·1	1·99	3·6	0·51	1·7	3·29	6·2	1·24	3·5	8·32	13·6	5·81	9·4	7·47	10·8	35·48	57·3
	1888		0·02	0·2	...	...	0·16	0·7	0·92	2·5	3·31	6·8	0·45	2·0	0·64	1·8	1·29	3·3	2·47	5·9	7·70	9·8	7·24	11·6	5·71	6·6	29·91	51·2
Malabar	Average of 10 years	14	0·17	0·3	0·08	0·3	0·74	1·5	2·50	4·7	8·31	9·7	30·08	24·9	27·65	26·4	19·17	22·0	9·42	16·0	10·15	14·9	5·18	8·7	1·21	2·9	114·66	132·3
	1886		0·03	0·1	...	...	0·01	0·1	2·10	3·0	13·03	15·3	24·69	27·4	27·69	26·4	7·64	18·6	6·62	15·2	8·32	17·4	3·68	6·3	0·83	1·2	94·64	131·0
	1887		...	...	0·06	0·4	0·69	2·0	3·45	7·6	3·37	7·7	39·48	26·5	26·35	26·4	5·76	14·8	5·94	12·7	11·7	16·0	7·28	11·2	1·33	3·1	105·50	128·4
	1888		...	...	0·09	0·4	0·06	0·2	4·41	4·3	12·07	14·2	46·79	28·3	29·27	29·6	20·18	27·9	4·61	10·0	4·39	9·6	6·95	9·1	0·12	0·4	128·94	134·0
Nellore	Average of 10 years	16	0·40	0·7	0·08	0·1	0·31	0·5	0·22	0·5	1·63	1·6	1·53	3·6	1·93	4·8	2·89	5·8	3·42	6·2	8·99	8·4	10·78	7·9	2·95	3·3	35·13	43·4
	1886		0·03	0·1	...	...	0·32	0·5	0·07	0·1	3·06	4·8	1·84	4·1	3·80	7·6	3·65	5·4	3·54	5·4	14·57	13·1	4·13	5·6	1·61	2·9	36·62	49·6
	1887		...	...	...	...	0·03	0·1	...	...	0·54	0·7	1·92	3·5	2·04	4·6	2·81	4·9	4·31	6·8	17·60	13·1	13·65	14·1	3·98	4·7	46·88	52·5
	1888		0·41	1·1	...	...	...	...	0·41	0·6	3·13	2·2	1·01	3·0	2·54	6·2	2·24	4·7	1·99	4·1	6·76	8·2	9·28	11·1	1·70	2·6	29·47	43·8
North Arcot.	Average of 10 years	19	0·37	0·6	0·10	0·1	0·29	0·5	0·42	0·9	2·45	4·2	2·60	4·6	2·57	5·3	6·15	9·1	4·99	7·0	6·99	8·8	8·14	8·2	3·16	3·5	38·23	52·8
	1886		0·02	0·2	...	...	0·71	0·9	...	...	5·60	5·2	4·07	6·5	6·28	8·3	5·22	7·5	5·04	7·5	5·60	8·4	5·20	5·1	0·85	2·4	38·59	52·3
	1887		...	...	...	...	0·12	0·3	0·04	0·1	1·71	2·6	4·52	6·4	0·97	2·3	4·82	7·9	5·10	6·9	12·79	10·8	10·12	13·0	6·78	6·7	46·97	57·0
	1888		0·03	0·2	...	...	...	...	0·08	0·3	5·31	4·2	2·00	3·3	2·04	4·3	4·70	7·3	6·00	6·5	6·71	7·9	9·39	8·4	1·73	2·6	37·99	45·0
Nilgiris	Average of 9 years	11	0·71	1·6	0·43	1·1	2·22	3·8	2·99	5·8	5·70	11·3	7·75	14·4	8·51	16·0	7·68	16·5	5·59	13·1	10·99	18·1	9·13	14·8	4·52	7·3	66·22	123·8
	1886		0·30	1·5	...	...	0·80	3·0	1·80	3·9	9·61	13·8	11·61	16·0	19·14	23·7	11·83	21·3	9·40	19·8	6·79	13·4	3·78	7·6	0·90	3·7	75·96	127·7
	1887		0·03	0·3	0·61	1·2	2·47	4·0	3·92	11·1	3·48	9·3	13·60	20·0	11·19	18·7	4·58	16·8	6·52	12·7	11·91	19·7	8·08	15·5	5·52	10·2	71·91	139·5
	1888		0·61	2·2	0·01	0·1	0·35	1·3	3·84	6·6	7·63	17·3	9·79	17·5	8·50	16·2	7·47	16·2	7·01	13·4	5·65	11·1	6·89	14·5	2·43	5·1	60·18	121·5

Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years



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1889

Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years.

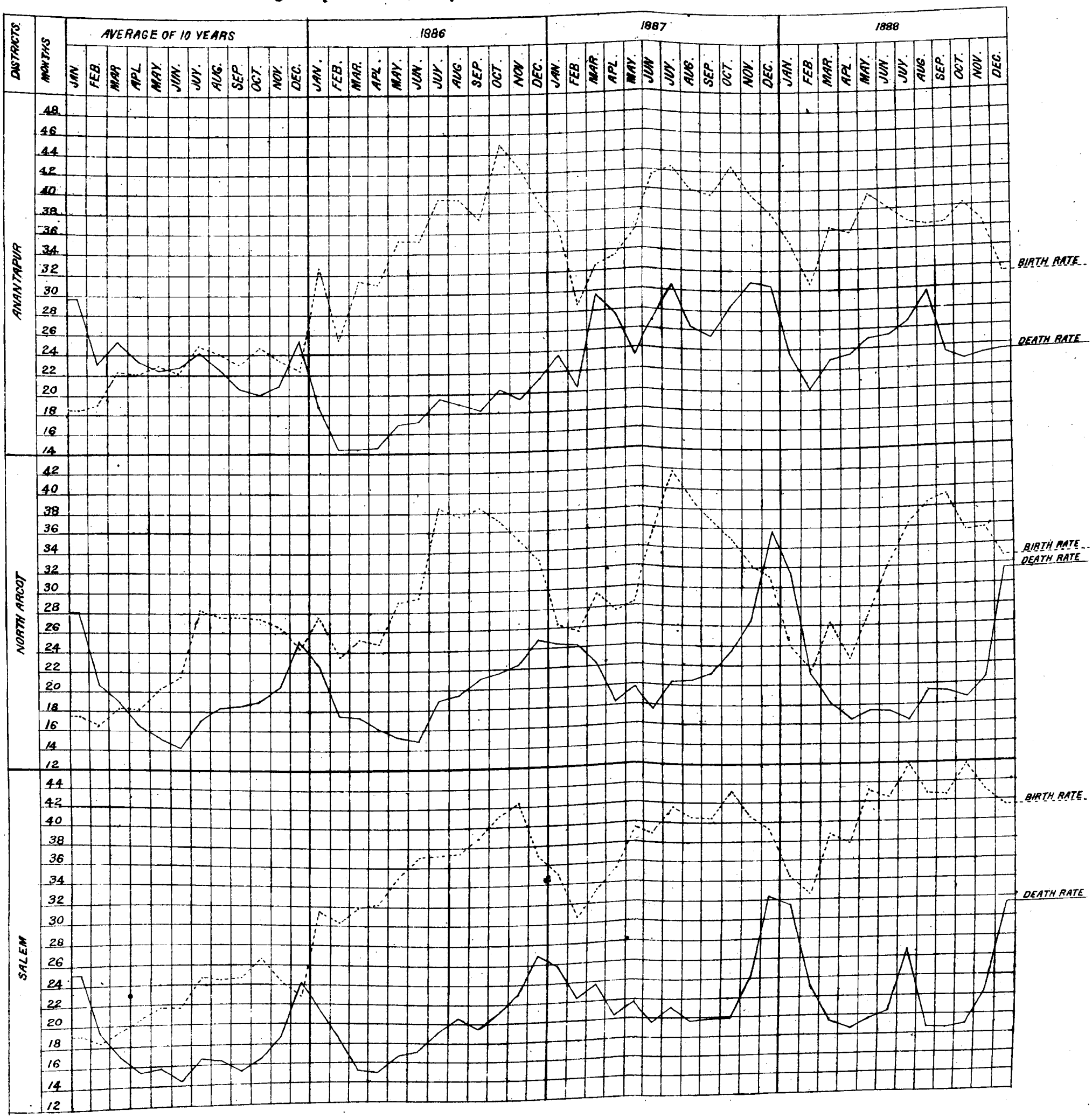

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Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years.

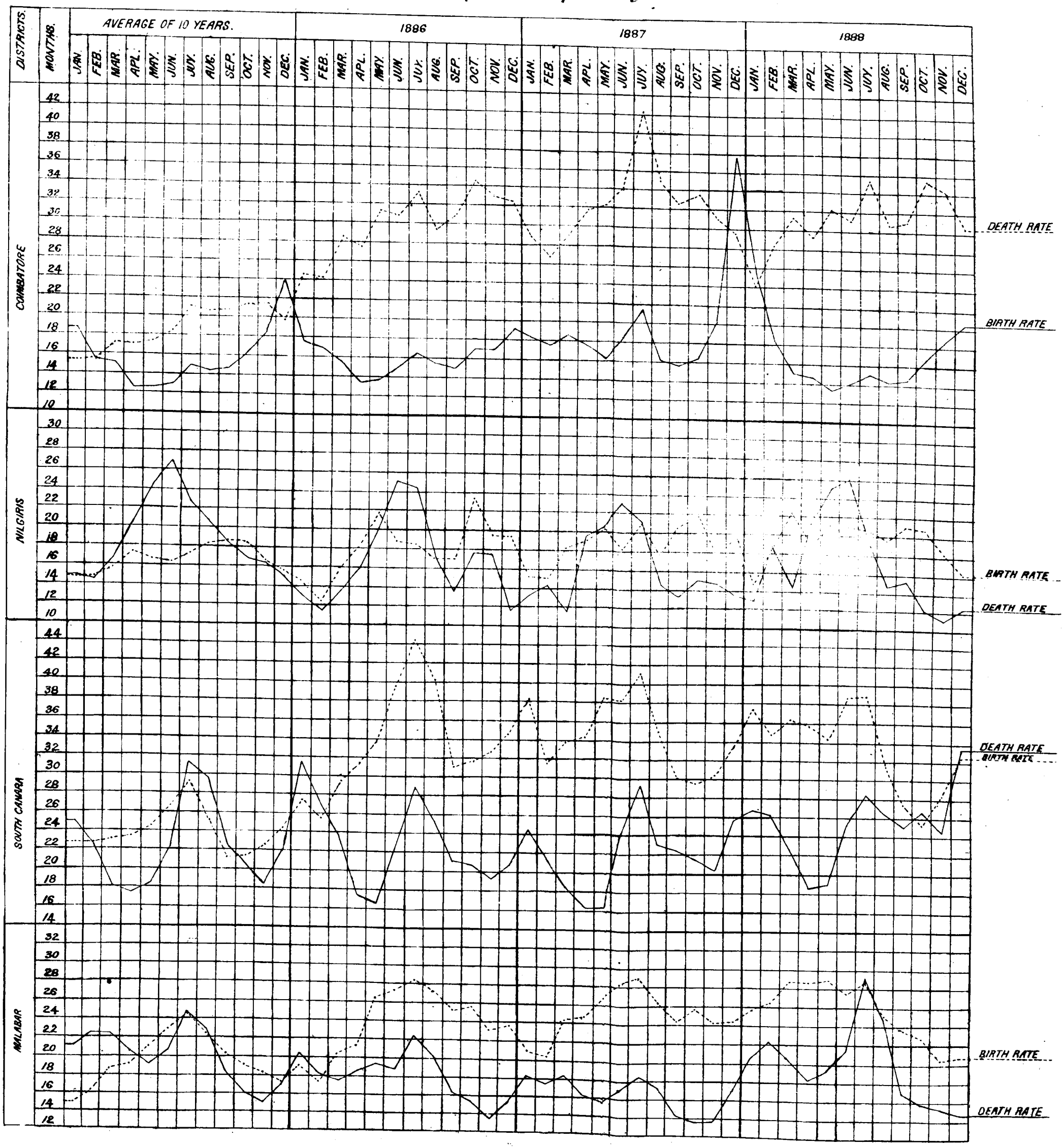

Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years.

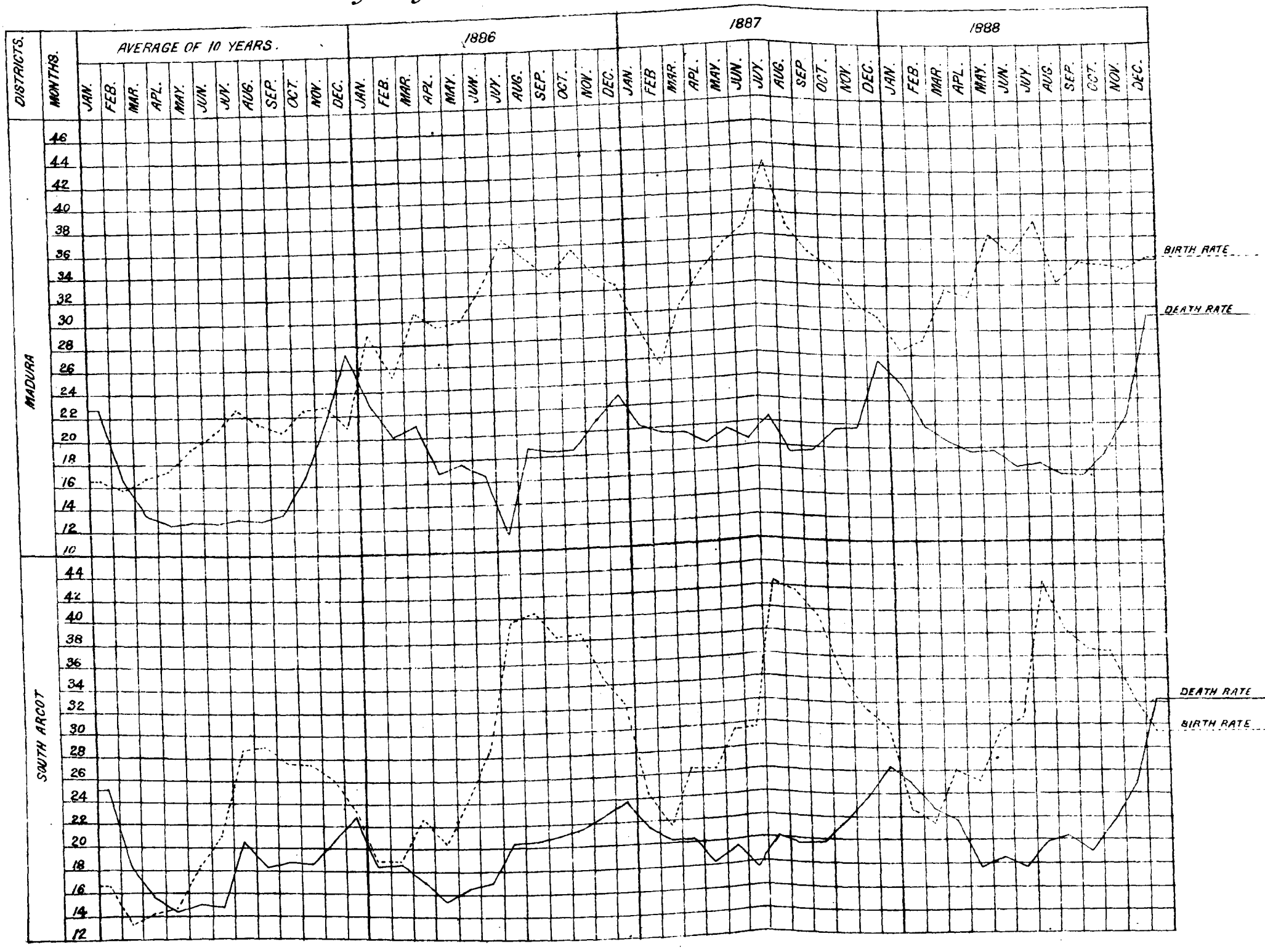

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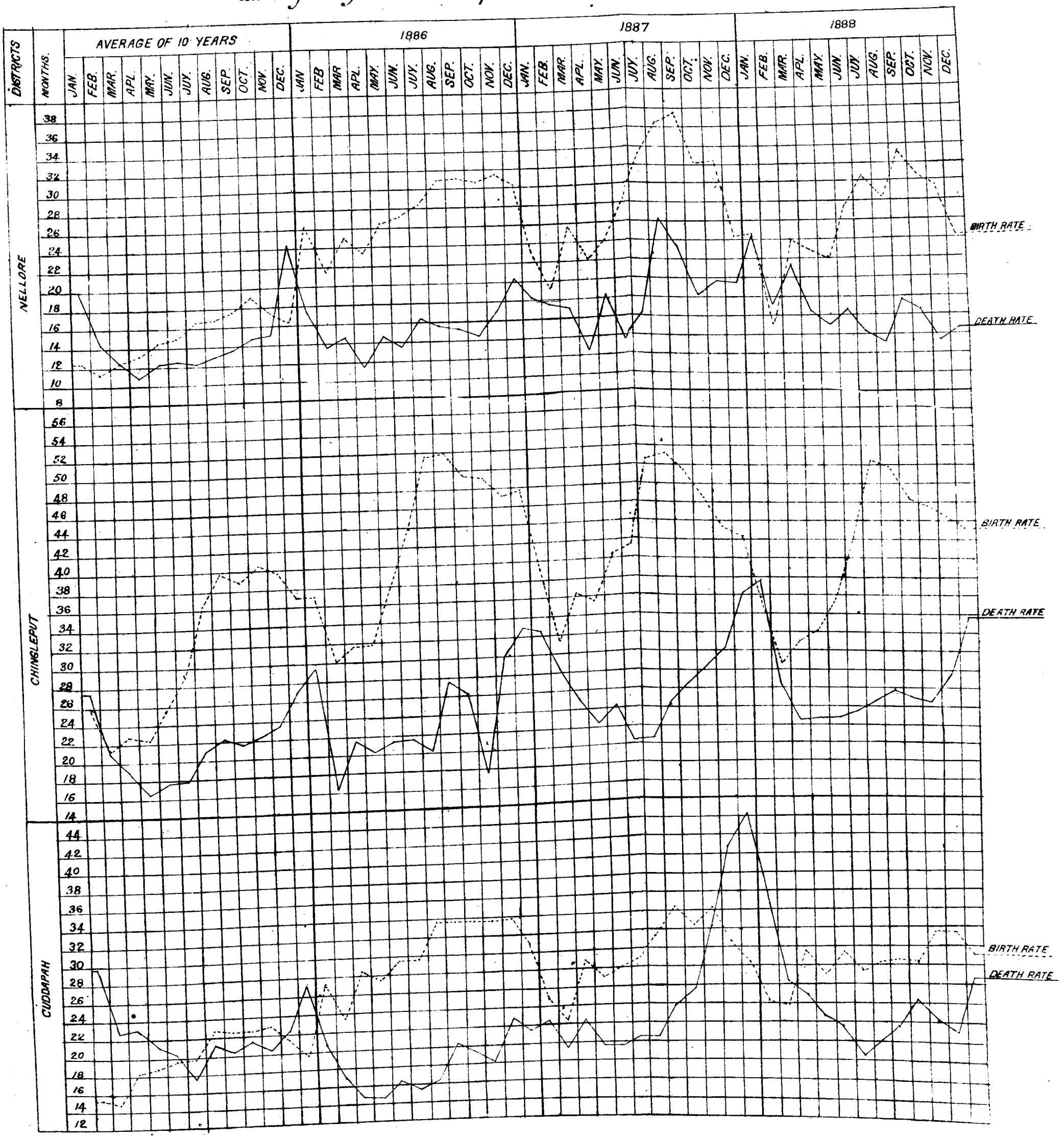
Diagram showing the Birth and Death rates per Mille per annum in the Undermentioned Districts during the year 1888 Compared with previous years



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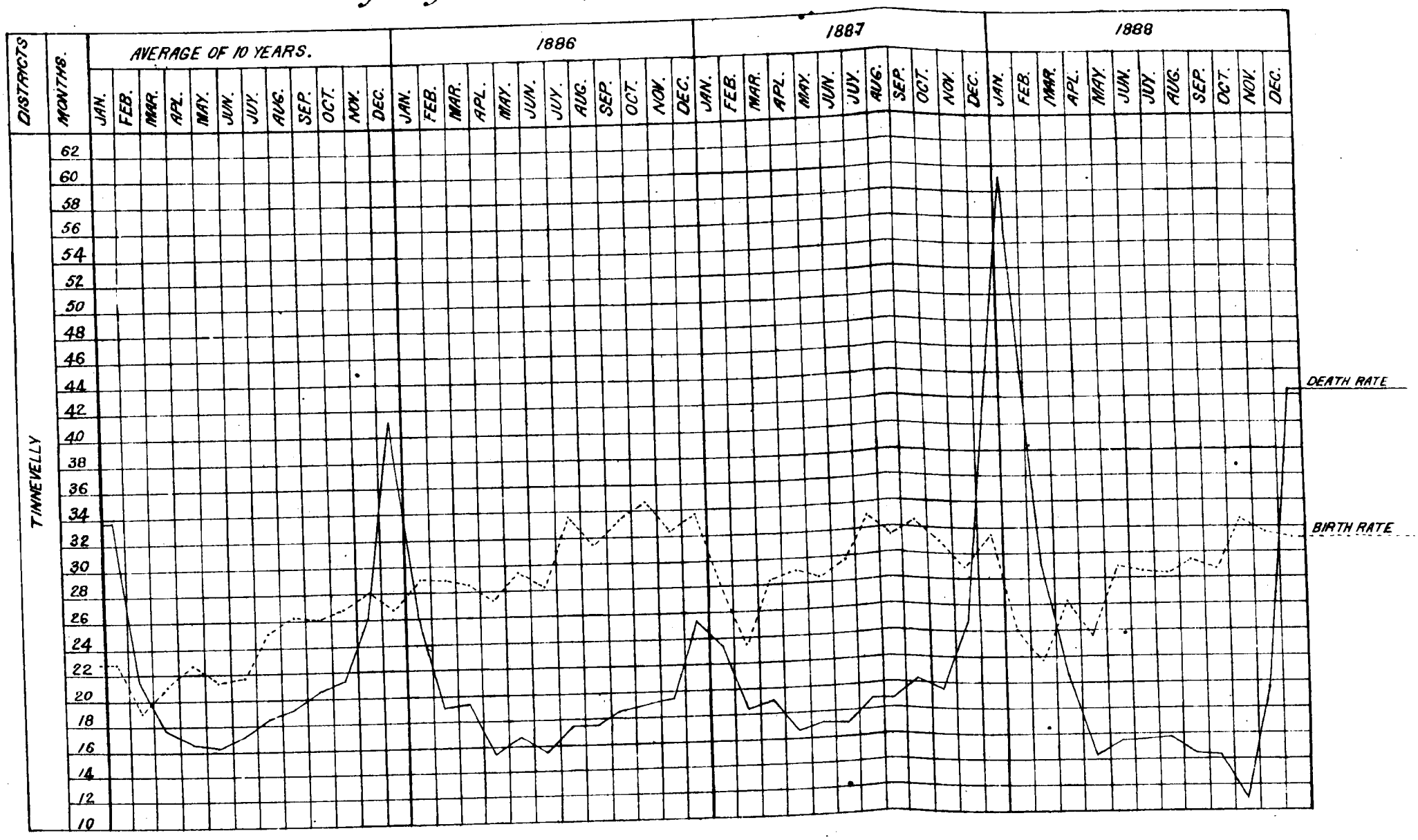

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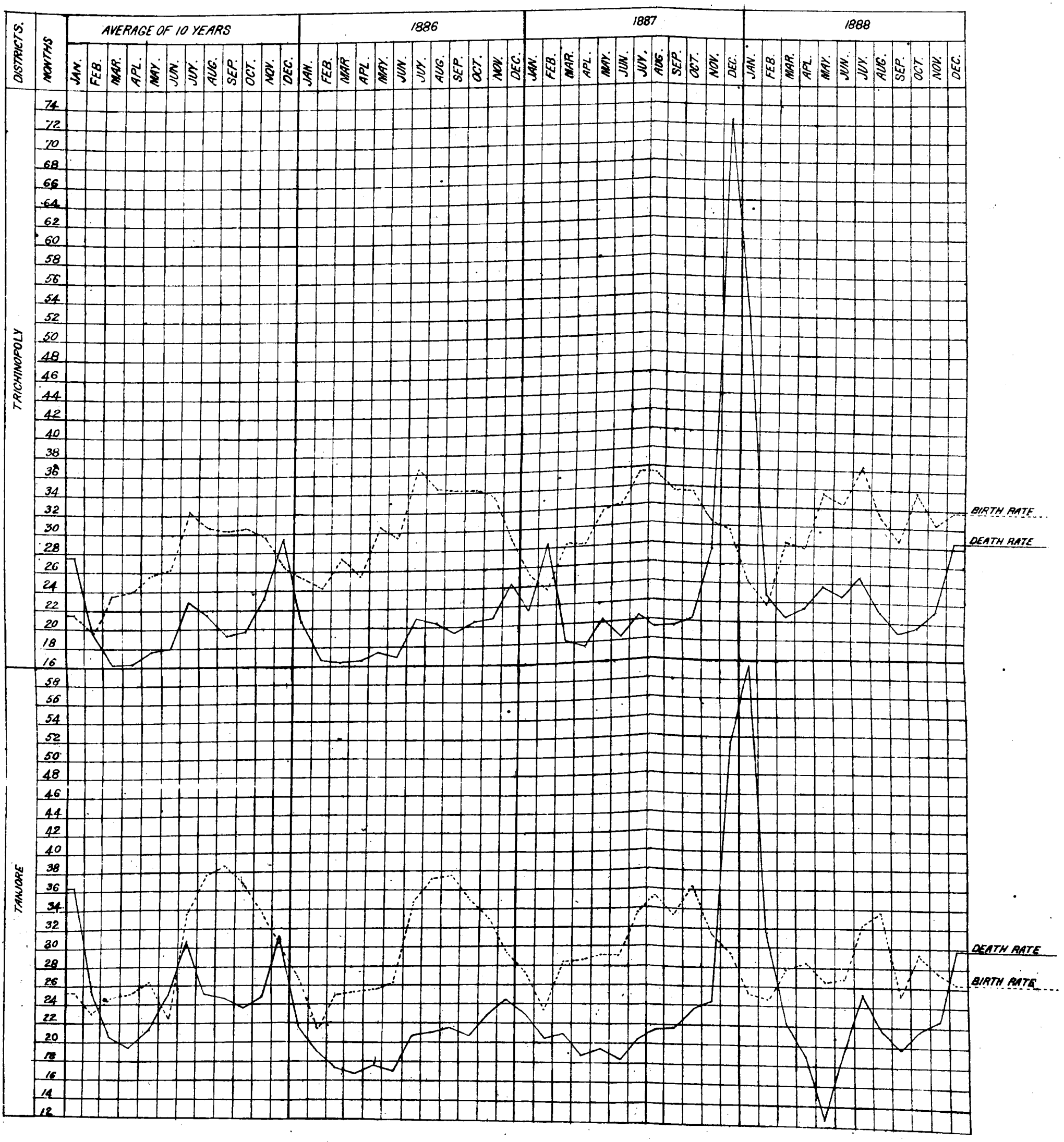
Diagram showing the Birth and Death rates per Mille per annum in the undermentioned Districts during the year 1888 Compared with previous years.



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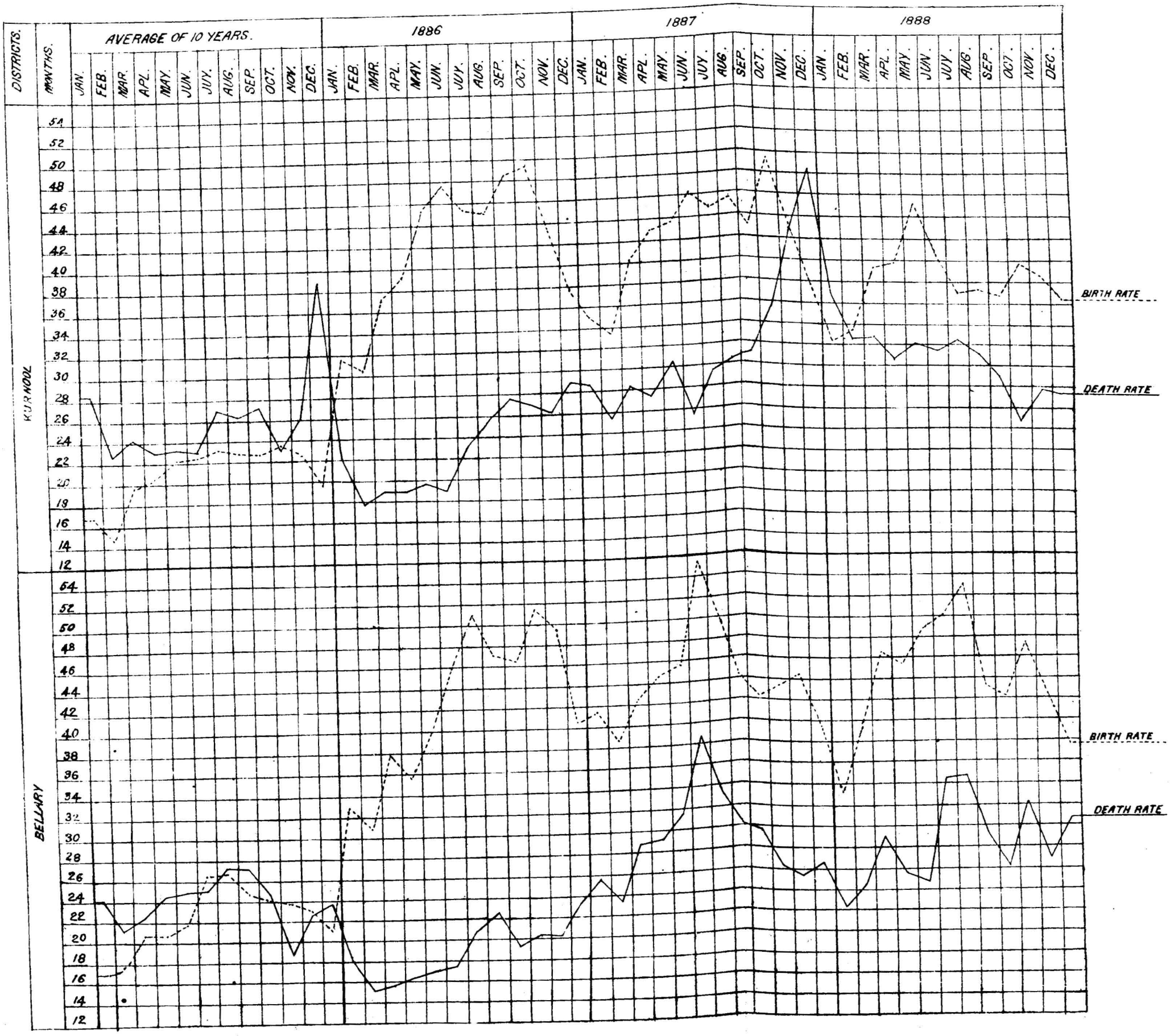

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MAP

ILLUSTRATING THE MORTALITY FROM CHOLERA IN THE MADRAS PRESIDENCY

During the Year

1888.

REFERENCE.

No. I	Indicates Deaths from 1 to 10 per 1000 of Population			
II	Do.	10 to 20	Do.	Do.
III	Do.	20 to 30	Do.	Do.
IV	Do.	30 to 40	Do.	Do.
V	Do.	40 to 50	Do.	Do.

NOTE. 1 THE DECIMAL FIGURES SHOW THE MORTALITY FROM CHOLERA PER 10000 OF POPULATION.

2 THE FRACTIONAL FIGURES TO THE LEFT OF DECIMAL FIGURES INDICATE THE DATE OF THE FIRST CASE IN EACH DISTRICT.

(Signed) J.A. Laing Surgeon Major
Sanitary Commissioner for Madras

Scale 1 Inch = 64 Miles.

Miles 100 90 80 70 60 50 40 30 20 10 0 100 200 Miles

Photo-Zincographed in Central Survey Office, Madras.

TWENTY-FIFTH ANNUAL REPORT

OF THE

SANITARY COMMISSIONER FOR MADRAS, 1888.

SECTION I.

METEOROLOGY OF THE YEAR.

Information given under SECTION V, GENERAL POPULATION.

SECTION II.

(*a*) EUROPEAN ARMY.

SECTION III.

(*a*) NATIVE ARMY.

SECTION IV.

(*a*) JAILS.

SECTION VII.

(*b*) VACCINATION.

(a) Omitted by Order of Government, dated 20th April 1888, No. 419, Public.
(b) Omitted by Orders of Government, dated 12th July 1886, No. 1455, and 3rd May 1888, No. 465, Public, and reported upon separately.

SECTION V.

GENERAL POPULATION.

RAINFALL.

1. In 1888 the amount of rain registered (43·92) was less than in either 1887 or 1886, and it was also below the average of 10 years by 1·14 inches. In 7 districts (South Canara, Chingleput, Madras, Malabar, South Arcot, Tanjore and Tinnevelly) the rainfall was above the average, but in the remaining 15 districts it was below. In Ganjam District the rainfall was much below the average, viz., 27·09 inches in 1888 against 46·56 inches in 1887 and 45·31 inches "the average of 10 years." It rained on a fewer number of days (62·3) in 1888 than the "average of 10 years" (64·5). The subjoined table shows the rainfall, the prices of food-supply, and the mortality from various causes during the year under notice compared with the figures for the preceding 5 years and with the mean average of the quinquennial period :—

Years.	Ratio per mille of population.							Rainfall.	Prices of food in seers of 80 tolas for the rupee.		
	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	All other causes.	Total.		Rice.	Ragi.	Cholum.
1888	2·1	0·8	7·3	1·0	0·4	9·8	21·4	43·92	15·3	29·4	27·5
1887	1·0	0·7	8·6	0·9	0·4	9·8	21·6	51·04	15·5	29·9	28·0
1886	0·4	0·6	7·8	0·9	0·4	9·3	19·7	47·70	14·5	28·0	26·4
1885	2·0	1·2	7·7	1·1	0·4	9·2	21·8	45·08	13·4	25·3	22·9
1884	2·7	2·1	7·6	1·0	0·4	9·1	23·1	47·08	15·1	30·1	28·8
1883	1·2	1·3	7·1	0·7	0·4	8·0	19·0	47·42	16·1	32·6	32·2
Average of quinquennial period (1883 to 1887).	1·5	1·2	7·8	0·9	0·4	9·1	21·0	47·66	14·9	29·2	27·7

2. This table shows that the mortality in 1888 was a little higher (0·4) than the average of 5 years (1883–1887), the increase being under "cholera" and "all other causes," that the rainfall was insufficient (in places), being the lowest amount registered for many years, and that the price of cholum was above, but of rice and ragi below, the average.

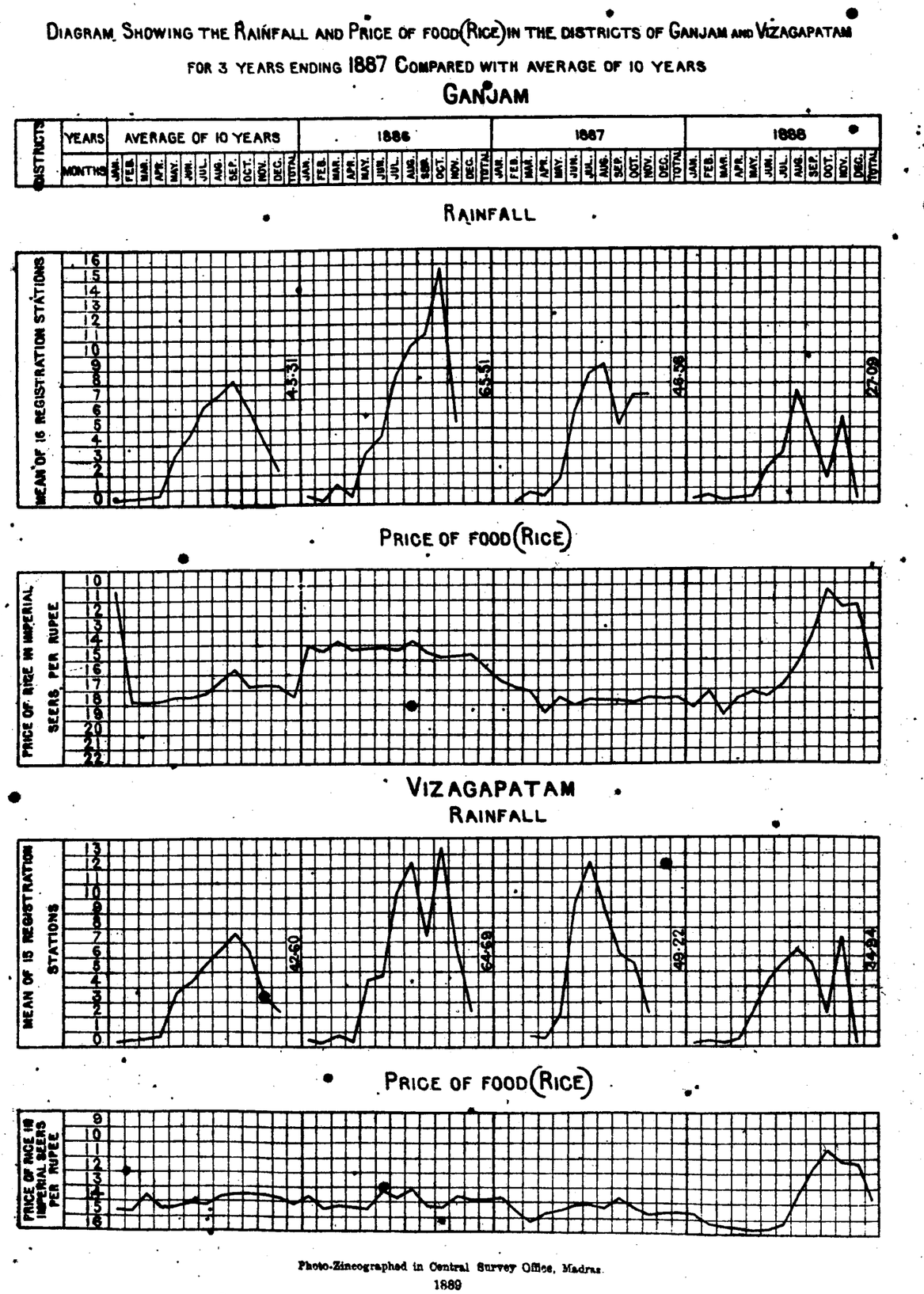

Photo-Zincographed in Central Survey Office, Madras.
1889

Table contrasting the Monthly Rainfall in the Madras Presidency during 1886, 1887 *and* 1888, *with the average of previous ten years ending* 1885, *exclusive of* 1876—continued.

Districts.		Number of places of observation.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Total.	
			Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.	Rainfall.	Days.
Salem ...	Average of 10 years	18	0·30	0·3	0·10	0·2	0·75	0·9	1·20	1·9	4·24	7·0	2·32	4·4	2·85	5·3	5·62	7·7	4·82	6·9	7·52	9·9	5·11	7·2	1·52	2·4	36·35	54·1
	1886		0·04	0·2	...	...	0·77	1·1	0·23	0·6	6·18	8·1	3·10	6·1	5·08	7·6	8·93	11·4	7·55	11·1	3·10	6·2	2·26	4·9	1·07	2·5	38·31	59·8
	1887		...	...	...	...	0·42	0·9	1·25	2·2	4·14	6·6	3·12	6·5	0·76	2·4	3·61	5·2	2·58	4·6	8·38	11·8	6·00	10·7	2·52	5·7	32·78	56·6
	1888		0·03	0·1	0·08	0·2	0·15	0·5	0·91	2·7	3·61	6·4	2·76	4·5	1·59	3·3	2·44	6·4	7·05	10·6	4·47	8·1	5·92	9·7	0·67	2·2	29·68	54·7
South Arcot.	Average of 10 years	17	0·49	0·8	0·04	0·1	0·21	0·4	0·40	0·6	2·63	3·5	1·61	3·8	2·55	5·4	5·81	8·8	5·79	7·9	7·45	9·3	10·27	10·2	5·19	5·9	42·44	56·7
	1886		0·92	1·1	...	...	0·61	1·2	...	...	5·89	5·4	3·40	6·1	3·34	5·7	7·93	9·2	5·98	7·5	5·74	9·7	5·22	7·1	2·76	5·1	41·79	58·1
	1887		...	0·1	...	...	1·14	1·4	0·17	0·5	2·14	2·7	3·01	6·1	1·97	4·1	7·98	9·9	4·93	6·6	18·79	14·1	12·85	14·1	9·69	8·4	62·67	68·1
	1888		0·11	0·4	...	...	...	...	0·38	0·8	6·53	5·3	1·01	2·4	2·81	4·1	5·74	9·4	4·44	6·7	10·31	11·0	8·61	12·1	7·98	6·0	47·92	58·2
Tanjore ...	Average of 10 years	17	0·98	1·8	0·15	0·3	0·30	0·5	0·39	0·9	1·64	2·6	1·70	3·0	1·54	3·3	4·42	6·9	4·23	6·8	8·29	10·2	12·41	12·4	8·91	9·1	44·96	57·8
	1886		2·58	3·6	1·26	0·8	0·28	0·4	0·02	0·1	6·54	6·0	3·65	6·4	5·20	7·3	7·70	8·2	6·14	9·7	8·05	10·4	8·71	8·4	3·04	6·0	53·17	67·3
	1887		0·01	0·1	0·29	0·3	2·03	1·4	1·24	1·8	1·30	1·6	3·50	5·4	0·50	2·1	5·73	9·4	2·83	5·0	14·52	17·4	13·26	14·1	14·09	13·5	59·30	72·1
	1888		0·11	0·8	...	...	0·08	0·1	0·72	1·2	6·88	7·5	0·84	2·0	1·88	4·1	1·81	5·0	3·26	5·7	10·25	11·7	10·57	15·6	10·34	8·4	46·74	62·1
Tinnevelly ...	Average of 10 years	11	0·76	1·5	0·62	1·1	1·46	2·4	1·53	2·6	2·10	3·5	1·22	2·5	0·89	2·4	0·91	2·5	1·88	2·4	5·60	8·9	8·24	10·1	5·13	6·3	30·34	46·2
	1886		0·97	2·0	0·21	0·7	0·49	0·9	0·64	1·5	1·80	4·8	0·91	2·5	1·16	3·3	2·01	4·1	1·62	3·9	5·73	7·3	4·42	7·3	0·88	2·8	20·84	41·1
	1887		0·03	0·1	0·63	1·3	1·20	2·1	4·45	7·5	0·49	1·5	0·46	2·5	0·52	1·6	0·64	2·1	0·31	1·1	10·10	14·3	8·37	12·1	7·36	11·5	34·56	57·7
	1888		0·05	0·3	...	...	1·21	1·4	1·70	2·7	2·65	5·7	0·96	3·6	0·23	0·7	0·23	1·2	1·31	3·9	13·26	13·6	7·60	12·3	6·44	7·0	35·64	52·4
Trichinopoly.	Average of 10 years	11	0·50	0·9	0·02	0·1	0·24	0·6	1·08	1·4	3·11	4·9	2·27	2·4	1·48	2·7	3·63	5·9	4·32	6·6	7·73	10·1	6·82	9·8	3·29	5·4	34·49	50·8
	1886		0·30	1·3	...	...	0·80	1·1	0·12	0·3	9·73	8·0	0·99	2·2	3·69	4·4	6·48	7·5	5·31	8·6	3·84	6·7	1·98	6·0	1·33	4·1	34·57	50·2
	1887		...	...	...	...	1·62	1·9	1·47	1·7	1·80	2·8	2·44	4·3	0·67	1·6	6·20	8·7	2·47	4·6	8·88	16·5	7·64	12·5	6·54	11·2	39·73	65·8
	1888		0·06	0·4	...	...	0·22	0·1	1·33	1·7	4·49	7·3	0·63	1·6	1·06	2·1	2·39	5·2	4·37	7·4	5·91	9·9	4·35	12·3	3·81	7·6	28·62	55·6
Vizagapatam.	Average of 10 years	25	0·26	0·7	0·36	0·8	0·75	1·2	0·81	1·7	3·71	5·2	4·24	6·0	5·79	10·9	6·61	10·9	7·75	11·5	6·60	7·4	3·32	3·9	2·40	1·3	42·60	61·5
	1886		0·02	0·1	...	...	0·99	2·0	0·13	0·5	4·53	7·1	4·65	9·3	10·18	14·3	12·32	15·8	8·14	11·2	13·48	16·5	7·46	4·9	2·79	3·5	64·69	85·2
	1887		...	...	...	...	0·94	1·2	0·66	1·4	2·07	3·3	9·60	9·2	12·50	14·4	9·66	12·8	6·20	8·8	5·51	6·9	2·08	3·7	...	...	49·22	61·7
	1888		0·05	0·2	0·20	0·4	0·26	0·9	0·64	1·3	2·40	3·4	4·36	7·2	5·75	12·3	6·54	11·4	5·54	8·1	2·16	3·8	7·01	8·3	0·03	0·2	34·94	57·5
Total ...	Average of 10 years	315	0·36	0·8	0·19	0·3	0·66	1·0	0·84	1·6	3·13	4·7	5·47	7·2	5·81	8·7	6·33	9·9	5·45	8·8	7·33	10·0	6·71	7·8	20·78	3·7	45·06	64·5
	1886		0·32	0·6	0·07	0·1	0·55	1·2	0·33	0·7	5·08	7·0	6·31	9·0	8·83	11·3	7·31	11·0	5·04	8·9	8·25	11·5	4·13	5·4	1·48	3·0	47·70	69·7
	1887		0·07	0·1	0·10	0·2	0·70	1·1	1·22	2·3	1·63	3·3	7·77	8·4	5·97	8·2	6·38	10·1	5·07	7·6	10·64	12·0	7·33	10·3	4·21	5·7	51·04	69·3
	1888		0·13	0·6	0·05	0·1	0·13	0·3	1·12	2·0	4·08	5·7	6·53	6·7	5·77	8·9	5·77	9·2	4·42	7·8	6·25	7·9	1·12	10·2	2·55	2·9	43·92	62·3

PRICES OF FOOD.

3. The following table shows the prices of the three grains in general use in the Madras Presidency during 1888, 1887 and 1886, compared with the average of 10 years. It will be seen that in most of the districts the prices of all the grains were below the average of 10 years. *Rice.*—In only two districts (Ganjam and Vizagapatam) were the prices of this staple article of food above the average. The prices (omitting the Nílgiris) varied from 17·3 seers for the rupee in the Chingleput District to 13·0 in the Madras District. *Cholum.*—Omitting South Canara and Malabar districts where this grain is not sold, the prices were below the average in all the districts, with the exception of Ganjam, Vizagapatam, Godávari, Kistna, and Trichinopoly, where they were higher. The prices ranged from 34·5 seers for the rupee in the Trichinopoly District to 23·0 in Madras. *Ragi.*—This grain was cheaper in all the districts in 1888, with the exception of Ganjam, Vizagapatam, Godávari and Madura, where it was dearer. The prices ranged from 41·1 seers for the rupee in the Bellary District to 23·5 in South Canara.

Table showing the Average Quantities of Food Grains, in seers of 80 tolas, procurable for a Rupee in the Madras Presidency during 1886, 1887 and 1888, compared with the average of the previous ten years ending 1885, exclusive of 1877.

Grain.	—		Ganjam.	Vizagapatam.	Godávari.	Kistna.	Nellore.	Cuddapah.	Anantapur.	Bellary.	Kurnool.	Madras.	Chingleput.	N. Arcot.	S. Arcot.	Tanjore.	Trichinopoly.	Madura.	Tinnevelly.	Coimbatore.	Nilgiris.	Salem.	S. Canara.	Malabar.
Second-sort rice.	January	Average of 10 years	11·2	15·6	16·9	14·3	13·9	14·3	*	14·1	12·8	12·7	15·0	15·4	15·3	14·8	14·3	13·7	13·3	13·7	10·3	14·6	14·1	13·4
		1886	14·1	13·4	15·3	13·5	15·3	14·1	13·2	13·6	13·0	12·8	13·9	14·6	15·5	15·0	13·6	14·0	13·5	13·6	11·3	14·1	14·8	13·2
		1887	17·3	14·8	16·0	14·6	14·9	16·0	16·7	13·8	13·8	14·5	17·2	17·7	17·4	16·1	15·0	14·5	13·9	15·2	13·2	17·4	15·4	15·5
		1888	19·0	15·7	16·0	16·2	15·5	16·3	17·1	14·1	15·1	12·8	16·2	18·0	17·1	17·0	14·6	13·9	13·0	15·6	12·7	16·3	15·7	15·1
	February	Average of 10 years	18·9	15·8	17·0	15·7	14·1	14·4	*	14·0	11·8	13·2	15·7	15·5	16·4	15·5	14·6	14·4	13·7	13·7	10·5	14·6	14·4	13·2
		1886	14·2	14·4	14·5	14·2	15·2	14·2	13·1	13·5	12·9	13·0	15·0	15·5	16·2	15·5	14·0	15·4	14·1	13·6	11·3	14·6	14·8	13·4
		1887	17·9	15·8	16·0	15·5	15·0	16·1	15·7	14·1	14·0	14·3	17·0	17·3	16·8	15·9	14·4	14·6	13·2	15·1	13·4	17·0	15·7	15·5
		1888	18·0	16·2	16·1	16·2	15·7	16·5	17·1	13·9	14·6	13·0	18·1	18·0	17·0	17·9	16·1	15·0	13·7	15·5	13·2	16·2	15·5	15·1
	March	Average of 10 years	18·9	14·7	17·0	15·7	14·1	14·5	*	14·0	12·9	13·3	14·7	15·5	16·1	15·7	14·6	14·4	13·8	13·9	10·5	14·2	14·1	13·2
		1886	13·8	14·3	14·4	14·3	15·1	13·9	12·9	13·0	12·7	12·9	15·2	15·6	16·6	16·5	15·5	16·1	14·4	14·2	12·4	14·9	15·1	13·5
		1887	18·1	16·5	16·4	15·3	15·0	18·1	16·8	14·0	14·1	13·9	17·0	17·2	16·7	16·4	14·5	15·0	13·6	15·3	13·6	16·9	15·8	14·9
		1888	19·7	16·5	17·1	16·6	15·7	16·4	17·3	14·4	14·9	13·0	18·4	18·0	17·5	18·3	16·8	15·9	14·5	15·5	13·4	16·1	15·7	15·3
	April	Average of 10 years	18·7	15·4	16·9	15·6	14·1	14·7	*	13·9	12·8	13·4	15·7	15·6	16·1	15·7	14·6	14·4	13·8	13·9	10·5	14·3	13·8	13·1
		1886	14·2	14·3	15·0	14·5	15·2	14·0	12·9	12·9	13·0	14·0	15·7	15·9	16·9	16·5	16·1	16·0	14·8	14·2	12·9	15·0	15·1	13·4
		1887	19·6	16·4	16·0	16·2	15·4	16·0	16·8	13·9	13·9	14·0	18·0	17·2	16·8	16·6	14·9	15·3	14·0	15·5	13·1	16·8	15·8	15·1
		1888	18·7	16·7	17·6	16·6	15·8	16·4	17·6	14·0	14·9	13·0	19·0	18·3	17·1	17·9	16·3	15·7	14·6	15·6	13·4	16·0	15·8	15·0
	May	Average of 10 years	18·4	15·3	16·1	15·1	14·4	14·9	*	14·0	12·8	13·3	15·7	15·8	15·1	15·3	14·4	14·6	13·8	13·7	10·5	14·5	13·5	13·1
		1886	14·3	14·3	15·0	14·6	15·1	14·1	13·3	13·1	13·0	14·7	15·7	15·2	16·4	16·6	15·9	16·1	14·3	14·0	12·8	15·2	15·1	13·3
		1887	18·4	15·9	15·5	16·2	15·5	16·3	17·1	13·6	14·0	13·7	18·1	17·4	16·9	17·0	15·1	15·0	13·9	15·4	13·1	16·9	16·0	14·9
		1888	18·0	16·8	17·8	16·5	15·6	16·7	17·5	13·9	15·0	13·0	18·4	18·1	16·7	17·4	16·0	15·1	14·1	15·2	13·0	16·1	15·8	14·4
	June	Average of 10 years	18·4	15·0	16·8	14·9	14·5	14·9	*	14·1	12·7	13·0	15·1	15·3	15·4	14·8	13·9	14·1	12·8	13·2	10·4	13·9	13·2	12·6
		1886	14·2	14·3	14·4	14·4	14·9	14·3	13·0	12·8	12·8	14·7	15·6	15·2	16·4	16·4	15·6	15·8	13·6	13·8	11·8	14·8	14·7	13·0
		1887	19·0	15·5	14·7	17·2	15·4	16·5	17·2	13·5	14·4	13·4	17·8	16·9	17·0	17·0	15·1	15·1	13·6	15·6	13·0	16·7	15·5	15·1
		1888	18·5	16·6	17·4	16·1	15·8	16·0	17·3	13·9	14·5	13·0	17·9	16·8	16·4	16·8	15·6	14·8	13·6	15·0	12·4	15·9	15·6	14·5
	July	Average of 10 years	18·0	15·1	16·6	14·7	14·5	14·7	*	13·7	12·6	12·6	14·3	15·0	14·8	14·1	13·3	13·5	12·3	13·0	10·2	13·3	13·1	12·9
		1886	14·2	13·9	14·6	14·4	15·1	14·3	13·2	13·0	12·6	14·7	15·4	15·4	16·3	16·6	15·4	15·4	13·5	13·9	11·6	14·7	14·5	12·8
		1887	18·8	15·0	14·7	17·0	15·4	16·4	17·2	13·5	14·1	13·0	16·9	16·4	16·9	16·5	15·0	14·3	13·3	15·2	13·0	16·5	15·3	15·2
		1888	17·8	16·1	17·3	16·3	16·1	16·9	16·9	13·9	14·1	13·0	17·3	16·8	16·2	16·1	14·8	14·4	13·5	14·5	12·9	15·5	15·4	14·4
	August	Average of 10 years	17·4	14·8	15·6	14·6	14·4	14·8	*	13·7	12·5	12·9	14·1	14·9	14·5	13·6	13·1	13·2	12·3	11·5	10·2	13·2	12·9	12·5
		1886	13·8	13·7	14·3	14·9	15·2	14·3	13·7	12·9	12·5	14·3	15·0	15·3	16·0	16·7	15·5	15·7	13·8	14·0	11·8	14·8	14·5	13·1
		1887	18·8	15·0	14·7	16·7	15·6	16·2	17·2	13·6	14·1	13·0	16·4	16·8	16·6	15·6	14·9	14·2	12·9	15·2	12·1	16·3	15·5	15·2
		1888	16·2	14·3	17·1	16·5	15·9	16·8	16·8	13·9	14·0	13·0	17·0	16·7	16·2	15·7	14·4	13·7	13·3	14·2	12·9	15·3	15·2	14·5
	September	Average of 10 years	16·8	14·6	16·1	14·6	14·4	13·4	*	13·6	12·6	12·7	14·1	14·8	14·7	13·8	13·2	13·0	12·4	11·5	10·0	13·2	13·1	12·9
		1886	14·6	13·6	14·1	14·4	15·2	14·6	13·7	13·1	12·8	14·2	15·2	15·7	16·1	17·0	15·8	16·0	14·2	14·0	12·1	15·0	14·9	13·8
		1887	18·8	15·2	14·7	16·7	15·4	16·0	17·3	13·7	14·0	13·0	16·4	16·7	16·9	15·5	14·8	13·8	12·8	14·9	12·8	16·0	15·4	15·5
		1888	14·5	12·8	16·0	15·6	15·9	17·2	16·3	13·7	13·6	13·0	17·0	16·4	16·0	15·7	14·2	13·6	13·3	13·9	12·9	14·8	15·1	14·4
	October	Average of 10 years	17·9	14·4	15·6	14·4	14·1	14·0	*	13·3	14·0	12·5	13·8	14·7	13·5	14·2	12·4	12·8	12·9	12·9	10·3	13·5	13·1	13·3
		1886	15·0	14·1	14·2	14·3	15·2	14·8	13·1	13·0	13·0	14·2	16·0	16·3	16·3	17·4	15·9	16·1	14·7	14·5	12·2	15·8	15·1	14·6
		1887	18·9	14·9	14·9	16·5	15·5	16·0	17·3	13·6	14·6	13·0	16·2	16·7	16·8	16·3	14·6	13·4	12·8	15·3	13·0	15·6	15·4	15·1
		1888	11·3	11·3	13·5	13·4	14·3	14·9	14·4	12·8	11·9	12·9	16·2	15·9	15·7	16·0	14·1	13·4	13·3	14·0	12·3	15·0	14·7	14·0
	November	Average of 10 years	17·8	14·5	14·8	14·0	13·8	13·8	*	13·0	12·2	12·3	13·9	14·5	14·7	14·7	13·6	12·9	13·0	13·3	9·5	14·0	13·1	13·2
		1886	15·1	14·1	14·6	14·3	15·1	14·9	14·2	13·2	13·1	14·0	17·1	16·9	17·1	17·5	16·3	16·4	15·1	15·3	12·4	16·8	15·2	14·8
		1887	18·5	15·4	15·2	16·0	15·5	16·1	17·2	13·7	14·8	13·0	16·1	16·7	16·6	16·7	14·5	13·7	13·3	15·6	12·4	16·2	15·2	14·9
		1888	12·6	12·0	14·2	14·0	14·3	14·6	14·7	12·2	12·3	12·9	15·9	15·8	15·7	15·5	14·1	13·3	13·2	13·9	11·7	14·9	14·2	13·9
	December	Average of 10 years	17·8	14·8	15·8	14·1	14·7	13·7	*	13·1	12·2	12·3	13·8	14·6	15·6	14·4	13·5	13·1	13·0	13·3	9·9	12·3	13·5	13·1
		1886	15·1	13·6	15·1	14·4	15·0	15·2	15·0	13·3	13·0	14·1	17·6	16·7	17·5	17·2	16·2	15·9	15·3	15·7	13·1	17·0	15·4	15·1
		1887	18·6	15·8	15·5	16·5	15·6	16·2	17·4	14·1	14·8	13·0	16·3	16·7	16·7	15·5	14·4	13·6	13·2	15·4	12·7	16·3	15·3	15·0
		1888	12·4	12·3	15·5	15·1	14·9	15·3	15·5	13·2	12·9	13·3	16·3	16·2	16·1	14·8	14·1	13·1	12·8	13·5	12·0	14·9	14·7	14·4
	Average	Average of 10 years	18·3	15·0	16·3	14·8	14·2	14·3	*	13·7	12·6	12·8	14·7	15·1	15·2	14·7	13·8	13·7	13·2	13·1	11·9	13·8	13·5	13·0
		1886	14·4	14·0	14·6	14·3	15·1	14·3	13·5	13·1	12·9	13·9	15·6	15·7	16·4	16·6	15·5	15·7	14·2	14·2	12·1	15·2	14·9	13·7
		1887	18·5	15·5	15·3	16·2	15·3	16·3	16·9	13·7	14·2	13·5	16·9	16·9	16·8	16·3	14·8	14·4	13·4	15·8	12·9	16·6	15·5	15·2
		1888	16·4	14·8	16·3	15·8	15·5	16·2	16·5	14·2	14·0	13·0	17·3	17·1	16·5	16·6	15·1	14·3	13·6	14·7	12·7	15·6	15·3	14·6

* Information not available.

Table showing the Average Quantities of Food Grains, in seers of 80 tolas, procurable for a Rupee in the Madras Presidency during 1886, 1887 and 1888, compared with the average of the previous ten years ending 1885, exclusive of 1877—continued.

Grain.	—		Ganjam.	Vizagapatam.	Godávari.	Kistna.	Nellore.	Cuddapah.	Anantapur.	Bellary.	Kurnool.	Madras.	Chingleput.	N. Arcot.	S. Arcot.	Tanjore.	Trichinopoly.	Madura.	Tinnevelly.	Coimbatore.	Nilgiris.	Salem.	S. Canara.	Malabar.
Cholum.	January	Average of 10 years	28·2	28·2	29·7	25·0	23·7	26·2	*	27·5	27·6	19·3	20·1	24·1	30·0	25·9	37·0	35·2	24·3	22·8	17·8	23·0	...	...
		1886	24·1	24·5	26·1	19·8	24·6	26·4	27·3	26·4	27·3	18·0	18·1	23·6	31·1	22·0	35·0	34·8	20·6	21·0	18·9	21·9	...	...
		1887	26·4	30·2	26·4	23·6	25·9	30·8	32·4	32·4	27·9	23·0	19·9	30·1	38·6	25·4	43·1	34·8	26·1	23·3	24·9	29·4	...	...
		1888	30·5	28·3	25·6	24·3	25·7	30·3	36·1	36·4	32·5	23·0	†	30·3	34·6	27·3	37·5	28·7	20·0	23·7	25·9	29·1	...	...
	February	Average of 10 years	31·5	28·5	30·2	25·1	24·1	25·7	*	27·0	27·5	19·3	20·1	24·2	31·0	16·6	41·1	33·2	24·7	23·0	17·7	23·4	...	...
		1886	24·1	24·7	25·9	19·9	24·4	26·2	26·1	25·9	26·7	...	19·0	22·7	35·3	23·6	35·8	38·6	21·6	21·1	19·3	22·4	...	...
		1887	30·5	29·6	27·2	24·3	27·1	30·6	31·4	33·4	28·7	23·0	19·9	28·9	33·3	29·4	41·9	32·6	22·8	22·5	24·7	22·7	...	...
		1888	32·8	28·4	26·4	24·7	24·9	32·3	35·1	35·9	33·8	23·0	†	26·2	35·8	26·8	37·3	29·9	20·8	23·7	25·5	28·9	...	...
	March	Average of 10 years	30·3	27·5	30·6	25·0	24·3	25·4	*	27·0	27·2	19·4	18·9	24·2	29·4	26·5	39·7	31·8	23·7	23·4	17·5	23·0	...	...
		1886	27·2	24·8	26·6	20·6	24·6	25·8	25·7	25·1	26·4	...	19·0	23·2	35·8	24·9	47·4	42·4	21·1	22·5	19·3	24·4	...	...
		1887	32·3	28·7	27·3	24·4	26·9	29·6	31·1	32·7	29·9	23·0	...	29·7	34·6	29·3	42·8	31·8	21·1	22·7	26·4	28·1	...	...
		1888	32·9	28·7	29·7	24·2	24·8	32·3	35·2	30·1	33·3	23·0	†	29·2	32·2	26·5	35·7	35·7	27·1	23·7	25·0	30·4	...	...
	April	Average of 10 years	29·9	27·1	30·5	24·2	25·0	26·4	*	27·1	26·4	19·2	18·8	24·2	26·9	26·5	42·7	30·7	25·4	23·6	17·2	23·7	...	...
		1886	29·6	24·5	26·3	21·2	25·0	25·7	26·1	26·2	26·7	...	19·0	24·0	34·7	25·4	56·4	39·5	20·9	22·8	19·5	25·7	...	...
		1887	30·1	28·9	27·4	23·7	27·1	28·9	31·5	32·8	30·2	23·0	...	30·7	31·7	30·6	41·9	32·6	21·1	23·6	25·5	27·8	...	...
		1888	31·3	28·6	30·0	23·8	25·3	32·0	35·2	34·6	33·2	23·0	†	29·9	...	27·6	37·6	38·9	27·7	24·6	24·6	29·4	...	...
	May	Average of 10 years	27·2	26·6	30·2	23·3	24·1	26·6	*	26·8	26·0	18·8	19·5	24·2	27·6	26·4	42·2	32·1	25·1	25·2	16·7	24·0	...	...
		1886	27·2	24·3	26·5	20·4	24·8	26·8	26·7	25·2	26·7	18·0	19·0	23·7	34·9	25·5	57·8	37·0	23·3	22·1	19·6	24·2	...	...
		1887	29·0	27·5	26·4	23·1	27·2	29·8	33·3	30·7	23·9	23·0	...	30·6	34·4	31·5	43·4	33·1	25·5	24·3	26·6	28·4	...	...
		1888	31·2	27·4	29·4	24·0	24·6	31·6	34·8	34·6	32·0	23·0	†	29·7	...	27·5	35·7	38·9	26·0	24·5	23·3	29·5	...	...
	June	Average of 10 years	26·6	25·7	29·9	22·7	25·2	26·4	*	26·0	24·8	19·1	19·8	23·9	28·1	24·6	37·1	31·0	23·5	22·6	17·1	24·2	...	...
		1886	24·1	22·7	26·8	20·1	24·6	25·8	25·3	24·7	26·3	...	16·2	24·9	31·4	26·0	52·3	36·7	25·4	21·8	19·1	24·8	...	...
		1887	30·4	24·4	24·6	25·7	27·0	30·0	33·4	29·5	30·2	23·0	...	29·4	33·5	30·5	36·1	34·3	25·2	24·2	25·2	31·2	...	...
		1888	29·5	26·5	28·9	23·2	25·5	30·8	34·4	32·8	30·1	23·0	†	28·6	25·2	26·7	32·8	31·9	25·0	24·5	25·4	27·7	...	...
	July	Average of 10 years	25·8	24·2	28·8	22·5	24·8	25·5	*	25·8	24·7	19·3	18·9	34·9	26·3	24·1	35·3	30·1	23·0	22·2	17·7	23·7	...	...
		1886	24·1	23·7	26·2	20·3	24·0	25·7	25·1	24·9	26·2	...	18·1	24·3	29·2	25·1	43·2	33·4	24·1	21·3	18·6	25·5	...	...
		1887	29·5	23·3	23·9	23·7	26·4	29·4	33·8	30·9	29·8	23·0	28·5	30·5	30·9	29·2	36·9	32·3	24·6	23·4	24·4	32·0	...	...
		1888	27·3	26·3	28·2	23·6	25·7	30·6	31·7	29·0	29·4	23·0	†	29·3	25·2	25·0	32·1	29·0	25·3	22·2	23·4	26·7	...	...
	August	Average of 10 years	21·9	24·4	28·1	22·9	24·4	24·4	*	25·6	24·8	19·3	20·6	26·2	25·1	22·5	32·9	28·8	22·5	20·2	17·5	22·8	...	...
		1886	27·2	24·1	26·2	21·2	24·5	25·0	26·8	25·7	26·8	...	18·4	25·6	28·6	24·0	37·7	33·0	25·5	21·7	19·4	27·2	...	...
		1887	24·7	23·4	22·5	24·3	25·6	28·9	34·0	31·3	31·0	23·0	28·5	29·1	30·9	27·0	28·0	30·8	24·0	23·0	22·6	31·2	...	...
		1888	27·3	23·4	28·4	23·7	23·9	31·0	32·0	33·0	28·9	23·0	†	30·0	25·2	...	32·9	27·8	25·8	22·0	23·6	26·2	...	...
	September	Average of 10 years	23·5	25·0	28·1	23·1	24·0	28·3	*	25·3	24·7	19·2	19·6	25·9	24·9	22·8	31·4	22·4	23·2	20·2	17·4	23·8	...	...
		1886	23·1	26·9	25·8	21·9	24·6	25·9	27·0	27·7	27·2	21·2	18·1	29·3	32·4	28·8	37·6	33·2	28·0	23·8	20·0	31·0	...	...
		1887	24·0	22·9	22·1	24·8	25·8	29·1	36·0	33·8	31·9	23·0	...	22·9	29·4	27·5	28·0	28·7	23·6	22·9	25·4	31·6	...	...
		1888	23·5	21·0	28·0	22·6	23·4	30·1	32·0	32·7	27·0	23·0	†	30·2	27·3	...	32·2	27·6	24·7	22·1	23·8	25·9	...	...
	October	Average of 10 years	25·2	24·3	27·2	22·8	23·6	25·3	*	25·9	25·4	19·3	20·1	25·4	25·4	25·2	32·0	27·3	23·8	20·9	19·3	24·7	...	...
		1886	26·8	27·2	25·5	21·9	25·0	28·2	29·6	28·6	26·9	25·0	18·1	29·5	33·9	29·8	38·2	34·8	28·5	25·1	22·3	32·0	...	...
		1887	24·4	22·7	22·6	24·0	26·0	30·6	35·9	35·1	32·6	23·0	...	29·4	32·0	28·2	28·4	26·2	21·0	22·7	25·2	31·1	...	...
		1888	18·3	18·7	23·0	19·3	22·1	27·4	29·4	28·6	22·4	...	†	26·8	25·9	...	33·8	27·0	24·5	21·9	25·4	24·4	...	...
	November	Average of 10 years	24·6	23·8	25·4	22·6	23·0	25·4	*	26·5	27·1	18·0	19·9	24·3	25·4	26·0	31·7	27·9	23·3	22·3	17·4	24·4	...	...
		1886	26·7	27·6	25·8	22·0	25·6	28·8	32·1	30·6	26·9	23·0	18·1	31·4	33·0	32·9	39·5	33·9	29·1	25·1	23·1	33·3	...	...
		1887	24·4	23·5	22·7	24·9	25·9	30·6	35·9	35·5	33·1	23·0	...	29·1	31·3	26·8	28·5	26·7	21·5	23·2	24·8	30·7	...	...
		1888	16·5	20·8	23·6	20·5	22·5	26·3	30·4	29·6	25·2	...	†	27·1	23·6	...	26·8	26·5	23·9	22·5	23·2	24·0	...	...
	December	Average of 10 years	26·9	26·1	26·6	23·2	23·2	25·8	*	26·7	26·8	19·0	19·5	24·5	27·5	24·5	32·2	31·0	23·6	22·8	17·6	23·8	...	...
		1886	26·4	27·3	24·5	21·9	25·4	30·0	31·9	31·0	26·0	23·0	18·1	30·1	33·2	28·1	44·9	40·1	29·3	25·8	24·2	28·7	...	...
		1887	29·1	26·5	24·9	25·9	25·8	31·9	35·9	35·3	33·4	23·0	...	28·9	32·8	26·4	30·3	27·4	19·8	25·0	26·4	30·2	...	...
		1888	18·3	24·2	25·6	23·0	22·7	28·1	31·5	31·6	25·5	...	†	27·2	23·6	...	39·2	28·0	24·1	21·9	24·0	24·0	...	...
	Average	Average of 10 years	26·8	25·9	28·8	23·5	24·1	25·9	*	26·4	26·1	19·1	19·6	24·5	27·6	25·1	36·3	30·1	23·8	22·3	17·5	23·5	...	...
		1886	25·9	25·2	26·3	20·9	24·8	26·7	27·5	26·9	26·7	21·0	18·2	26·0	32·8	26·2	43·8	36·4	24·6	22·9	20·3	26·8	...	...
		1887	27·9	25·9	24·8	24·4	26·4	30·0	33·7	32·8	30·2	23·0	24·2	29·1	32·8	28·6	35·8	30·9	23·0	23·2	25·2	30·1	...	...
		1888	26·6	25·2	27·2	23·1	24·3	30·2	33·1	32·4	29·4	23·0	†	28·7	27·9	26·8	34·5	30·8	24·6	23·1	24·1	27·2	...	...
Ragi.	January	Average of 10 years	28·2	28·2	30·5	29·3	26·1	28·7	*	30·2	27·2	23·8	23·9	26·8	28·9	28·5	28·6	29·8	28·7	27·8	18·4	36·2	18·9	20·2
		1886	28·1	27·0	30·6	26·8	29·0	29·6	30·2	29·9	29·4	25·7	26·3	29·0	31·9	27·3	30·6	31·6	27·1	26·9	20·9	28·6	21·1	21·4
		1887	34·3	29·9	30·9	31·2	29·2	32·9	35·8	37·7	29·3	27·0	26·5	31·8	32·7	28·5	30·1	29·8	25·9	29·3	24·2	32·6	22·9	24·8
		1888	31·4	27·8	29·1	30·4	30·7	36·1	39·2	43·1	32·1	28·7	27·8	34·8	30·8	29·9	31·0	30·2	27·6	31·6	25·9	34·2	24·8	29·2
	February	Average of 10 years	27·7	27·7	30·9	29·9	26·2	28·8	*	29·7	27·9	23·7	23·6	26·6	28·7	28·9	28·9	29·8	27·4	27·5	18·2	25·7	18·6	20·1
		1886	27·6	26·7	29·0	27·3	28·7	29·7	29·2	30·5	29·5	26·0	24·6	28·6	31·8	28·4	32·3	32·7	26·8	27·2	21·1	28·4	20·5	21·5
		1887	34·4	28·8	30·9	31·4	29·0	32·6	35·4	38·9	30·6	27·4	26·2	31·5	30·4	29·3	27·7	28·7	25·6	28·5	25·2	31·9	22·7	25·0
		1888	21·2	27·8	28·5	30·5	30·9	35·9	37·7	42·7	29·9	28·8	29·2	34·9	30·6	31·5	32·3	31·0	27·5	31·2	25·8	34·3	24·0	30·1
	March	Average of 10 years	27·7	28·7	30·9	30·0	26·3	24·0	*	29·9	25·3	23·3	23·1	26·4	27·1	29·1	28·2	28·6	26·4	27·3	18·2	25·9	18·1	19·7
		1886	27·4	27·0	28·1	28·8	28·6	29·6	28·7	29·5	28·2	25·9	26·0	28·3	31·5	27·6	32·4	31·5	26·7	27·4	21·7	28·6	19·9	21·3
		1887	34·4	28·3	30·2	32·3	29·7	32·7	36·2	39·6	29·5	26·0	25·9	31·7	27·9	27·1	26·9	28·2	25·7	29·9	26·2	32·8	22·6	25·7
		1888	31·5	27·8	29·9	30·8	30·6	36·3	37·6	42·0	33·7	28·8	29·1	34·4	29·7	30·1	31·8	28·8	27·9	31·4	26·1	34·3	23·6	31·4
	April	Average of 10 years	27·9	27·9	31·0	29·8	27·4	29·6	*	30·1	26·2	23·1	23·4	26·9	26·4	28·1	28·3	29·1	26·5	28·3	18·3	27·4	17·9	19·7
		1886	27·9	27·5	28·0	29·3	29·7	29·9	28·2	30·8	27·9	26·6	26·4	28·2	29·7	26·5	32·3	30·5	26·0	37·4	22·9	29·4	20·2	21·7
		1887	33·9	27·9	30·2	30·0	30·3	33·8	37·0	40·2	27·8	26·6	28·1	32·1	28·2	29·7	27·4	29·5	25·4	30·7	26·0	32·6	22·4	26·1
		1888	31·1	27·4	29·5	31·4	30·7	36·3	37·5	42·0	31·0	28·7	29·0	34·6	28·2	28·7	30·5	28·7	26·2	30·6	25·8	34·6	23·9	30·7
	May	Average of 10 years	27·6	27·6	30·9	29·5	27·9	29·9	*	29·4	27·7	23·2	23·7	27·6	26·5	27·5	27·3	28·6	25·9	27·9	18·3	27·1	17·8	19·3
		1886	27·6	27·5	29·0	29·2	29·7	29·8	28·2	29·5	28·3	26·7	26·8	29·6	28·8	26·3	31·8	29·2	25·7	27·2	22·7	29·1	20·4	21·6
		1887	32·5	27·9	29·3	31·5	30·8	34·9	38·3	39·4	25·6	27·2	29·2	33·3	28·4	30·9	26·5	31·0	25·7	31·1	25·7	33·3	23·0	25·6
		1888	31·0	27·1	27·3	31·0	30·6	36·2	37·6	42·5	30·2	29·0	29·0	34·2	26·7	27·4	29·4	28·2	25·1	30·4	24·5	34·3	23·4	28·0
	June	Average of 10 years	26·7	26·7	31·2	29·1	27·9	29·7	*	28·6	27·1	23·0	23·0	26·8	25·9	26·7	26·8	28·0	24·5	26·8	18·0	27·5	17·6	19·4
		1886	27·5	27·3	28·6	29·1	29·0	29·0	27·9	27·9	27·9	26·7	26·6	29·3	28·4	25·8	30·4	27·6	25·4	26·7	21·2	28·9	19·3	20·8
		1887	31·3	26·2	27·6	35·7	30·9	34·3	38·1	37·6	31·1	27·8	27·6	32·9	28·3	29·7	26·8	31·1	25·1	30·7	25·1	34·2	22·6	26·8
		1888	29·0	25·7	29·1	31·6	30·4	35·6	37·2	41·0	31·4	28·7	28·4	33·2	26·5	27·0	29·2	27·5	25·0	29·3	23·7	32·2	23·1	27·4
	July	Average of 10 years	26·3	26·3	30·6	28·0	27·7	29·6	*	28·1	26·6	22·7	22·3	28·4	24·8	25·9	26·1	30·9	23·6	26·0	17·6	26·4	17·0	19·4
		1886	27·4	27·3	28·5	28·6	29·6	29·3	27·3	28·2	27·9	25·8	25·8	29·1	28·5	26·4	30·0	27·8	24·0	26·4	20·4	28·9	19·0	20·9
		1887	31·2	24·6	27·1	33·3	31·2	34·4	37·5	36·7	30·8	27·6	27·6	32·6	28·1	28·3	26·6	29·2	24·3	30·3	25·7	33·9	23·0	27·3
		1888	26·0	25·5	28·8	30·8	30·2	35·1	36·4	41·5	30·4	28·4	28·0	32·9	25·8	26·3	28·6	26·5	24·5	28·2	24·0	31·8	23·5	27·9
	August	Average of 10 years	27·5	27·5	29·5	28·0	27·2	28·0	*	27·6	25·3	23·0	22·6	26·2	25·1	25·2	29·6	27·5	23·2	23·5	17·5	25·4	16·8	19·5
		1886	28·2	28·5	28·7	28·7	29·1	29·2	30·0	27·9	28·9	25·3	24·9	28·0	29·3	29·1	29·7	29·8	23·9	26·5	21·3	30·4	18·8	21·3
		1887	28·5	25·4	26·6	33·3	31·0	33·8	37·2	37·1	31·9	28·0	27·7	32·3	28·3	26·9	26·3	28·2	23·4	30·0	23·6	33·6	24·2	30·3
		1888	24·1	24·7	28·1	30·6	29·9	33·9	35·3	41·6	30·7	27·4	28·1	33·0	25·8	25·1	26·9	25·5	24·8	27·6	24·4	31·4	23·5	26·4
	September	Average of 10 years	28·8	28·8	30·1	28·1	27·0	27·6	*	27·7	25·3	23·1	22·3	26·2	27·0	26·0	26·3	27·0	24·2	24·2	17·7	25·4	16·6	19·6
		1886	29·6	30·7	28·0	28·8	28·7	29·4	30·5	30·1	28·9	25·4	24·5	28·9	30·1	32·3	29·8	32·6	26·9	28·5	21·9	31·2	18·8	22·2
		1887	30·9	25·9	26·6	33·9	30·5	34·6	39·9	39·4	32·1	28·1	28·3	32·7	29·4	27·9	26·7	27·9	23·5	28·7	25·8	33·9	24·3	29·8
		1888	24·2	25·1	26·9	28·9	28·8	33·2	36·3	41·9	27·9	27·4	27·8	32·8	26·4	27·0	31·7	25·9	24·5	26·7	23·7	30·5	23·2	26·3
	October	Average of 10 years	28·2	28·2	28·8	27·5	26·5	27·8	*	28·2	25·1	23·2	24·3	27·2	29·2	28·4	28·0	27·0	25·1	25·0	17·8	25·6	17·3	19·9
		1886	35·1	31·6	27·7	28·2	29·4	30·7	33·0	32·0	27·6	25·6	25·4	30·6	31·6	32·9	32·8	35·1	28·2	30·6	22·6	32·0	19·9	21·9
		1887	31·5	25·5	25·2	32·2	30·6	34·3	41·1	41·1	33·0	28·3	29·4	33·9	31·3	28·1	28·6	26·1	23·0	29·1	26·0	34·3	24·2	30·7
		1888	21·5	20·7	22·6	24·8	25·6	32·5	33·8	36·8	24·8	26·5	28·3	32·7	29·4	26·8	28·1	25·8	26·5	28·6	23·5	30·0	22·9	25·7
	November	Average of 10 years	28·0	28·0	27·8	26·7	25·5	27·9	*	29·4	25·9	23·4	24·3	27·2	29·2	28·0	27·3	27·2	25·2	28·1	17·7	27·0	17·7	19·7
		1886	34·3	30·4	27·6	28·8	29·3	32·2	35·3	34·5	28·2	25·2	26·6	30·6	32·7	35·0	33·2	35·6	29·2	31·6	23·3	31·7	21·0	23·9
		1887	31·2	26·5	25·8	33·5	30·7	35·3	40·9	42·0	33·1	28·4	30·3	34·6	31·8	28·5	28·3	26·2	23·3	30·5	25·4	34·3	24·4	30·0
		1888	22·8	22·9	23·9	22·7	25·4	31·7	35·1	36·8	25·2	25·9	29·0	32·6	30·3	27·5	27·5	26·1	25·9	28·4	23·2	30·2	23·0	24·1
	December	Average of 10 years	27·8	22·9	29·2	26·8	25·5	28·2	*	29·4	26·6	23·4	23·7	26·7	28·5	27·5	27·9	28·9	26·4	28·1	18·1	26·8	18·2	19·8
		1886	34·3	30·4	28·9	30·0	29·3	31·8	35·6	36·9	27·8	25·3	26·5	31·1	33·0	30·8	32·3	35·3	29·8	32·1	23·7	33·4	22·3	25·4
		1887	31·7	26·7	28·0	32·1	30·8	35·8	40·8	42·4	30·6	28·4	29·6	34·1	31·5	29·2	30·0	27·7	23·5	31·1	25·8	34·7	25·0	30·4
		1888	22·1	22·9	24·9	24·6	26·4	32·6	36·6	40·8	27·3	26·3	28·8	32·8	30·1	28·7	27·8	26·8	26·8	28·7	23·9	31·1	22·8	26·4
	Average	Average of 10 years	27·9	27·9	30·1	28·5	26·7	28·7	*	29·0	26·3	23·2	23·3	26·9	27·3	27·5	27·8	28·5	25·6	26·7	18·0	26·5	17·7	19·7
		1886	29·6	28·5	28·5	28·6	29·2	30·0	30·3	30·6	28·4	25·8	25·9	29·3	30·6	29·0	31·5	31·6	26·6	28·2	22·0	30·0	21·0	22·0
		1887	32·1	26·9	28·2	32·5	30·4	34·1	38·2	39·3	30·4	27·6	28·0	32·8	29·7	28·7	27·7	28·6	24·5	29·9	25·4	33·5	23·4	27·7
		1888	26·3	25·5	27·4	29·0	29·1	34·6	36·7	41·1	29·5	27·9	28·5	33·6	28·4	28·0	29·6	27·6	26·0	29·4	24·5	32·4	23·5	27·8

* Information not available. † Not cultivated.

VITAL STATISTICS OF THE GENERAL POPULATION.

BIRTHS

4. During the year 1888 there were 833,345 births (exclusive of European, Eurasian, and still-births) registered, giving a birth-rate of 29·9 per 1,000. The births are thus 16,206 less than the number registered in the previous year, but the birth-rate (29·9), with the exception of that for 1887 (30·4), is the highest on record.

5. The following table shows the number of births and deaths registered in each year from 1871 and their ratios per 1,000 of population :—

Years.	Population for which returns were received.	Births.	Birth-ratio per mille.	Deaths.	Death-ratio per mille.
1871	24,555,046	506,707	20·6	444,371	18·0
1872	30,147,779	543,325	18·02	501,482	16·6
1873	30,287,842	527,363	17·4	506,894	16·4
1874	30,360,221	569,631	18·7	516,848	17·0
1875	30,278,903	625,953	20·6	641,260	21·1
1876	29,157,056	619,748	21·2	680,384	23·3
1877	29,209,542	467,543	16·01	1,556,312	53·2
1878	29,127,205	341,388	11·7	810,921	27·8
1879	28,991,267	467,938	16·1	549,390	18·9
1880	28,778,097	641,769	22·3	454,101	15·7
1881	28,676,375	716,672	24·9	465,682	16·2
1882	28,887,111	743,777	25·7	470,700	16·2
1883	28,503,100	774,754	27·2	541,930	19·0
1884	28,151,952	810,102	28·8	650,335	23·1
1885	28,118,178	807,105	28·7	615,449	21·8
1886	28,043,538	837,077	29·8	553,927	19·7
1887	27,907,840	849,551	30·4	604,775	21·6
1888	27,852,474	833,345	29·9	597,015	21·4

6. The subjoined table shows the birth and death-rates in each district of the Presidency contrasted with those for 1887 and the mean of 10 years :—

No.	Districts.	Ratio of births per mille of population.		Average of birth-ratio for previous 10 years.	Ratio of deaths per mille of population.		Average of death-ratio for previous 10 years.
		1888.	1887.		1888.	1887.	
1	Anantapur	40·06	40·7	29·1	26·6	27·6	20·7
2	Bellary						
3	Chingleput	39·2	41·1	35·9	26·5	25·6	23·2
4	Coimbatore	30·9	32·03	23·2	16·8	19·2	15·2
5	Cuddapah	27·7	28·8	24·4	23·9	25·2	19·7
6	Ganjam	20·9	21·2	22·5	17·9	24·3	17·8
7	Godávari	21·0	20·2	20·7	15·2	19·7	20·8
8	Kistna	35·3	35·2	27·7	19·5	21·8	20·3
9	Kurnool	37·4	41·06	28·9	31·1	31·0	23·8
10	Madras	39·6	40·5	38·9	37·8	39·4	38·2
11	Madura	31·8	32·5	26·2	19·2	18·9	18·0
12	Malabar	25·0	24·4	21·8	19·7	15·8	18·7
13	Nellore	25·9	27·6	20·7	16·8	17·6	13·9
14	Nilgiris	19·1	18·3	16·4	16·3	16·2	17·1
15	North Arcot	30·4	31·7	24·6	21·2	22·1	18·0
16	Salem	40·3	37·6	27·4	22·1	21·8	17·1
17	South Arcot	30·5	30·8	24·6	21·8	20·1	18·8
18	South Canara	32·2	33·3	26·4	25·3	20·9	20·1
19	Tanjore	27·5	29·2	29·0	25·8	22·7	24·2
20	Tinnevelly	27·3	28·9	26·5	23·2	20·9	21·7
21	Trichinopoly	29·5	30·2	27·5	24·8*	24·1	20·8
22	Vizagapatam	21·5	20·5	19·5	12·5	19·2	15·5
	Total, Madras Presidency ...	29·9	30·4	25·5	21·4	21·6	19·5

[redacted].

7. From the above table it will be seen that the ratios were higher in six districts (Godávari, Kistna, Malabar, Nílgiris, Salem and Vizagapatam) in 1888 than in 1887, but in all the others they were lower. The districts of Salem and Vizagapatam show the largest increase in 1888 over 1887 in the rate per mille, and Kurnool and Chingleput the greatest decrease. The highest birth-rates registered were 40·3 in Salem and 40·06 in the Bellary-Anantapur districts. Excluding the Nílgiris, the birth-rate was lowest in the Ganjam district (20·9), next to it Godávari (21·0), and then Vizagapatam (21·5). These 3 districts as mentioned in last year's report have for some years always returned the lowest birth-rates, and defective registration is doubtless the reason why the recorded birth-rates are so low. The birth-rates for Ganjam district have been steadily decreasing year by year since 1884 as the figures in the margin will show. Vizagapatam and Godávari districts, however, show an improvement in the registration of births in 1888 when compared with that for 1887.

—	Birth-rate per mille per annum.				
	1884.	1885.	1886.	1887.	1888.
Ganjam	24·8	24·2	22·9	21·2	20·9

In only 2 districts (Bellary-Anantapur and Salem) the birth-rate was above 40 per mille of population, in 9 it was over 30 and under 40 per mille, and in 10 under 30 per mille.

8. Of the births registered in 1888, 426,749 were males and 406,596 females. The birth-rate among males was 15·3 and among females 14·6 per 1,000 of population. Taking the Presidency as a whole, there were 104·9 male births registered to every 100 female births. The ratio between male and female births registered in 1887 was 104·6 to 100, almost exactly the same as this year's ratio.

9. In table XI in the Appendix the birth-rates among the various sections of the population in each district are given. The Hindus return the highest birth-rate, viz., 30·2 per 1,000 of population, the Muhammadans next (28·0), and then Native Christians (22·6).

10. The following table shows the birth-rates according to the months of the year compared with 1887 and the monthly mean of the previous 10 years :—

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Mean of 10 years *	1·8	1·7	1·8	1·9	1·9	2·1	2·5	2·5	2·4	2·3	2·3	2·2	25·5
1887	2·2	1·9	2·3	2·3	2·5	2·6	2·9	2·9	2·8	2·8	2·6	2·5	30·4
1888	2·1	1·9	2·3	2·2	2·5	2·6	2·9	2·7	2·7	2·7	2·6	2·5	29·9

* Exclusive of famine years 1877 and 1878.

The greatest number of births are usually registered in July, and the fewest in February, and this year is in accordance with the experience of former years.

11. Taking the Presidency as a whole, there were 236,330 more births than deaths registered, the birth-rate being 8·5 per 1,000 higher than the death-rate. In all districts there was an excess of births over deaths.

12. The birth-rate per 1,000 of population among the rural and urban population in each district during 1888 and 1887 is given in the following table :—

No.	Districts.		Ratio of births per 1,000 of population. 1888.	Ratio of births per 1,000 of population. 1887.	Ratio of deaths per 1,000 of population. 1888.	Ratio of deaths per 1,000 of population. 1887.	No.
1&2	Anantapur and Bellary	Urban ...	30·1	34·9	36·7	28·6	1&2
		Rural ...	40·8	41·1	25·8	27·5	
3	Chingleput	Urban ...	22·4	32·8	29·2	28·8	3
		Rural ...	40·2	41·5	26·2	25·3	
4	Coimbatore	Urban ...	41·7	42·4	27·8	31·1	4
		Rural ...	30·5	31·6	16·5	18·8	
5	Cuddapah	Urban ...	19·6	21·2	31·7	41·7	5
		Rural ...	27·8	29·0	23·7	24·9	
6	Ganjam	Urban ...	22·8	27·6	31·3	42·2	6
		Rural ...	20·9	20·8	17·0	23·0	
7	Godávari	Urban ...	23·8	23·9	19·1	23·5	7
		Rural ...	20·7	19·9	14·9	19·4	
8	Kistna	Urban ...	27·9	26·6	20·1	18 0	8
		Rural ...	35·9	35·6	19·5	21·9	
9	Kurnool	Urban ...	33·2	34·4	37·8	30·4	9
		Rural ...	37·6	41·3	30·8	31·0	
10	Madura	Urban ...	37·1	36·8	28·2	27·4	10
		Rural ...	31·3	32·0	18·3	18·0	
11	Malabar	Urban ...	31·2	31·9	35·3	25·5	11
		Rural ...	24·5	23·8	18 4	15·0	
12	Nellore	Urban ...	30·1	33·8	23·5	26·9	12
		Rural ...	25·8	27·5	16·6	17·3	
13	Nílgiris	Urban ...	26·3	25·0	20·7	24·0	13
		Rural ...	16·7	16·0	14·5	13·8	
14	North Arcot	Urban ...	26·4	25·6	28·6	23·4	14
		Rural ...	30·6	32·1	20·8	22·0	
15	Salem	Urban ...	31·0	22·2	26·8	17·9	15
		Rural ...	40·9	38·8	21·7	22·1	
16	South Arcot	Urban ...	22·3	22·6	23·0	17·4	16
		Rural ...	30·8	31·2	21·8	20·2	
17	South Canara	Urban ...	36·9	42·9	46·9	32·5	17
		Rural ...	32·0	33·6	24·7	20·5	
18	Tanjore	Urban ...	23·6	27·2	30·2	27·2	18
		Rural ...	27·8	29·5	25·3	22·3	
19	Tinnevelly	Urban ...	24·6	20·7	23·5	23·2	19
		Rural ...	27·6	29·2	23·2	20·6	
20	Trichinopoly	Urban ...	18·0	22·6	29·5	32·5	20
		Rural ...	30·6	30·9	24·4	23·3	
21	Vizagapatam	Urban ...	27·0	23·4	21·2	26·7	21
		Rural ...	21·0	20·3	11·7	18·6	
	Total ...	Urban ...	27·0	28·6	27·9	26·1	
		Rural ...	29·8	30·4	20·7	21·0	

The urban birth-rate for the Presidency was, as usual, smaller than the rural, the ratios per 1,000 of population being 27·0 and 29·8 respectively. In 1887 the urban birth-rate was 28·6 and the rural 30·4. In 9 districts (Coimbatore, Ganjam, Godávari, Madura, Malabar, Nellore, Nílgiris, South Canara and Vizagapatam) the birth-rates were higher in urban than in rural populations, the difference being most marked in the Coimbatore and Nílgiri districts. In the remaining 11 districts the birth-rates were higher in the rural than in the urban populations, the difference being most marked in the Chingleput and Trichinopoly districts.

13. In the table on page 13 is given the birth-rates per 1,000 of population of the 55 Municipal towns in the Presidency exclusive of Madras. It will be seen that only 4 towns have returned a birth-rate exceeding 40 per 1,000, 25 between 30 and 40 per 1,000, and 26 below 30 per 1,000. The highest recorded birth-rates are those of the towns of Erode (50·2) and Dindigul (46·9), and the lowest Tirupati (9·6) and Trichinopoly (14·9). The most marked improvement over last year took place in the towns of Vaniyambadi and Tirupatur, in which birth-rates of 35·8 and 33·5 were recorded, against 6·4 and 12·3 respectively in 1887. In some towns the registration of births is still much neglected, and especially so in Tirupati, where the birth-rate for 1888 was only 9·6 per 1,000.

In 25 towns—Gudiyattam, Calicut, Berhampore, Mangalore, Bellary, Srirungam, Kurnool, Conjeeveram, Máyavaram, Kumbaconam, Cannanore, Palamcottah, Tellicherry, Salem, Adóni, Cuddapah, Tinnevelly, Negapatam, Chidambaram, Tanjore, Coonoor, Parlákimedi, Cuddalore, Trichinopoly and Tirupati—the birth-rate was lower than the death-rate.

DEATHS.

14. There were 597,015 deaths registered during the year under report—*vide* table on page 8. In the previous year 604,775 deaths, or 7,760 more than in 1888, were registered. The death-rate of the Presidency in 1888 (21·4 per mille) was lower than the rate for 1887 (21·6), but a little higher than the average rate for the five years, 1883–87 (21·0).

15. Of the total deaths registered, 308,296 occurred among males and 288,719 among females, the rate per 1,000 being 22·3 for males and 20·5 for females. The registered male is thus higher than the registered female death-rate, and is in accordance with the experience of former years. The excess of male over female deaths was most marked in the South Canara and Ganjam districts.

For every 100 females who died, 106·7 deaths among males were registered, but their proportions vary considerably in some districts.

In Godávari	district	116·6	male deaths were recorded for every	100 female deaths.
In Ganjam	do.	116·0	do.	do. do.
In Vizagapatam	do.	114·9	do.	do. do.

In only 2 districts—Madras and Tanjore—there was an excess of deaths among females over the deaths among males.

16. The following table shows the total deaths in 1888 under different ages:—

No.	Ages.	Deaths.	Ratio per 1,000 of population.*	Percentage on total deaths.
1	Under 1 year	128,269	142·7	21·5
2	1 year and under 5 years	82,967	28·8	13·9
3	5 years and under 10 years ...	33,766	8·3	5·7
4	10 years and under 15 years ...	23,351	6·3	3·9
5	15 years and under 20 years ...	29,878	11·9	5·0
6	20 years and under 30 years ...	59,000	11·3	9·9
7	30 years and under 40 years ...	56,912	13 1	9·5
8	40 years and under 50 years ...	50,347	17·4	8·4
9	50 years and under 60 years ...	49,395	27·4	8·3
10	60 years and upwards	83,130	51·6	13·9
	Total ...	597,015	21·4	...

* Worked on the census population of 1881, including Europeans and Eurasians.

The mortality amongst infants under one year and children above one year but under five is as usual very high in comparison with other periods of life. The deaths in children under five years of age formed 35·4 per cent. of the total deaths, and as has been pointed out, this high rate of mortality among children of tender years is a proof of local causes of insanitation throughout the Presidency. The period when fewest deaths occurred was in the age of above 10 and under 15, the rate being 6·3 per 1,000. The percentage on total deaths amongst infants under one year is 21·5 against 22·9 in 1887.

17. The total deaths by sexes according to age are given in Form IV in the Appendix. From infancy up to 15 years of age females have a better chance of life than males, and also from 30 years upwards. Between the ages of 15 and 30 the death-rate amongst males, is less than that of females. This experience is similar to that of former years. The death-rate of male children under one year of age is 156·3, and that of female children of the same age 129·1, or for all children under one year 142·7. These rates are calculated on the strength of male and female children under one year of age, as given in the census of 1881, but in England the ratios are calculated on the number of children born during the year. For 1888 the infantile death-rate or proportion of deaths of infants in the first year of life to the registered births was 137 to 1,000 births in England and Wales, 148 in the 50 large town districts, and 154 in the 28 great towns. Calculated on the

number of children born, the death-rate among infants under one year in 1888 for the Madras Presidency was 153·9. The number of deaths among females between 20 and 30 years of age as compared with the number of deaths among males at the same age period in the North Arcot district is very high. The number of deaths registered at that age period was 2,365 females and only 1,728 males. The registered death-rate was 13·5 for females and 11·1 for males, while the corresponding ratios for the Presidency were 11·4 and 11·1 respectively.

18. The deaths according to classes are given in Form V in the Appendix. The recorded death-rates among Muhammadans was 23·1, among Hindus 21·4, among Native Christians 17·3, and among other classes 14·7. The death-rates are higher than those in 1887 for Muhammadans, Native Christians and other classes, but lower for Hindus. For Muhammadans the maximum rate (42·6 per 1,000) took place in Madras, and the minimum (10·6) in Vizagapatam. In 1887 these results were 44·2 and 12·4 and occurred in Madras and South Arcot. Amongst Hindus the maximum rate (37·6) was in Madras and the minimum 12·5 in Vizagapatam. In 1887 these results occurred in Madras (39·4) and Nílgiris (15·2). For Native Christians the maximum death-rate was (31·2) and took place in Madras, and the minimum 9·0 in North Arcot. In 1887 the results were 29·8 and 6·3 and occurred in Madras and Ganjam. In 10 districts, Anantapur and Bellary, Coimbatore, Ganjam, Madras, Malabar, North Arcot, Salem, South Arcot, South Canara and Vizagapatam, deaths were registered among "other classes."

19. The monthly distribution of deaths is shown in Statement III in the Appendix and in the following table are seen the death-rates during each month of the year in 1888 contrasted with the death-rates in 1887 and the mean for ten years:—

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Mean of 10 years *	2·0	1·5	1·4	1·3	1·4	1·4	1·7	1·6	1·5	1·4	1·7	2·1	19·5
1887	1·9	1·6	1·7	1·4	1·6	1·5	1·7	1·7	1·7	1·8	1·9	2·7	21·6
1888	2·6	1·8	1·7	1·5	1·5	1·6	1·7	1·7	1·6	1·6	1·7	2·2	21·4

* Exclusive of famine years 1877 and 1878.

During 1888 the greatest number of deaths (73,090) took place in January and the least (41,850) in April. The most unhealthy months were December, January and February, and April and May the most healthy. As usually happens a sudden rise occurred in the death-rate in the month of December.

20. The death-rates in each district in 1888 are given in table on page 8. The highest death-rate (37·8), as has been the case for some years past, occurred in Madras, then Kurnool (31·1) being 6·7 less than Madras, and the lowest in Vizagapatam (12·5) and Godávari (15·2).

In 11 districts (Chingleput, Kurnool, Madura, Malabar, Nílgiris, Salem, South Arcot, South Canara, Tanjore, Tinnevelly and Trichinopoly) the recorded death-rates per 1,000 of population were higher in 1888 than in 1887, but in all the others they were lower. The greatest increase in the death-rates took place in the Malabar, South Canara and Tanjore districts and was chiefly due to the prevalence of cholera and small-pox in these districts in 1888. In South Canara there was also a marked increase in the number of deaths in 1888 from all other causes. The greatest decrease in the death-rate took place in the Vizagapatam district where fewer deaths were registered from all causes in 1888 than in 1887.

As in 1887 the mortality in Madras and Kurnool district was higher than in any other district being above 30 per 1,000. In 10 districts the death-rates were between 20 and 30 per 1,000 and in 9 districts below 20 per 1,000. The districts of Vizagapatam and Godávari in which the registered death-rates were 12·5 and 15·2 per 1,000 respectively are manifestly incorrect.

21. The death-rate per 1,000 of population among the urban and rural populations in each district of the Presidency during the year 1888 as compared with 1887 is given on page 10. The death-rates among the urban and rural populations were respectively 27·9 and 20·7 against 26·1 and 21·0 in 1887. In all districts the urban death-rate was higher than the rural. The difference is most marked in the districts of South Canara and Malabar, the death-rates being respectively 46·9 and 35·3 in urban, and 24·7 and 18·4 in rural circles.

22. In the following table is given the deaths registered in the 55 Municipal towns proportionally considered with the population:—

Table showing the Birth and Death Rates of Districts and Towns arranged in order of sequence.

Districts (exclusive of Municipal Towns).						Municipalities.					
Birth-rate.			Death-rate.			Birth-rate.			Death-rate.		
No.	Districts.	Ratio per mille.	No.	Districts.	Ratio per mille.	No.	Municipalities.	Ratio per mille.	No.	Municipalities.	Ratio per mille.
1	Anantapur }	40·7	1	Madras ...	37·8	1	Erode	50·2	1	Gudiyátam ...	50·5
2	Bellary }		2	Kurnool ...	30·9	2	Dindigul ...	46·9	2	Calicut ...	44·0
3	Salem ...	40·7	3	Chingleput ...	26·1	3	Karúr	42·2	3	Berhampore ...	43·6
4	Madras ...	39·6	4	Anantapur }	25·8	4	Anakapalle ...	40·3	4	Mangalore ...	40·7
5	Chingleput ...	39·4	5	Bellary }		5	Coimbatore ...	39·4	5	Bellary ...	40·2
6	Kurnool ...	37·5	6	Tanjore ...	25·3	6	Ongole ...	38·6	6	Srírangam ...	37·9
7	Kistna ...	35·8	7	South Canara.	24·8	7	Periyakulam ...	38·2	7	Kurnool ...	37·8
8	South Canara.	32·1	8	Trichinopoly...	24·4	8	Anantapur ...	37·9	8	Conjeeveram ...	36·4
9	Madura ...	31·2	9	Cuddapah ...	23·7	9	Calicut ...	37·9	9	Máyavaram ...	35·3
10	South Arcot ...	30·7	10	Tinnevelly ...	22·9	10	Mangalore ...	36·9	10	Kumbakónam ...	35·2
11	Trichinopoly...	30·6	11	Salem ...	21·6	11	Wálajápet ...	36·8	11	Cannanore ...	34·1
12	Coimbatore ...	30·5	12	North Arcot ...	20·7	12	Madura ...	36·7	12	Palamcottah ...	33·4
13	North Arcot ...	30·4	13	South Arcot ...	20·1	13	Cochin	36·3	13	Tellicherry ...	32·8
14	Cuddapah ...	27·8	14	Kistna ...	19·4	14	Tuticorin ...	36·3	14	Anantapur ...	32·6
15	Tanjore ...	27·8	15	Malabar ...	18·5	15	Vániyambádi ...	35·8	15	Bezváda ...	32·6
16	Tinnevelly ...	27·2	16	Madura ...	18·3	16	Vellore ...	35·1	16	Salem	32·5
17	Nellore ...	25·8	17	Ganjam ...	17·0	17	Vizianagrum ...	35·1	17	Adóni	32·4
18	Malabar ...	24·5	18	Nellore ...	16·6	18	Tirupatúr ...	33·5	18	Wálajápet ...	32·4
19	Ganjam ...	20·7	19	Coimbatore ...	16·5	19	Conjeeveram ...	33·2	19	Erode	32·2
20	Vizagapatam.	20·7	20	Nílgiris ...	15·1	20	Kurnool ...	33·1	20	Cuddapah ...	31·7
21	Godávari ...	20·6	21	Godávari ...	14·9	21	Pálghat ...	33·0	21	Tuticorin ...	31·7
22	Nílgiris ...	17·3	22	Vizagapatam.	11·7	22	Bezváda ...	32·9	22	Dindigul ...	31·6
						23	Salem	32·2	23	Cochin ...	30·2
						24	Bimlipatam ...	32·1	24	Karúr	29·7
						25	Srírangam ...	31·5	25	Madura ...	29·5
						26	Máyavaram ...	31·1	26	Tinnevelly ...	29·3
						27	Gudiyátam ...	30·5	27	Negapatam ...	28·8
						28	Vizagapatam ...	30·2	28	Chidambaram ...	28·7
						29	Adóni	30·1	29	Vizianagrum ...	28·4
						30	Palamcottah ...	29·8	30	Vellore ...	27·8
						31	Cocanada ...	29·7	31	Tanjore ...	27·4
						32	Tellicherry ...	29·1	32	Trichinopoly ...	27·4
						33	Masulipatam ...	28·7	33	Coimbatore ...	26·3
						34	Ootacamund ...	28·3	34	Coonoor ...	25·9
						35	Palni	27·7	35	Pálghat ...	25·6
						36	Bellary ...	27·4	36	Rajahmundry ...	25·4
						37	Nellore ...	27·2	37	Tirupatúr ...	24·8
						38	Ellore ...	26·6	38	Nellore ...	24·4
						39	Rajahmundry ...	26·0	39	Bimlipatam ...	24·1
						40	Kumbakónam ...	25·7	40	Chicacole ...	23·6
						41	Mannárgudi ...	25·4	41	Periyakulam ...	23·1
						42	Berhampore ...	25·1	42	Palni	23·0
						43	Chicacole ...	23·9	43	Mannárgudi ...	23·0
						44	Chidambaram ...	23·9	44	Vizagapatam ...	22·8
						45	Guntúr ...	22·8	45	Anakapalle ...	22·5
						46	Tanjore ...	22·4	46	Ongole	20·9
						47	Cannanore ...	21·1	47	Parlákimedi ...	20·8
						48	Coonoor ...	20·9	48	Cuddalore ...	19·6
						49	Tinnevelly ...	20·9	49	Cocanada ...	19·4
						50	Negapatam ...	19·9	50	Guntúr	18·8
						51	Cuddapah ...	19·5	51	Ellore	18·7
						52	Cuddalore ...	18·3	52	Ootacamund ...	18·6
						53	Parlákimedi ...	17·9	53	Vániyambádi ...	17·9
						54	Trichinopoly ...	14·9	54	Masulipatam ...	17·2
						55	Tirupati ...	9·6	55	Tirupati ...	17·2
	Total ...	28·7		Total ...	20·9		Total ...	30·1		Total ...	29·7

This table shows the great difference that exists between the mortality in municipalities and districts. The average death-rate of the 55 Municipal towns was 29·7 per 1,000, or 8·8 higher than the district rate. This shows how much has still to be done for the sanitation of our large towns, and also that improved

sanitation is more urgently required in them than in the country. In 23 municipalities the death-rate ranged from 30 to 50 per 1,000, in 24 from 20 to 30, and in 8 the death-rate was below 20 per 1,000.

The highest recorded death-rates are those of the towns of Gudiyátam and Calicut, viz., 50·5 and 44·0 per 1,000, respectively, although the death-rates of the districts of North Arcot and Malabar are only 20·7 and 18·5 per 1,000 respectively. The lowest death-rates were recorded in the towns of Tirupati, Masulipatam and Vániyambádi, and are almost certainly due to defective registration.

SECTION VI.

GENERAL HISTORY OF CHIEF DISEASES.

23. The subjoined table shows the number of deaths registered under the principal causes of mortality during the year 1888 compared with previous years :—

Years.	Total deaths.	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	Other causes.	Years.
1868 ...	390,956	8,036	34,330	105,692	...	9,242	233,659	1868
1869 ...	451,981	21,034	17,448	132,346	...	9,310	271,843	1869
1870 ...	451,020	55,867	11,252	151,027	...	12,325	220,549	1870
1871 ...	444,371	17,656	20,823	192,469	38,928	15,323	159,172	1871
1872 ...	501,482	13,247	39,074	214,148	39,387	16,150	180,476	1872
1873 ...	506,894	840	51,784	222,843	36,392	14,251	180,784	1873
1874 ...	516,848	313	48,343	226,220	37,993	13,065	190,914	1874
1875 ...	641,260	94,546	24,775	252,042	37,484	12,421	219,992	1875
1876 ...	680,384	148,193	23,469	230,092	38,176	11,175	229,279	1876
1877 ...	1,556,312	357,430	88,321	469,241	133,366	16,460	491,494	1877
1878 ...	810,921	47,167	56,360	374,443	48,083	15,007	269,861	1878
1879 ...	549,390	13,296	17,840	285,477	23,218	12,619	196,940	1879
1880 ...	454,101	613	14,529	209,940	19,622	10,845	198,552	1880
1881 ...	465,682	9,416	15,776	203,542	18,961	11,527	206,430	1881
1882 ...	470,700	23,604	20,159	188,561	19,958	11,611	206,807	1882
1883 ...	541,930	36,284	37,975	203,786	22,098	11,509	230,278	1883
1884 ...	650,335	75,476	61,247	215,977	28,775	11,502	257,358	1884
1885 ...	615,449	58,109	34,726	218,786	31,209	11,659	260,960	1885
1886 ...	553,927	12,417	17,129	221,679	27,379	13,103	262,220	1886
1887 ...	604,775	28,359	21,472	240,860	26,679	11,328	276,077	1887
1888 ...	597,015	58,677	21,858	204,561	27,721	11,401	272,797	1888

This statement shows that, although the total mortality was less than that recorded in 1887, yet the number of deaths registered under each of the principal causes (with the exception of " fevers " and " other causes ") was greater.

CHOLERA.

24. During the year 1888 there were 58,677 deaths registered from cholera in the Presidency, or 30,318 more than in the preceding year. The total number of deaths from cholera for the past 21 years is seen in the table above. The number of cholera deaths in 1888 was exceeded in 4 out of the 20 years quoted and was 16,548 above the last quinquennial mean. The following table shows the ratios of cholera deaths for the past 21 years :—

Years.	Ratio of cholera deaths per mille of population.	Years.	Ratio of cholera deaths per mille of population.
1868	0·3	1879	0·4
1869	0·8	1880	0·02
1870	2·3	1881	0·3
1871	0·7	1882	0·8
1872	0·4	1883	1·2
1873	0·02	1884	2·7
1874	0·01	1885	2·06
1875	3·1	1886	0·4
1876	5·08	1887	1·01
1877	12·2	1888	2·1
1878	1·6		

This table and also the one above, *vide* para. 23, clearly show the cycle in which the disease seems to run, viz., that every sixth year is a year of minimum intensity. The years of minimum intensity were 1868, 1874, 1880 and 1886, and it will be interesting to see if 1892 will also be a year of minimum intensity.

25. The next table shows the monthly distribution of the deaths from cholera for the past eight years :—

Years.	Deaths from cholera.												Total.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1881	51	4	12	92	92	151	16	1	4	297	1,323	7,403	9,446
1882	10,794	4,193	1,081	491	590	843	550	780	644	777	799	2,062	23,604
1883	3,671	1,826	1,392	1,007	497	1,168	2,248	1,298	623	1,247	6,143	15,164	36,284
1884	21,268	7,362	2,374	1,550	2,108	3,975	6,267	3,298	2,677	1,645	3,639	19,313	75,476
1885	22,885	8,366	5,385	3,617	3,883	2,703	4,686	3,077	1,439	723	681	664	58,109
1886	1,224	554	582	1,219	1,597	1,214	1,564	774	640	1,111	1,003	935	12,417
1887	945	679	1,111	483	966	1,445	1,184	2,104	1,718	1,640	2,258	13,626	28,359
1888	18,787	9,399	4,421	2,251	1,694	2,565	4,587	3,551	1,805	1,813	1,494	6,310	58,677
Ratio per mille of population for 1888.	0·6	0·3	0·1	0·08	0·06	0·09	0·1	0·1	0·06	0·06	0·05	0·2	2·1
Number of districts affected during 1888	18	21	20	16	17	19	19	20	18	14	16	19	21

There was no month in the year when cholera was absent from the Madras Presidency. Taking the totals for each month it would appear that, as regards the Madras Presidency, cholera attains its maximum degree of intensity during the cold weather months. As a rule the greatest number of deaths are registered in either December or January.

In January 1888 the exciting cause of the disease was especially active when 18,787 deaths were registered. The disease then gradually subsided, and in May the deaths recorded were 1,694. In June and July the disease became intensified, causing 2,565 and 4,587 deaths respectively; it then decreased till December, when a rise took place.

26. The deaths from cholera in the several districts in the Presidency during each month of the year are given in annual Form VII in the Appendix. The only district in the Presidency in which the disease did not appear was the Nílgiris. The ravages of the disease were most severely felt in the district of Tanjore, where 9,120 deaths (4·3 per 1,000 of population) were registered. In Tinnevelly District the death-rate was also high, viz., 4·3 per 1,000 of population. In the Vizagapatam District its incidence was but slight, 257 deaths being reported.

27. Of the 58,677 deaths registered from cholera, 30,397 were males and 28,280 females. The ratio per mille of males was 2·2 and of females 2·0. The female deaths exceeded the male deaths in three districts (Madras, Malabar and South Canara), but in the remaining 19 the reverse was the case.

28. Annual Form VI-B shows the mortality from different causes in the principal towns of the Presidency. Of the 77 towns, 64 suffered from cholera during the year, and in 13 no deaths were recorded. In the following 26 towns the death-rate was above 5 per mille of population, and this is exceedingly high :—

Name of town.	Name of district.	Population of town.	Death-rate per 1,000.
Gudiyátam	North Arcot	16,690	30·3
Ponáni	Malabar	12,421	20·6
Cannanore	Do.	26,386	18·3
Calicut	Do.	57,085	16·9
Anantapur	Anantapur	4,907	13·4
Tellicherry	Malabar	24,581	12·1
Tenkási	Tinnevelly	11,987	10·8
Ádóni	Bellary	22,441	10·4

Name of town.	Name of district.	Population of town.	Death-rate per 1,000.
Palamcottah	Tinnevelly	17,964	10·0
Tinnevelly	Do.	23,221	9·9
Viravanallur	Do.	12,318	9·6
Ambúr	North Arcot	10,300	8·8
Conjeeveram	Chingleput	37,275	8·6
Salem	Salem	59,631	8·2
Kalladakurchi	Tinnevelly	10,936	7·1
Kumbakónam	Tanjore	50,098	6·9
Saidápet	Chingleput	10,290	6·6
Chidambaram	South Arcot	19,837	6·6
Tanjore	Tanjore	54,745	6 6
Erode	Coimbatore	9,864	6·3
Arcot	North Arcot	10,718	6·2
Negapatam	Tanjore	53,775	5·8
Tirupati	North Arcot	13,232	5·5
Karúr	Coimbatore	9,205	5·2
Máyavaram	Tanjore	23,044	5·2
Trichinopoly	Trichinopoly	84,449	5·1

29. Of the 55 municipal towns (excluding Madras) 50 were affected. The following table shows the mortality from cholera in the 50 towns which were affected and the death-rate in each as compared with the death-rate of the district in which it is situated:—

Districts, exclusive of municipal towns.	Ratio of cholera deaths per mille of population.	Municipalities.	Ratio of cholera deaths per mille of population.
Anantapur	1·6	Anantapur	13·4
		Bellary	2·1
Bellary		Adóni	10·4
Chingleput	2·3	Conjeeveram	8·6
Coimbatore	0·9	Coimbatore	1·3
		Erode	6·3
		Karúr	5·2
Cuddapah	1·9	Cuddapah	5·0
		Berhampore	2·2
Ganjam	0·6	Chicacole	1·7
		Parlakimedi	0·06
		Ellore	1·0
Godávari	1·6	Rajahmundry	0·3
		Cocanada	0·09
		Masulipatam	1·7
Kistna	2·2	Guntúr	2·5
		Bezváda	2·5
Kurnool	0·5	Kurnool	1 3
		Madura	1·1
Madura	0·6	Dindigul	2·9
		Periyakulam	0·1
		Palni	0·4
		Tellicherry	12·1
		Calicut	16·9
Malabar	1·9	Pálghat	1·0
		Cochin	2·6
		Cannanore	18·3
Nellore	1·0	Nellore	4·3
		Ongole	1·6
		Vellore	4 2
North Arcot	2·4	Wálajápet	2·7
		Gudiyátam	30·3
		Tirupati	5·5
		Salem	8·2
Salem	1·7	Vániyambádi	1·4
		Tirupatúr	0·7
South Arcot	1·5	Cuddalore	3·6
		Chidambaram	6·6
South Canara	1·5	Mangalore	2·1

Districts, exclusive of municipal towns.	Ratio of cholera deaths per mille of population.	Municipalities.	Ratio of cholera deaths per mille of population.
Tanjore	4·0	Tanjore	6·6
		Kumbakónam	6·9
		Negapatam	5·8
		Máyavaram	5·2
		Mannárgudi	4·2
Tinnevelly	4·1	Tinnevelly	9·9
		Palamcottah	10·0
		Tuticorin	0·7
Trichinopoly	3·5	Trichinopoly	5·1
		Srírangam	3·9
Vizagapatam	0·2	Vizianagrum	0·09

In 38 municipal towns the death-rate exceeded that of the district, and in 12 it was less. In 5 Municipalities (Ootacamund, Coonoor, Vizagapatam, Bimlipatam and Anakápalle) no deaths were recorded from cholera.

30. The table on page 18 is the statement ordered by the Government of India to be appended to the cholera map, and it shows each district affected by cholera, its population, the dates of first and last cases, the total cholera deaths, their ratios per 1,000 of population, the period of maximum intensity, the number of villages in the districts, and the number of those affected and not affected by the disease.

31. The measures which were resorted to by the district authorities to prevent the spread of the disease were generally satisfactory. On cholera making its appearance in any town or village, steps were at once taken to improve the surface conservancy and to conserve, as far as possible, the water-supply. In some cases people were prevented from taking water from supplies which were thought bad. These measures, although they may have had some effect, can only be looked upon as palliative, the real remedy being the introduction of cleanliness into every village at *all* times irrespective of epidemic times or seasons, and not confined only to periods when sickness is prevailing. The chief factor in reducing the mortality, not only from cholera, but also other diseases and notably fevers which cause many more deaths than cholera does, has been the introduction of cleanliness in villages and towns, and wherever thorough cleanliness prevails the mortality is reduced.

Statement illustrating the distribution, &c., of Cholera in the Madras Presidency during the year 1888, *to accompany the Cholera Map.*

1	2	3	4	5	6	7		8	9	10	
Districts.	Number of Circles of Registration.	Name of the Circle.	Population for which Returns were received.	Date of First Case of Cholera in the Circle during the Year.	Date of Last Case of Cholera in the Circle during the Year.	Cholera.		Period of Maximum Intensity of the Disease.	Number of Villages in each of the Circles.	Number of those	
						Total Deaths in each of the Circles.	Ratio per 1,000 of Population.			Affected by Cholera.	Not affected by Cholera.
Ganjam.	1	Chicacole Taluk ...	152,540	5th Feb. ...	29th Feb....	21	0·1	...	307	2	305
	2	Berhampore do. ...	209,221	6th Feb. ...	30th Dec....	319	1·5	August ...	552	44	508
	3	Gumsoor do. ...	139,469	18th Aug....	29th Dec....	56	0·4	November...	825	15	810
	4	M. T. Chicacole ...	18,302	14th Feb. ...	17th Mar....	31	1·7	March ...	1	1	...
	5	M. T. Berhampore ...	23,599	7th Feb. ...	14th Dec. ...	54	2·2	February ...	1	1	...
	6	M. T. Parlákimedi ...	15,365	16th Aug....	16th Aug.	1	0·06	...	1	1	...
	7	Zemindaries	406,159	25th Feb....	31st Dec....	206	0·5	August ...	2,754	36	2,718
	8	Agency Tracts ...	8,798	...	...	...	...	...	2,733	...	2,733
		Total ...	973,453	5th Feb. ...	31st Dec....	688	0·7	August ...	7,174	100	7,074
Vizagapatam.	9	Sarvasiddhi Taluk.	107,538	...	...	...	...	...	152	...	152
	10	Narsapatnam do.	76,702	...	...	...	...	...	178	...	178
	11	Anakápalle do.	68,920	5th May ...	10th May...	9	0·1	...	144	1	143
	12	Vizagapatam do.	27,282	...	...	...	...	...	74	...	74
	13	Viravilli do.	128,632	11th Feb....	25th June...	187	1·4	March ...	238	20	218
	14	Bimlipatam do.	53,923	...	...	...	...	...	117	...	117
	15	Srunguvarapukottah do.	98,973	...	...	...	...	...	178	...	178
	16	Vizianagrum do.	73,394	8th Sept.	15th Sept....	7	0·09	...	186	1	185
	17	Gajapatinagar do.	83,288	3rd Aug....	7th Aug. ..	3	0·03	...	224	1	223
	18	Chipurupalle do.	94,716	12th Aug....	12th Aug....	1	0·01	...	268	1	267
	19	Sálúr do.	49,388	...	...	...	...	...	156	...	156
	20	Bobbili do.	95,116	4th Sept.	13th Sept....	9	0·09	...	178	1	177
	21	Pálkonda do.	113,716	2nd Aug...	22nd Dec....	9	0·07	August ...	362	6	356
	22	Párvatipur do.	66,252	2nd Jan....	16th Feb. ...	30	0·4	January ...	208	1	207
	23	M. T. Vizagapatam ...	30,291	...	...	...	...	...	1	...	1
	24	M. T. Bimlipatam ...	8,582	...	...	...	...	...	1	...	1
	25	M. T. Vizianagrum ...	22,577	6th Sept.	8th Sept....	2	0·09	...	1	1	...
	26	M. T. Anakápalle ...	13,341	...	...	...	...	...	1	...	1
		Total ...	1,232,631	2nd Jan. ...	22nd Dec....	257	0·2	March ...	2,667	33	2,634
Godávari.	27	Rámachandrapuram Taluk	220,780	10th Feb....	23rd April.	164	0·7	February ...	163	15	148
	28	Amalápuram do.	227,157	15th Feb....	30th Aug....	47	0·2	August ...	172	4	168
	29	Narsápur do.	200,153	15th Mar....	17th Sept...	747	3·7	July ...	139	60	79
	30	Bhimavaram do.	108,599	24th Feb....	6th Sept....	751	6·9	Do. ...	149	54	95
	31	Tanuku do.	188,306	1st Feb....	12th Sept...	809	4·3	Do. ...	180	40	140
	32	Ellore do.	124,216	6th Jan. ...	1st Aug....	118	0·9	April ...	248	10	238
	33	Yernagúdem do.	159,364	7th Jan. ..	3rd Sept...	94	0·6	June ...	211	6	205
	34	Rajahmundry do.	106,641	9th Feb....	16th April.	24	0·2	April ...	139	2	137
	35	Peddápuram do.	124,314	...	...	...	...	...	213	...	213
	36	Bhadráchalam do.	35,656	...	...	...	...	...	313	...	313
	37	M. T. Cocanada ...	30,441	6th Feb. ...	20th Feb. ...	3	0·09	...	1	1	...
	38	M. T. Rajahmundry ...	24,555	15th Feb....	3rd April.	9	0·3	April ...	1	1	...
	39	M. T. Ellore	25,092	21st Jan....	3rd Mar....	26	1·0	February ...	1	1	...
	40	Zemindaries	216,238	18th Jan....	26th Mar....	17	0·08	March ...	272	4	268
		Total ...	1,791,512	6th Jan....	17th Sept...	2,809	1·6	July ...	2,202	198	2,004
Kistna.	41	Répalle Taluk ...	184,340	1st Jan. ...	10th Aug.	401	2·2	February ...	150	64	86
	42	Bápatla do. ...	151,736	Do. ...	4th Sept...	443	2·9	Do. ...	114	64	50
	43	Guntúr do. ...	116,437	8th Jan....	10th June.	129	1·1	Do. ...	113	30	83
	44	Palnád do. ...	125,799	10th Feb....	3rd Sept...	98	0·7	March ...	97	14	83
	45	Narasaraopet do. ...	128,791	15th Jan....	19th April.	628	4·8	February ...	114	32	82
	46	Gudiváda do. ...	99,233	1st Jan. ...	20th Aug...	108	1·0	Do. ...	203	20	183
	47	Sattenapalle do. ...	140,426	4th Jan....	20th Sept...	465	3·3	March ...	194	46	148
	48	Masulipatam do. ...	107,288	26th Jan....	10th Aug...	181	1·6	February ...	172	21	151
	49	Nandigáma do. ...	73,559	1st Jan....	14th Aug...	232	3·1	Do. ...	111	30	81
	50	Bezváda do. ...	66,977	2nd Feb....	18th April.	166	2·4	Do. ...	71	11	60
	51	Vinukonda do. ...	35,056	2nd Jan....	20th Aug....	63	1·7	Do. ...	1	1	...
	52	M. T. Masulipatam ...	19,646	23rd Jan....	11th Mar....	50	2·5	Do. ...	1	1	...
	53	M. T. Guntúr	9,336	2nd April.	23rd July ..	23	2·5	April ...	1	1	...
	54	M. T. Bezváda ...	179,566	1st Jan. ...	3rd Sept...	222	1·2	February ...	321	43	278
	55	Zemindaries	1,548,480	1st Jan. ...	20th Sept...	3,422	2·2	February ...	1,837	396	1,441
		Total ...									
Nellore.	56	Gúdúr Taluk	89,033	1st Jan. ...	24th Sept...	115	1·3	January ...	124	15	109
	57	Rápúr do.	49,214	17th Jan....	11th April.	25	0·5	April ...	116	1	115
	58	Nellore do.	133,025	3rd Jan. ...	8th Nov. ..	244	1·8	February ...	154	27	127
	59	Atmakúr do.	82,642	1st Jan. ...	6th April.	114	1·4	Do. ...	112	14	98
	60	Kávali do.	59,444	5th Jan. ...	29th April.	92	1·5	April ...	57	4	53
	61	Udayagiri do.	47,306	1st Jan. ...	4th Feb....	22	0·5	February ...	54	2	52
	62	Kanukúr do.	96,884	3rd Jan. ...	19th April.	117	1·2	Do. ...	126	10	116
	63	Kanigiri do.	50,174	11th Mar....	11th Mar....	1	0·02	...	58	1	57

Statement illustrating the distribution, &c., of Cholera in the Madras Presidency during the year 1888, *to accompany the Cholera Map*—continued.

1	2	3	4	5	6	7		8	9	10	
Districts.	Number of Circles of Registration.	Name of the Circle.	Population for which Returns were received.	Date of First Case of Cholera in the Circle during the Year.	Date of Last Case of Cholera in the Circle during the Year.	Cholera.		Period of Maximum Intensity of the Disease.	Number of Villages in each of the Circles.	Number of those	
						Total Deaths in each of the Circles.	Ratio per 1,000 of Population.			Affected by Cholera.	Not affected by Cholera.
Nellore—*cont.*	64	Ongole Taluk	143,503	1st Jan. ...	6th Dec. ...	387	2·7	February ...	124	37	87
	65	M. T. Nellore	27,505	7th Jan....	1st April...	120	4·3	Do. ...	1	1	...
	66	M. T. Ongole	9,200	3rd Feb....	23rd Feb. ...	15	1·6	...	1	1	...
	67	Zemindaries	397,188	4th Jan....	29th Dec. ...	111	0·3	February ...	947	21	926
		Total ...	1,185,118	1st Jan....	29th Dec. ...	1,363	1·2	February ...	1,874	134	1,740
Madras.	68	Madras Town	405,848	3rd Jan....	27th Dec. ...	521	1·3	August ...	1	1	...
Chingleput.	69	Saidápet Taluk ...	204,580	1st Jan. ...	30th Dec ...	654	3·2	September...	281	70	211
	70	Chingleput do. ...	117,218	5th Jan. ...	Do. ...	214	1·8	June ...	302	53	249
	71	Madurántakam do. ...	223,067	11th Jan. ...	31st Dec. ...	163	0·7	Sept. & Oct.	510	52	458
	72	Conjeeveram do. ...	148,374	1st Jan. ...	30th Dec. ...	495	3·3	August ...	373	70	303
	73	Tiruvallúr do. ...	143,324	Do. ...	14th Dec. ...	355	2·5	January ...	293	56	237
	74	Ponnéri do. ...	107,543	2nd Jan....	31st Dec. ...	358	3·3	Do. ...	240	58	182
	75	M. T. Conjeeveram ...	37,275	1st Jan. ..	27th Dec. ...	322	8·6	Do. ...	1	1	...
		Total ...	981,381	1st Jan. ...	31st Dec. ...	2,561	2·6	January ...	2,000	360	1,640
South Arcot.	76	Cuddalore Taluk ...	254,978	7th Feb. ...	31st Dec. ...	486	1·9	December...	241	72	169
	77	Villupuram do. ...	243,896	1st Feb. ...	Do. ...	129	0·5	February ...	319	28	291
	78	Chidambaram do. ...	245,413	1st Jan. ...	Do. ..	775	3·1	January ...	493	147	346
	79	Tindivanam do. ...	264,261	16th Jan. ...	29th Dec. ...	190	0·7	October ...	563	33	530
	80	Kallakurchi do. ...	196,029	4th Jan. ...	31st Dec. ...	112	0·6	February ...	315	29	286
	81	Tirukoilúr do. ...	206,489	28th Jan. ...	Do. ...	320	1·5	December...	374	57	317
	82	Tiruvannámalai do. ...	154,859	6th Feb. ...	28th Dec. ...	75	0·5	Do. ...	516	18	498
	83	Vriddháchalam do. ...	187,068	3rd Jan. ...	31st Dec. ...	583	3·1	February ...	323	83	240
	84	M. T. Cuddalore ...	43,545	29th Feb. ..	30th Dec. ...	156	3·6	November...	1	1	...
	85	M. T. Chidambaram ...	19,837	2nd Jan. ...	31st Dec. ...	131	6·6	December...	1	1	...
		Total ...	1,816,375	1st Jan. ...	31st Dec. ...	2,957	1·6	December...	3,146	469	2,677
Trichinopoly.	86	Trichinopoly Taluk ...	231,296	1st Jan. ...	31st Dec. ...	877	3·7	January ...	360	189	171
	87	Musiri do. ...	258,068	Do. ...	28th Dec. ...	732	2·8	Do. ...	208	98	110
	88	Kulitalai do. ...	201,990	Do. ...	21st Dec. ...	248	1·2	Do. ...	131	41	90
	89	Perambalúr do. ...	172,281	Do. ...	31st Dec. ...	519	3·0	Do. ...	199	82	117
	90	Udayárpálaiyam do. ...	247,176	Do. ..	30th Dec. ...	1,546	6·2	Do. ...	595	146	449
	91	M. T. Trichinopoly ...	84,449	Do. ...	25th June ...	431	5·1	Do. ...	1	1	...
	92	M. T. Srírangam ...	19,773	Do. ...	22nd June...	77	3·9	Do. ...	1	1	...
		Total ...	1,215,033	1st Jan. ...	31st Dec. ...	4,430	3·6	January ...	1,495	558	937
Tanjore.	93	Tanjore Taluk ...	320,341	1st Jan. ...	31st Dec. ...	1,452	4·5	January ...	407	25	382
	94	Kumbakónam do. ...	320,625	Do. ...	Do. ...	2,719	8·4	Do. ...	505	42	463
	95	Máyavaram do. ...	215,950	Do. ...	Do. ...	746	3·4	Do. ...	341	16	325
	96	Shiyáli do. ...	114,041	2nd Jan. ...	30th Dec. ...	327	2·8	Do. ...	191	12	179
	97	Nannilam do. ...	220,202	1st Jan. ...	31st Dec. ...	1,191	5·4	Do. ...	397	25	372
	98	Negapatam do. ...	163,091	Do. ...	20th Dec. ...	488	2·9	Do. ...	322	17	305
	99	Mannárgudi do. ...	162,241	Do. ...	16th Nov....	277	1·7	Do. ...	299	8	291
	100	Tirnturaipúndi do. ...	168,103	Do. ...	29th Dec. ...	114	0·6	Do. ...	238	7	231
	101	Patukóta do. ...	244,717	2nd Jan. ...	Do. ...	582	2·3	October ...	840	15	825
	102	M. T. Tanjore	54,745	1st Jan. ...	30th Dec. ...	364	6·6	January ...	1	1	...
	103	M. T. Kumbakónam ...	50,098	Do. ...	4th July ...	346	6·9	Do. ...	1	1	...
	104	M. T. Máyavaram ...	23,044	Do. ...	25th Dec. ...	121	5·2	Do. ...	1	1	...
	105	M. T. Negapatam ...	53,776	Do. ...	31st Dec. ...	312	5·8	February ...	1	1	...
	106	M. T. Mannárgudi ...	19,409	2nd Jan. ...	22nd Mar....	82	4·2	Do. ...	1	1	...
		Total ...	2,130,383	1st Jan. ...	31st Dec. ...	9,120	4·3	January ...	3,545	172	3,373
Madura.	107	Madura Taluk ...	138,486	18th Jan. ...	31st Dec. ...	66	0·5	December...	277	10	267
	108	Melúr do. ...	132,537	2nd Jan. ...	28th Dec. ..	76	0·5	August ...	90	14	76
	109	Tirumangalam do. ...	203,693	29th April...	27th Dec. ...	101	0·4	May ...	266	15	251
	110	Periyakulam do. ...	215,677	22nd Jan. ...	20th May....	8	0·4	Do. ...	85	2	83
	111	Dindigul do. ...	290,601	1st Jan. ...	31st Dec. ...	334	1·1	February ...	210	45	165
	112	Palni do. ...	158,200	28th Jan. ...	13th May ...	86	0·5	Do. ...	124	15	109
	113	Sattenandal Villages ...	1,161	...	...	...	...	...	4	...	4
	114	M. T. Madura	76,847	2nd Jan. ...	31st Dec. ...	83	1·1	January ...	1	1	...
	115	M. T. Dindigul ...	14,182	8th Jan. ..	Do. ...	41	2·9	December...	1	1	...
	116	M. T. Periyakulam ...	13,315	5th April...	10th June...	2	0·1	...	1	1	...
	117	M. T. Palni	16,446	23rd Jan. ...	29th Jan. ...	5	0·4	...	1	1	...
	118	Zemindaries	33,237	10th Jan. ...	Dec. ...	57	1·7	January ...	3	2	1
		Total ...	1,294,382	1st Jan. ...	31st Dec. ...	859	0·6	February ...	1,063	107	956

Statement illustrating the distribution, &c., of Cholera in the Madras Presidency during the year 1888, *to accompany the Cholera Map*—continued.

1	2	3	4	5	6	7		8	9	10	
Districts.	Number of Circles of Registration.	Name of the Circle.	Population for which Returns were received.	Date of First Case of Cholera in the Circle during the Year.	Date of Last Case of Cholera in the Circle during the Year.	Cholera.		Period of Maximum of the Intensity of Disease.	Number of Villages in each of the Circles.	Number of those	
						Total Deaths in each of the Circles.	Ratio per 1,000 of Population.			Affected by Cholera.	Not affected by Cholera.
Tinnevelly.	119	Otapidáram Taluk ...	253,516	3rd Jan....	30th Dec....	46	0·2	January ...	412	19	393
	120	Tenkarai do. ...	283,110	1st Jan. ...	31st Dec....	1,917	6·7	Do. ...	155	105	50
	121	Tinnevelly do. ...	130,193	Do. ...	Do. ...	1,068	8·2	Do. ...	143	82	61
	122	Srívilliputur do. ...	163,608	20th Jan....	25th Feb....	6	0·03	February ...	111	2	109
	123	Sankaranainárkoil do. ...	181,064	5th Jan. ...	31st Dec....	48	0·2	Do. ...	114	16	98
	124	Nángunéri do. ...	174,347	1st Jan. ...	Do. ...	1,970	11·2	December...	250	151	99
	125	Ambásamudram do. ...	165,152	Do. ...	Do. ...	1,110	6·7	January ...	94	70	24
	126	Sátúr do. ...	150,886	16th May ...	28th Dec....	85	0·5	May ...	230	16	214
	127	Tenkási do. ...	140,405	2nd Jan. ...	31st Dec....	610	4·3	February ...	104	47	57
	128	M. T. Tinnevelly ...	23,221	1st Jan. ...	Do. ...	231	9·9	January ...	1	1	...
	129	M. T. Palamcottah ...	17,964	Do. ...	29th Dec....	179	10·0	Do. ...	1	1	...
	130	M. T. Tuticorin ...	16,281	4th Jan. ...	31st Dec....	11	0·7	December...	1	1	...
		Total ...	1,699,747	1st Jan. ...	31st Dec....	7,281	4·3	January ...	1,616	511	1,105
Kurnool.	131	Rámallakót Taluk ...	74,369	26th May...	18th Aug....	127	1·7	July ...	106	15	91
	132	Pattikonda do. ...	105,438	12th June...	7th Dec....	42	0·3	June ...	107	12	95
	133	Nandikótkur do. ...	72,741	11th Feb....	20th Aug....	16	0·2	February ...	101	6	95
	134	Nandyál do. ...	78,282	31st May ...	19th Dec....	3	0·03	...	92	2	90
	135	Koilkuntla do. ...	76,296	25th July ...	25th July ...	1	0·01	...	85	1	84
	136	Sirvél do. ...	57,197	...	...	...	...	...	86	...	86
	137	Cumbum do. ...	109,851	15th Feb....	30th Dec....	124	1·1	March ...	101	18	83
	138	Márkápur do. ...	84,048	Do. ...	31st Dec. ...	71	0·8	December...	79	12	67
	139	M. T. Kurnool ...	20,329	26th June...	12th Aug....	27	1·3	July ...	1	1	...
		Total ...	678,551	11th Feb....	31st Dec....	411	0·6	July ...	758	67	691
Cuddapah.	140	Badvél Taluk ...	82,445	13th Jan....	22nd Sept...	25	0·3	July ...	115	5	110
	141	Proddutur do. ...	90,653	24th June...	10th Oct...	237	2·6	August ...	90	21	69
	142	Sidhout do. ...	59,076	2nd Jan....	4th Oct....	57	0·9	January ...	79	10	69
	143	Pullampet do. ...	134,366	1st Jan. ...	31st Dec ...	1,115	8·3	Do. ...	130	54	76
	144	Cuddapah do. ...	128,471	Do. ...	13th Dec....	354	2·7	September...	146	41	105
	145	Jammalamadugu do. ...	91,958	24th Mar....	29th Sept...	105	1·1	Do. ...	127	11	116
	146	Pulivendla do. ...	95,617	14th Jan...	23rd Nov....	73	0·7	August ...	105	15	90
	147	Ráyachóti do. ...	92,541	1st Jan. ...	14th Dec....	97	1·0	January ...	93	17	76
	148	Kadiri do. ...	116,252	7th Feb....	10th Sept	17	0·1	February ...	139	11	128
	149	Váyalpád do. ...	104,462	1st Jan. ...	26th Dec....	34	0·3	December...	117	9	108
	150	Madanapalle do. ...	106,215	Do. ...	27th Nov....	6	0·05	January ...	96	4	92
	151	M. T. Cuddapah ...	18,982	Do. ...	25th Dec....	93	5·0	August ...	1	1	...
		Total ...	1,121,038	1st Jan. ...	31st Dec. ...	2,213	2·0	January ...	1,238	199	1,039
Bellary.	152	Bellary Taluk ...	95,477	9th Mar. ..	12th Dec....	106	1·1	June ...	170	19	151
	153	Hospet do. ...	84,986	7th Mar. ..	24th Dec....	153	1·8	Do. ...	149	24	125
	154	Kúdligi do. ...	74,690	7th June...	31st Dec....	82	1·09	October ...	384	11	373
	155	Hadagalli do. ...	75,572	11th Jan. ...	18th Dec....	237	3·1	Do. ...	152	28	124
	156	Harpanahalli do. ...	70,620	8th Oct. ...	30th Dec. .	123	1·7	November...	250	13	237
	157	Alúr do. ...	65,586	8th June...	29th Dec....	248	3·7	June & Dec.	108	24	84
	158	Adóni do. ...	99,644	26th Feb....	8th Dec....	262	2·6	June ...	202	25	177
	159	Ráyadrug do. ...	83,799	1st Jan. ...	11th Dec. ..	30	0·3	January ...	156	6	150
	160	M. T. Bellary	53,460	25th Jan. ...	23rd Dec....	112	2·1	December...	1	1	...
	161	M. T. Adóni	22,441	29th May ...	28th Dec....	235	10·4	June ...	1	1	...
	162	Zemindaries	10,532	2nd June...	25th Dec....	63	5·9	November...	24	9	15
		Total ...	736,807	1st Jan. ...	31st Dec....	1,651	2·2	June ...	1,597	161	1,436
Anantapur.	163	Anantapur Taluk ...	86,909	2nd Aug....	31st Oct....	106	1·2	August ...	122	17	105
	164	Gooty do. ...	110,597	8th Feb....	31st Dec. ..	70	0·6	September...	153	10	143
	165	Tadpatri do. ...	98,964	5th June ..	20th Oct....	224	2·1	July ...	96	21	75
	166	Penukonda do. ...	73,023	6th July...	4th Oct....	28	0·4	September...	99	4	95
	167	Dharmavaram do. ...	97,106	9th July..	31st Dec....	331	3·4	August ...	185	24	161
	168	Hindupur do. ...	73,270	26th Oct. ...	26th Oct....	1	0·01	...	100	1	99
	169	Madakasíra do. ...	55,113	...	...	...	...	...	150	...	150
	170	M. T. Anantapur ...	4,907	29th July ...	16th Nov....	66	13·4	October ...	1	1	...
		Total ...	599,889	8th Feb....	31st Dec....	826	1·4	August ...	906	78	828
North Arcot.	171	Chittoor Taluk ...	171,907	1st Jan. ...	31st Dec....	242	1·4	January ...	337	19	318
	172	Chendragiri do. ...	79,919	Do. ...	Do. ...	298	2·7	Do. ...	227	27	200
	173	Palmanér. do. ...	41,815	Do. ...	20th Feb ...	32	0·7	Do. ...	88	4	84
	174	Gudiyátam do. ...	137,956	2nd Jan....	31st Dec....	336	3·4	Do. ...	177	42	135
	175	Vellore do. ...	129,258	1st Jan. ...	Do. ...	1,012	7·8	Do. ...	151	43	108
	176	Pólúr do. ...	111,877	4th Jan. ..	29th Dec....	109	0·9	Do. ...	265	19	246
	177	Wandiwash do. ...	148,100	7th Jan....	31st Dec....	129	0·8	December...	285	35	250

Statement illustrating the distribution, &c., of Cholera in the Madras Presidency during the year 1888, *to accompany the Cholera Map*—continued.

1	2	3	4	5	6	7		8	9	10	
Districts.	Number of Circles of Registration.	Name of the Circle.	Population for which Returns were received.	Date of First Case of Cholera in the Circle during the Year.	Date of Last Case of Cholera in the Circle during the Year.	Cholera.		Period of Maximum of the Intensity of Disease.	Number of Villages in each of the Circles.	Number of those	
						Total Deaths in each of the Circles.	Ratio per 1,000 of Population.			Affected by Cholera.	Not affected by Cholera.
N. Arcot—*cont.*	178	Arcot Taluk ...	147,388	1st Jan. ...	31st Dec. ...	311	2·1	January ...	258	50	208
	179	Wálajápet do. ...	188,790	Do. ...	Do. ...	712	3·7	Do. ...	249	61	188
	180	M. T. Vellore ...	40,958	Do. ...	Do. ...	171	4·2	December...	1	1	...
	181	M. T. Wálajápet ...	10,387	Do. ...	17th Dec. ...	28	2·7	January ...	1	1	...
	182	M. T. Gudiyátam ...	16,690	Do. ...	31st Dec. ...	507	30·3	Do. ...	1	1	...
	183	M. T. Tirupati ...	13,232	Do. ...	25th Dec. ...	73	5·5	December...	1	1	...
	184	Zemindaries ...	584,596	Do. ...	31st Dec. ...	1,010	1·7	January ...	1,597	122	1,475
		Total ...	1,822,873	1st Jan. ...	31st Dec. ...	4,970	2·7	January ...	3,638	426	3,212
Salem.	185	Salem Taluk ...	267,547	7th Jan. ...	30th Dec. ...	454	1·6	January ...	518	35	483
	186	Atúr do. ...	158,554	Do. ...	Do. ...	655	4·1	Do. ...	181	61	120
	187	Námakal do. ...	254,577	1st Jan. ...	31st Dec. ...	395	1·5	Do. ...	378	49	329
	188	Tiruchengód do. ...	191,328	Do. ...	20th Dec. ...	391	2·04	April ...	309	45	264
	189	Hosúr do. ...	131,770	5th Feb. ...	29th Nov. ...	34	0·2	November...	952	2	950
	190	Kistnagiri do. ...	120,929	1st Jan. ...	31st Dec. ...	264	2·1	December...	541	34	507
	191	Dharmapuri do. ...	135,826	2nd Jan. ...	Do. ...	101	0·7	Do. ...	704	17	687
	192	Tirupatúr do. ...	133,070	1st Jan. ...	27th Dec. ...	244	1·8	January ...	338	16	322
	193	Uttankarai do. ...	109,456	13th Jan. ...	30th Dec. ...	58	0·5	December...	555	14	541
	194	M. T. Salem ...	59,631	2nd Jan. ...	31st Dec. ...	488	8·2	January ...	1	1	...
	195	M. T. Tirupatúr ...	14,278	13th Jan. ...	3rd April...	10	0·7	March ...	1	1	...
	196	M. T. Vániyambádi ...	15,933	5th Jan. ...	31st Dec. ...	23	1·4	January ...	1	1	...
		Total ...	1,592,899	1st Jan. ...	31st Dec. ...	3,117	1·9	January ...	4,479	276	4,203
Coimbatore.	197	Coimbatore Taluk ...	228,837	1st Jan. ...	25th May ...	107	0·04	January ...	263	25	238
	198	Erode do. ...	185,805	Do. ...	17th June...	456	2·4	Do. ...	197	40	157
	199	Satyamangalam do. ...	151,313	Do. ...	10th April .	126	0·8	February ...	178	25	153
	200	Polláchi do. ...	172,909	Do. ...	7th Mar....	77	0·4	January ...	161	23	138
	201	Palladam do. ...	213,391	Do. ...	17th April...	141	0·6	Do. ...	195	33	162
	202	Bhaváni do. ...	94,123	3rd Jan. ...	6th Aug ...	62	0·6	Jan. & April.	62	16	46
	203	Kollegál do. ...	77,522	...	...	...	...	...	125	...	125
	204	Udamalpet do. ...	112,572	2nd Jan....	24th Feb. ...	82	0·7	January ...	91	23	68
	205	Karúr do. ...	167,950	1st Jan....	24th Dec. ..	151	0·8	Do. ...	95	36	59
	206	Dhárápuram do. ...	195,252	Do. ...	25th April.	289	1·4	Do. ...	82	68	14
	207	M. T. Coimbatore ...	38,967	Do. ...	22nd Dec. ..	50	1·3	Do. ...	1	1	...
	208	M. T. Erode ...	9,864	Do. ...	11th April.	62	6·3	Do. ...	1	1	...
	209	M. T. Karúr ...	9,205	2nd Jan....	21st Dec. ...	48	5·2	Do. ...	1	1	...
		Total ...	1,657,690	1st Jan. ...	24th Dec. ...	1,651	0·9	January ...	1,452	292	1,160
Nílgiris.	210	Nílgiri Taluk	46,756	...	Nil.	...	...	...	33	...	...
	211	Wellington Cantonment.	1,725						1	...	...
	212	South-East Wynaad ...	25,440						12	...	...
	213	M. T. Ootacamund ...	12,335						1	...	...
	214	M. T. Coonoor ...	4,778						1	...	...
		Total ...	91,034	...	...	...	...	...	48	...	...
S. Canara.	215	Mangalore Taluk ...	216,950	1st Sept...	31st Dec. ...	383	1·3	December...	306	76	230
	216	Kásaragód do. ...	243,881	16th June...	Do. ...	577	2·3	October ...	243	36	207
	217	Uppinangadi do. ...	110,367	1st Sept ...	Do. ...	69	0·6	December...	278	19	259
	218	Udipi do. ...	237,432	5th Jan. ...	Do. ...	319	1·3	November...	258	55	203
	219	Kundapur do. ...	115,113	20th Nov....	Do. ...	9	0·07	December...	190	3	187
	220	M. T. Mangalore ...	32,099	1st Nov....	Do. ...	70	2·1	Do. ...	1	1	...
		Total ...	955,842	5th Jan. ...	31st Dec. ...	1,427	1·5	December...	1,276	190	1,086
Malabar.	221	Chirakal Taluk ...	246,283	19th June...	9th Dec....	362	1·4	August ...	43	25	18
	222	Kóttayam do. ...	141,194	18th June...	13th Nov....	226	1·6	July ...	27	17	10
	223	Kurumbranád do. ...	261,024	2nd Feb. ...	6th Nov....	426	1·6	Do. ...	57	22	35
	224	Calicut do. ...	148,877	1st Jan. ..	16th Sept ...	95	0·6	Feb. & Aug.	38	14	24
	225	Ernád do. ...	296,143	3rd Jan. ...	31st Dec. ...	705	2·3	May ...	52	24	28
	226	Ponáni do. ...	392,654	6th Jan. ...	17th Dec. ...	2,009	5·1	July ...	73	57	16
	227	Walawanád do. ...	308,102	1st Jan. ...	29th Sept ...	157	0·5	June ...	64	21	43
	228	Pálghat do. ...	306,115	Do. ...	24th May ...	247	0·8	January ...	56	30	26
	229	Wynaad do. ...	88,091	18th June ..	24th June...	18	0·2	...	13	1	12
	230	Cochin do. ...	1,463	4th Sept...	10th Sept...	2	1·3	...	1	1	...
	231	Anjengo do. ...	2,534	15th Jan. ...	24th Dec....	22	8·6	August ...	1	1	...
	232	Tangachéri do. ...	1,665	15th July ...	21st Aug....	49	29·4	Do. ...	1	1	...
	233	M. T. Tellicherry ...	24,581	1st June...	12th Sept...	299	12·1	July ...	1	1	...
	234	M. T. Calicut ...	57,085	1st Jan. ...	19th Sept....	966	16·9	January ...	1	1	...
	235	M. T. Pálghat ...	36,389	4th Jan..	20th April.	37	1·0	February ...	1	1	...
	236	M. T. Cochin ...	15,698	15th Feb. ...	4th Oct. ...	42	2·6	Do. ...	1	1	...
	237	M. T. Cannanore ...	26,386	9th June...	28th Aug....	484	18·3	July ...	1	1	...
		Total ...	2,354,234	1st Jan. ...	31st Dec. ...	6,143	2·6	July ...	431	219	212

NOTE.—*In this statement the ratios are worked on the population including Europeans and Eurasians.*

SMALL-POX.

32. In 1888 the deaths from small-pox of 11,117 males and 10,741 females or a total of 21,858 persons were recorded against 21,472 in 1887 and a quinquennial mean of 34,510.

33. The number of deaths registered from small-pox in each year since 1868 is seen in the table on page 14, and in the following table the ratios per mille of population are given :—

Table showing the ratios of Small-pox Deaths for a series of years.

Years.	Ratio per mille of population.	Years.	Ratio per mille of population.
1868	1·2	1879	0·6
1869	0·7	1880	0·5
1870	0·5	1881	0·5
1871	0·8	1882	0·6
1872	1·2	1883	1·3
1873	1·7	1884	2·1
1874	1·5	1885	1·2
1875	0·8	1886	0·6
1876	0·8	1887	0·7
1877	3·0	1888	0·8
1878	1·9		

The small-pox death-rate for the Presidency in 1888 was a little greater than in the previous two years, but lower than the mortality recorded in 1883, 1884 and 1885, and the average of the previous five years.

34. In Annual Form No. VIII it will be seen that the disease, as often happens, reached its maximum intensity (2,561) in March, after which date it commenced to decline, and the minimum (1,293) was registered in October.

35. There were 4,513 children under one year of age, and 8,487 over one and under twelve years of age, who died from small-pox during the year, out of a total of 21,858. A percentage of 20·7 occurred among infants under one year of age, whilst 38·8 per cent. took place among children over one and under twelve, and the remaining 40·5 per cent. was among persons above twelve years of age.

36. During the year deaths from small-pox were registered in all the districts. The highest ratios—2·4 and 2·2—took place, respectively, in the Kurnool and Ganjam districts. In these two districts, vaccination has always been opposed by the people, and its practice has been carried on under many disadvantages. In the Madura, South Canara, North Arcot and Bellary-Anantapur districts, the ratios per 1,000 of population were respectively 1·5, 1·5, 1·2, and 1·2. The lowest ratios—0·02, 0·04, and 0·09—took place, respectively, in Godávari, Kistna and Madras districts.

37. From Annual Form VI-A in the appendix we find that in districts the death-rate from small-pox was 0·7, the same as in the previous year, and in towns 1·4 against 1·2 in 1887.

38. In the following table is shown the small-pox mortality in the municipal towns during the year under report :—

No.	Municipalities.	Number of deaths from small-pox.	Ratio per mille of population.	Ratio per mille of successful vaccination to population.	No.	Municipalities.	Number of deaths from small-pox.	Ratio per mille of population.	Ratio per mille of successful vaccination to population.
1	Mangalore ...	306	9·5	80·3	11	Calicut ...	114	2·0	29·6
2	Parlákimedi ...	106	6·9	57·8	12	Cannanore ...	46	1·7	48·8
3	Kurnool ...	129	6·3	63·1	13	Vellore ...	67	1·6	30·5
4	Salem ...	310	5·2	30·3	14	Gudiyátam ...	25	1·5	22·0
5	Dindigul ...	68	4·8	43·5	15	Madura ...	101	1·3	39·3
6	Srírangam ...	86	4·3	28·3	16	Negapatam ...	72	1 3	38·2
7	Trichinopoly ...	262	3·1	47·5	17	Tanjore ...	65	1·2	26·0
8	Berhampore ...	62	2·6	24·0	18	Karur ...	10	1·1	44·3
9	Tellicherry ...	66	2·6	51·9	19	Máyavaram ...	26	1·1	31·2
10	Ádóni ...	52	2·3	40·1	20	Bellary ...	56	1·0	34·4

No.	Municipalities.	Number of deaths from small-pox.	Ratio per mille of population.	Ratio per mille of successful vaccination to population.	No.	Municipalities.	Number of deaths from small-pox.	Ratio per mille of population.	Ratio per mille of successful vaccination to population.
21	Cuddalore ...	43	1·0	20·3	40	Vániyambádi...	2	0·1	20·3
22	Cuddapah ...	15	0·8	39·8	41	Ootacamund ...	1	00·8	38·9
23	Conjeeveram ...	21	0·5	14·0	42	Tirupatúr ...	1	0·07	25·2
24	Palni ...	7	0·5	46·8	43	Palamcottah ...	1	0·06	51·0
25	Nellore ...	14	0·5	86·8	44	Masulipatam ...	1	0·03	28·8
26	Mannárgudi ...	10	0·5	24·4	45	Anantapur ...	...	...	69·8
27	Erode ...	4	0·4	54·7	46	Ellore ...	...	...	30·5
28	Periyakulam ...	6	0·4	21·9	47	Rajahmundry.	...	...	50·1
29	Coonoor ...	2	0·4	65·7	48	Guntúr ...	...	...	14·0
30	Coimbatore ...	11	0·3	24·6	49	Bezwada ...	...	...	29·4
31	Cocanada ...	9	0·3	13·1	50	Cochin ...	...	...	63·2
32	Kumbakónam.	14	0·3	26·5	51	Ongole ...	...	...	37·6
33	Tinnevelly ...	8	0·3	33·3	52	Tirupati ...	...	...	3·6
34	Vizianagrum ...	6	0·3	45·7	53	Chidambaram.	...	...	49·0
35	Chicacole ...	4	0·2	36·6	54	Bimlipatam ...	...	...	55·2
36	Pálghat ...	9	0·2	54·1	55	Anakapálle ...	...	...	27·3
37	Wálajápet ...	3	0·2	32·6					
38	Tuticorin ...	4	0·2	36·6					
39	Vizagapatam...	7	0·2	35·5		Total ...	2,232	1·5	36·4

Of the 55 municipalities, in 44 there were deaths from small-pox recorded. The highest death-rate, 9·5 per 1,000 of population, was in Mangalore, the district rate being 1·2. Parlákimedi comes next with a ratio of 6·9, the rate for the district being 2·2. The lowest ratio (0·03) per 1,000 of population took place in Masulipatam.

39. The following statement gives the death-rates and number of deaths that occurred from small-pox in the town of Madras from 1873 to 1888, and it is gratifying to notice the fall in the mortality of small-pox since the introduction of compulsory vaccination :—

Years.	Madras Town. Deaths from small-pox.	Madras Town. Small-pox death-rate per 1,000 of population.	Years.	Madras Town. Deaths from small-pox.	Madras Town. Small-pox death-rate per 1,000 of population.
1873	1,062	2·6	1884	4,064	10·0
1874	330	2·08			
1875	196	0·4	Total, 1873–84 ...	19,523	4·01
1876	421	1·0			
1877	6,758	16·9	1885	26	0·06
1878	447	1·1	1886	1	0·002
1879	910	2·2	1887	13	0·03
1880	869	2·1	1888	36	0·08
1881	1,654	4·2			
1882	355	0·8	Total, 1885–88 ...	76	0·04
1883	1,957	4·8			

Vaccination was made compulsory in the Madras Municipality on the 15th May 1884.

FEVERS.

40. During 1888 there were 106,802 males and 97,759 females, or a total of 204,561 persons reported to have died from fever against 240,860 in 1887. There was thus a decrease of 36,299 for the year under report as compared with 1887, and the mortality was less in 1888 than in any of the four preceding years. On looking at the table on page 14, it will be seen that the greatest number of deaths are from "fevers," and although cholera attracts more attention and naturally causes greater panic than fever, yet it ought not to be as much dreaded as "fevers," which are a far more prominent cause of excessive mortality than cholera. From

1879 to 1888 there were 316,281 deaths from cholera, but the deaths from fever for the same period were 2,193,169 or nearly seven times greater than the mortality from cholera. Although a principal cause in the reduction of the number of deaths from fever in 1888 would appear to have been the deficient rainfall and dryness of the year, yet there can be no doubt that there is some other factor or factors at work, besides the moisture which assist in the causation of fever.

41. The following table shows the deaths from fevers in the several districts of the Presidency in each year since 1877 :—

Districts.	Population for which returns were received during 1888.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Anantapur ...	1,336,017	30,555	25,480	13,223	10,508	8,799	4,632	4,359	4,622	4,789	4,377	6,185	**2,212**
Bellary ...							2,089	1,530	1,548	1,358	1,370	2,407	**5,444**
Chingleput ...	978,524	10,500	6,203	7,313	7,455	7,040	5,582	5,574	6,082	6,114	6,741	6,198	**5,393**
Coimbatore ...	1,657,144	21,592	13,922	14,405	9,876	10,888	11,125	12,843	12,897	10,776	11,185	12,898	**11,016**
Cuddapah ...	1,120,714	61,708	44,559	25,177	22,411	15,490	13,285	11,243	12,282	14,648	15,412	18,906	**18,258**
Ganjam	973,102	11,508	15,555	11,728	11,831	14,203	12,038	12,016	10,789	10,354	10,739	16,669	**11,414**
Godávari ...	1,790,850	13,398	16,403	17,586	11,453	12,018	14,366	14,221	16,857	16,617	19,205	17,444	**12,145**
Kistna ...	1,548,355	10,807	16,701	15,047	11,396	9,998	13,221	12,933	14,056	12,910	14,925	14,486	**11,310**
Kurnool ...	678,464	55,394	32,660	19,780	16,295	14,897	11,925	9,984	10,771	11,015	11,492	15,916	**15,008**
Madras ...	389,984	5,971	4,851	3,421	3,507	3,645	3,674	3,422	3,726	3,553	3,758	3,973	**3,306**
Madura ...	1,293,829	27,393	20,050	16,318	8,033	8,048	8,043	9,158	9,496	10,265	9,845	7,760	**7,083**
Malabar ...	2,351,152	15,910	18,822	15,558	15,233	17,687	17,856	27,961	24,816	22,577	19,290	17,311	**18,617**
Nellore ...	1,184,765	26,641	29,604	9,812	6,293	6,306	6,097	7,702	8,094	8,999	8,999	9,481	**8,708**
Nílgiris ...	88,324	1,527	995	672	689	771	772	768	1,063	1,177	1,088	931	**1,050**
North Arcot ...	1,822,312	46,124	26,764	21,627	14,782	11,079	9,296	10,487	11,755	15,724	15,821	16,901	**13,839**
Salem ...	1,592,274	50,306	24,440	21,684	11,379	10,833	9,251	10,081	10,908	12,517	14,136	16,142	**13,810**
South Arcot ...	1,815,916	28,610	15,672	18,323	10,826	10,611	9,262	10,110	10,524	10,563	12,193	13,075	**12,797**
South Canara...	955,595	6,068	17,413	10,970	5,633	6,059	4,462	7,410	10,384	8,992	7,727	6,866	**6,680**
Tanjore ...	2,129,538	5,844	5,825	5,604	4,389	4,660	3,405	3,742	4,074	3,356	3,486	3,556	**3,196**
Tinnevelly ...	1,699,056	10,607	11,215	10,001	7,417	7,518	5,750	5,937	6,448	5,900	5,055	5,550	**4,932**
Trichinopoly ...	1,214,485	13,486	10,356	7,511	5,968	6,777	5,905	6,323	5,973	5,605	5,530	6,194	**6,132**
Vizagapatam ...	1,232,074	15,292	16,953	19,717	14,566	16,215	16,525	15,982	18,812	20,977	19,355	22,011	**12,211**
Total Presidency.	27,852,474	469,241	374,443	285,477	209,940	203,542	188,561	203,786	215,977	218,786	221,679	240,860	**204,561**

In all the districts, with the exception of Bellary, Malabar, and Nílgiris, fevers caused a lower mortality during the year under review than in 1887. The greatest decrease (9,800) in the number of deaths from fever in 1888 when compared with 1887 was in the Vizagapatam district.

42. In table IX in appendix is seen the monthly distribution of these deaths. The cold weather months were those in which the greatest number of deaths occurred from fevers. In January there were 20,741 deaths, and in December 20,234. A great many cases of chest diseases are no doubt entered as "fevers" during the cold weather months, and the village officers cannot be supposed to be always able to distinguish between them and fever. The minimum mortality (15,480) took place in the month of April.

43. The subjoined table shows the recorded deaths and death-rates from fever in districts and municipalities :—

No.	Districts, exclusive of municipal towns.	Number of deaths from fevers.	Ratio per mille of population.
1	Kurnool	14,684	22·3
2	Cuddapah ...	18,098	16·4
3	Nílgiris	923	12·9
4	Ganjam	10,686	11·6
5	Vizagapatam ...	11,612	10·0
6	Salem	13,214	8·7
7	Madras	3,306	8·5
8	Malabar	18,024	8·2
9	North Arcot ...	13,357	7·6
10	Kistna	11,093	7·4
11	Nellore	8,516	7·4
12	South Arcot ...	12,526	7·1
13	South Canara ...	6,551	7·1
14	Godávari	11,816	6·9
15	Coimbatore ...	10,732	6·7
16	Anantapur ...	2,201	5·6
17	Bellary	4,714	
18	Madura	6,437	5·5
19	Chingleput ...	5,152	5·4
20	Trichinopoly ...	5,631	5·0
21	Tinnevelly ...	4,739	2·9
22	Tanjore	2,335	1·2
	Total ...	196,347	7·4

No.	Municipalities.	Number of deaths from fevers.	Ratio per mille of population.
1	Berhampore ...	393	16·8
2	Kurnool	324	16·0
3	Parlákimedi ...	181	11·8
4	Bellary	565	10·6
5	Vizianagrum ...	221	9·8
6	Coonoor	44	9·2
7	Cuddapah ...	160	8·4
8	Tuticorin ...	135	8·3
9	Vániyambádi ...	131	8·2
10	Tirupatúr ...	117	8·2
11	Chicacole ...	149	8·1
12	Anakápalle ...	104	7·8
13	Vizagapatam ...	234	7·7
14	Ádóni	165	7·4
15	Chidambaram ...	139	7·0
16	Rajahmundry ...	171	6·9
17	Ootacamund ...	83	6·7
18	Vellore	271	6·6
19	Pálghat	238	6·5
20	Conjeeveram ...	241	6·4
21	Guntúr	119	6·1
22	Periyakulam ...	98	6·0
23	Madura	457	5·9
24	Tirupati ...	79	5·9
25	Salem	348	5·8
26	Kumbakónam ...	276	5·5
27	Wálajápet ...	56	5·4
28	Nellore	146	5·3
29	Máyavaram ...	120	5·2
30	Coimbatore ...	198	5·1
31	Karúr	47	5·1
32	Trichinopoly ...	428	5·1
33	Ongole	46	5·0
34	Bimlipatam ...	40	4·6
35	Gudiyátam ...	76	4·5
36	Bezváda ...	41	4·4
37	Ellore	103	4·1
38	Negapatam ...	219	4·1
39	Mángalore ...	129	4·0
40	Erode	39	3·9
41	Cochin	60	3·8
42	Palni	49	3·7
43	Tanjore	202	3·6
44	Srírangam ...	73	3·6
45	Tellicherry ...	81	3·3
46	Cuddalore ...	132	3·0
47	Dindigul	42	2·9
48	Calicut	163	2·8
49	Mannárgudi ...	44	2·3
50	Anantapur ...	11	2·2
51	Cannanore ...	51	1·9
52	Cocanada	55	1·8
53	Masulipatam ...	57	1·6
54	Tinnevelly ...	35	1·5
55	Palamcottah ...	23	1·3
	Total ...	8,214	5·6

The death-rates in 23 municipal towns were greater in 1888 than in 1887, in 29 less, and in 3 equal. The highest death-rate is reported as in 1887 from Berhampore. The mortality was however much less in 1888, 16·8 per 1,000 of population against 43·2 per 1,000 in 1887. The lowest death-rate (1·3) was recorded by Palamcottah.

In 14 municipal towns the mortality from fevers was greater than that of the districts. The death-rate for municipalities was 5·6 per 1,000 of population, against 6·3 in 1887 and among the rural population it amounted to 7·4, against 8·8 in the previous year.

R

BOWEL-COMPLAINTS.

44. As might be expected owing to the greater prevalence of cholera in 1888 than in 1887, more deaths were returned from bowel-complaints in the year under review than in the one preceding it.

45. During the year bowel-complaints caused the deaths of 14,687 males and 13,034 females or a total of 27,721 persons against 26,679 deaths in 1887. At table on page 14 is seen the number of deaths from bowel-complaints in each year since 1871. The number of deaths was exceeded in 10 out of the 17 years quoted, but was 493 above the last quinquennial mean. The death-rates from bowel-complaints for a series of years are given in the following table:—

Years.	Ratio per mille of population.	Years.	Ratio per mille of population.
1881	0·6	1885	1·1
1882	0·6	1886	0·9
1883	0·7	1887	0·9
1884	1·0	1888	1·0

46. The death-rate for the year under review was 1·0 per 1,000 against 0·9 the rate for last year and 0·9 the average rate per 1,000 for the 5-year period, 1883–1887. In 13 districts the death-rate was higher in 1888 than in 1887, in 2 equal, and in 6 lower. The increase in the death-rate in some districts was probably due to the deficient rainfall, as the water of tanks was much reduced in quantity, and therefore had a much larger percentage of suspended and dissolved impurities, and, in places where wells, &c., failed, people had to take water from impure sources. Madras, as usual, heads the list, with the high death-rate of 6·5 per 1,000 of population or 0·8 less than in 1887. Following it comes Chingleput with a ratio of 4·2 per 1,000 against 4·0 per mille in 1887, and next to it South Canara (2·3). These three districts also obtained the highest death ratios in 1887. The lowest ratios, viz., 0·3, was returned by the Kistna and Vizagapatam districts. In 1887 the ratio in the Kistna district was 0·2, and in the Vizagapatam district 0·6.

47. Table X in appendix shows the deaths from bowel-complaints during each month of the year. The greatest number of deaths from bowel-complaints occurred in January. The greatest mortality from these causes usually occurs in the cold weather months, and the experience of this year is in accordance with the general rule. In December 2,991 deaths were registered, and in January 3,165. The fewest deaths (1,788) were recorded in April.

48. The following table shows the number of deaths reported from bowel-complaints in each district and municipality in 1888:—

No.	Districts, exclusive of municipalities.	Number of deaths from bowel-complaints.	Ratio per mille of population.	No.	Municipalities.	Number of deaths from bowel-complaints.	Ratio per mille of population.
1	Madras	2,524	6·5	1	Tuticorin	153	9·4
2	Chingleput	3,932	4·1	2	Berhampore ...	163	6·8
3	South Canara ...	2,032	2·2	3	Tinnevelly ...	148	6·4
4	Malabar	4,282	1·9	4	Negapatam ...	306	5·7
5	Anantapur	354	0·9	5	Calicut	309	5·4
6	Bellary	803		6	Tanjore	298	5·4
7	Nílgiris	52	0·7	7	Mangalore ...	170	5·3
8	Coimbatore	976	0·6	8	Bezváda	49	5·2
9	Cuddapah	718	0·6	9	Madura	399	5·2
10	North Arcot	1,185	0·6	10	Tirupatúr	74	5·2
11	Tinnevelly	959	0·6	11	Mannárgudi ...	100	5·1
12	Nellore	661	0·5	12	Bimlipatam ...	43	5·0
13	Kurnool	304	0·4	13	Coonoor	23	4·8
14	Salem	657	0·4	14	Conjeeveram ...	161	4·3
15	South Arcot	840	0·4	15	Vizianagrum ...	94	4·1
16	Trichinopoly	486	0·4	16	Periyakulam ...	65	3·9
17	Godávari	448	0·3	17	Kumbakónam ...	185	3·7
18	Madura	377	0·3	18	Rajahmundry ...	90	3·6
19	Tanjore	662	0·3	19	Máyavaram ...	83	3·6
20	Ganjam	245	0·2	20	Trichinopoly ...	311	3·6
21	Kistna	371	0·2	21	Cochin	54	3·4
22	Vizagapatam	163	0·1	22	Karúr	31	3·3
				23	Erode	32	3·2
				24	Cocanada	100	3·2
				25	Cuddalore	141	3·2
				26	Vizagapatam ...	97	3·2
				27	Coimbatore ...	122	3·1
				28	Chidambaram ...	60	3·0
				29	Palamcottah ...	52	2·9
				30	Srírangam ...	59	2·9
				31	Ootacamund ...	32	2·6
				32	Ongole	23	2·5
				33	Vellore	97	2·4
				34	Ellore	57	2·2
				35	Dindigul	28	2·0
				36	Salem	118	1·9
				37	Cuddapah ...	35	1·8
				38	Chicacole	32	1·7
				39	Pálghat	64	1·7
				40	Kurnool	27	1·3
				41	Bellary	62	1·2
				42	Tellicherry ...	29	1·2
				43	Palni	15	1·1
				44	Tirupati	15	1·1
				45	Gudiyátam ...	16	0·9
				46	Anakápalle ...	11	0·8
				47	Vániyambádi ...	11	0·7
				48	Anantapur	3	0·6
				49	Cannanore	11	0·4
				50	Wálajápet	5	0·4
				51	Guntúr	7	0·3
				52	Nellore	10	0·3
				53	Parlákimedi ...	3	0·2
				54	Adóni	2	0·1
				55	Masulipatam ...	5	0·1
	Total ...	23,031	0·8		Total ...	4,690	3·2

The district Presidency rate was 0·8 or 2·4 less than the Municipal Presidency rate (3·2). In 46 municipal towns the death-rate was higher than in the districts, in only 8 it was lower, and in 1 equal. The highest death-rate in municipal towns from bowel-complaints is reported to have occurred at Tuticorin, where it attained the rate of 9·4 per 1,000 against 8·2 in 1887. The lowest death-rate (0·1) was recorded by Masulipatam and Adóni.

INJURIES.

49. The deaths from injuries in 1888 were 11,401 or 73 more than in 1887; of the 11,401 deaths, 2,483 were registered as due to suicide, 6,587 wounds and accidents, and 2,331 were killed by snakes and wild beasts. There was an increase in the number of suicides (699), and persons killed by snakes and wild beasts (126) in 1888 as compared with 1887, but a decrease in the deaths from wounds and accidents (752). The greatest number of suicides occurred in Nellore district, and the fewest in Madras. The highest death-rate from injuries (0·7) was obtained by Nellore, and the lowest (0·08) by Nílgiris.

50. The following table shows the deaths from injuries for a series of years :—

Years.	Suicides.	Wounds and accidents.	Snake-bite and killed by wild beasts.	Total.	Years.
1868 ...	602	6,007	2,653	9,242	1868
1869 ...	694	6,057	2,559	9,310	1869
1870 ...	1,438	8,158	2,729	12,325	1870
1871 ...	2,370	9,566	3,387	15,323	1871
1872 ...	2,366	9,668	3,116	15,150	1872
1873 ...	2,077	9,185	2,889	14,251	1873
1874 ...	1,876	8,590	2,899	13,065	1874
1875 ...	1,811	8,057	2,553	12,421	1875
1876 ...	1,715	7,083	2,377	11,175	1876
1877 ...	2,575	11,797	2,088	16,460	1877
1878 ...	2,464	10,554	1,989	15,007	1878
1879 ...	1,926	8,324	2,369	12,619	1879
1880 ...	1,487	6,985	2,373	10,845	1880
1881 ...	1,603	7,532	2,392	11,527	1881
1882 ...	1,644	7,665	2,302	11,611	1882
1883 ...	1,477	7,714	2,318	11,509	1883
1884 ...	1,514	7,498	2,290	11,502	1884
1885 ...	1,573	7,716	2,370	11,659	1885
1886 ...	1,628	9,057	2,418	13,103	1886
1887 ...	1,784	7,339	2,205	11,328	1887
1888 ...	2,483	6,587	2,331	11,401	1888

ALL OTHER CAUSES.

51. There were 272,797 deaths registered under the head of "all other causes," being 3,280 less than in 1887, when 276,077 were returned under this head. The death-rates under this head during the last eight years were as per margin.

Years.	Ratio per mille of population.	Years.	Ratio per mille of population.
1881	7·2	1885 ...	9·2
1882	7·1	1886 ...	9·3
1883	8·0	1887 ...	9·8
1884	9·1	1888 ...	9·8

52. The following statements showing the ratios of deaths from cholera, small-pox, fevers, and bowel-complaints per mille of population in each circle of registration and the daily record of Meteorological observations and deaths from cholera in the towns of Negapatam and Salem are given as required by the Government of India. *Vide* G.O., No. 2366 Mis., dated 12th November 1886, Public :—

Districts.	No.	Circles of Registration.	Population for which returns were received.	Ratio per mille of population. Cholera.	Small-pox.	Fevers.	Bowel-complaints.
Ganjam.	1	Chicacole Taluk	152,540	0·1	1·3	11·6	0·1
	2	Berhampore do.	209,221	1·5	2·1	10·2	0·4
	3	Goomsur do.	139,469	0·4	1·5	8·8	0·2
	4	M. T. Chicacole	18,302	1·7	0·2	8·1	1·7
	5	M. T. Berhampore	23,599	2·2	2·6	16·8	6·8
	6	M. T. Parlâkimedi	15,365	0·06	6·9	11·8	0·2
	7	Zemindaries	406,159	0·5	2·5	12·8	0·2
	8	Agency Tracts	8,798	...	13·7	38·1	0·3
		Total ...	973,453	0·7	2·2	11·7	0·4
Vizagapatam.	9	Sarvasiddhi Taluk	107,538	...	...	10·2	0·09
	10	Narsapatnam do.	76,702	...	0·04	12·5	0·2
	11	Anakápalle do.	88,920	0·1	...	7·5	0·2
	12	Vizagapatam do.	27,282	...	...	19·4	0·5
	13	Viravilli do.	98,632	1·9	0·02	12·1	0·04
	14	Bimlipatam do.	53,923	...	0·1	13·3	0·2
	15	Srunguvarapukottah do.	98,973	...	...	7·7	0·04
	16	Vizianagrum do.	73,394	0·09	0·2	9·5	0·1
	17	Gajapatinagar do.	83,288	0·03	0·9	9·7	0·4
	18	Chipurupalle do.	94,716	0·01	1·1	8·1	0·2
	19	Sálúr do.	49,388	...	0·7	12·3	0·1
	20	Bobbili do.	95,116	0·09	0·6	10·9	0·06
	21	Pálkonda do.	113,716	0·08	0·7	8·3	0·07
	22	Párvatipur do.	66,252	0·4	0·8	12·0	0·07
	23	M. T. Vizagapatam	30,291	...	0·2	7·7	3·2
	24	M. T. Bimlipatam	8,582	...	...	4·6	5·0
	25	M. T. Vizianagrum	22,577	0·09	0·3	9·8	4·1
	26	M. T. Anakápalle	13,341	...	...	7·8	0·8
		Total ...	1,232,631	0·2	0·4	9·9	0·3
Godávari.	27	Rámachandrapuram Taluk	220,780	0·7	0·01	7·1	0·2
	28	Amalápuram do.	227,157	0·2	0·01	6·0	0·2
	29	Narsápur do.	200,153	3·7	0·01	2·5	0·2
	30	Bhímavaram do.	108,599	6·9	0·009	3·6	0·3
	31	Tanuku do.	188,306	4·3	0·01	7·4	0·2
	32	Ellore do.	124,216	0·9	0·008	7·6	0·3
	33	Yernagúdem do.	159,364	0·6	...	8·7	0·2
	34	Rajahmundry do.	106,641	0·2	0·02	8·1	0·3
	35	Peddápuram do.	124,314	...	0·04	11·3	0·2
	36	Bhadráchalam do.	35,656	...	0·1	6·8	0·8
	37	M. T. Cocanada	30,441	0·09	0·3	1·8	3·2
	38	M. T. Rajahmundry	24,555	0·3	...	6·9	3·6
	39	M. T. Ellore	25,092	1·0	...	4·1	2·2
	40	Zemindaries	216,238	0·08	0·03	7·7	0·3
		Total ...	1,791,512	1·6	0·02	6·8	0·4
Kistna.	41	Répalle Taluk	184,340	2·2	0·005	3·7	0·2
	42	Bápatla do.	151,736	2·9	0·01	7·8	0·3
	43	Guntúr do.	116,437	1·1	0·1	7·0	0·4
	44	Palnád do.	125,799	0·7	0·03	11·6	0·3
	45	Narasaraopet do.	128,791	4·8	0·03	9·5	0·3
	46	Gudiváda do.	99,233	1·0	0·01	3·3	0·1
	47	Sattenapalle do.	110,290	1·9	0·03	10·6	0·1
	48	Masulipatam do.	140,426	3·3	0·02	2·3	0·2
	49	Nandigáma do.	107,288	1·6	0·02	8·3	0·3
	50	Bezváda do.	73,559	3·1	0·04	12·3	0·4
	51	Vinukonda do.	66,977	2·4	0·03	10·3	0·3
	52	M. T. Masulipatam	35,056	1·7	0·03	1·6	0·1
	53	M. T. Guntúr	19,646	2·5	...	6·1	0·3
	54	M. T. Bezváda	9,336	2·5	...	4·4	5·2
	55	Zemindaries	179,566	1·2	0·09	7·6	0·09
		Total ...	1,548,480	2·2	0·04	7·3	0·3
Nellore.	56	Gúdúr Taluk	89,033	1·3	0·1	4·2	0·4
	57	Rápúr do.	49,214	0·5	0·4	13·1	1·0
	58	Nellore do.	133,025	1·8	0·2	7·4	0·6
	59	Atmakúr do.	82,642	1·4	1·1	9·4	0·9
	60	Kávali do.	59,444	1·5	0·6	8·7	0·9
	61	Udayagiri do.	47,306	0·5	0·9	8·9	0·8
	62	Kandukúr do.	96,884	1·2	0·4	8·7	0·5
	63	Kanigiri do.	50,174	0·02	0·4	9·2	0·7

Districts.	No.	Circles of Registration.	Population for which returns were received.	Ratio per mille of population.			
				Cholera.	Small-pox.	Fevers.	Bowel-complaints.
Nellore—cont.	64	Ongole Taluk	143,503	2·7	0·2	5·9	0·4
	65	M. T. Nellore	27,505	4·3	0·5	5·3	0·3
	66	M. T. Ongole	9,200	0·6	...	5·0	2·5
	67	Zemindaries	397,188	0·3	0·3	6·5	0·5
		Total ...	1,185,118	1·2	0·4	7·3	0·6
Madras.	68	Madras Town	405,848	1·3	0·08	8·1	6·2
Chingleput.	69	Saidápet Taluk	204,580	3·2	0·3	5·7	3·8
	70	Chingleput do.	117,218	1·8	0·1	5·1	6·3
	71	Madurántakam do.	223,067	0·7	0·2	4·6	3·0
	72	Conjeeveram do.	148,374	3·3	0·5	6·1	6·5
	73	Tiruvallúr do.	143,324	2·5	0·4	5·9	2·9
	74	Ponnéri do.	107,543	3·3	0·06	5·2	3·1
	75	M. T. Conjeeveram	37,275	8·6	0·5	6·4	4·3
		Total ...	981,381	2·6	0·3	5·5	4·2
South Arcot.	76	Cuddalore Taluk	254,978	1·9	0·4	5·2	0·4
	77	Villupuram do.	243,896	0·5	1·0	4·8	0·5
	78	Chidambaram do.	245,413	3·1	0·2	5·5	0·4
	79	Tindivanam do.	264,261	0·7	0·7	4·2	0·9
	80	Kullakurchi do.	196,029	0·6	0·4	11·3	0·1
	81	Tirukoilúr do.	206,489	1·5	0·8	7·6	0·3
	82	Tiruvannámalai do.	154,859	0·5	1·4	10·9	0·6
	83	Vriddháchalam do.	187,068	3·1	2·1	10·7	0·3
	84	M. T. Cuddalore	43,545	3·6	1·0	3·0	3·2
	85	M. T. Chidambaram	19,837	6·6	...	7·0	3·0
		Total ...	1,816,375	1·6	0·8	7·0	0·6
Trichinopoly.	86	Trichinopoly Taluk	231,296	3·7	1·0	3·2	0·4
	87	Musiri do.	258,068	2·8	0·2	3·3	0·3
	88	Kulitalai do.	201,990	1·2	0·2	1·9	0·1
	89	Perambalúr do.	172,281	3·0	1·0	6·2	0·6
	90	Udayárpálaiyam do.	247,176	6·2	0·5	10·1	0·6
	91	M. T. Trichinopoly	84,449	5·1	3·1	5·1	3·6
	92	M. T. Srírangam	19,773	3·9	4·3	3·6	2·9
		Total ...	1,215,033	3·6	0·8	5·0	0·7
Tanjore.	93	Tanjore Taluk	320,341	4·5	0·9	1·6	0·6
	94	Kumbakónam do.	320,625	8·4	0·6	1·2	0·3
	95	Máyavaram do.	215,950	3·4	0·8	2·2	0·7
	96	Shiyáli do.	114,041	2·8	0·06	0·9	0·2
	97	Nannilam do.	220,202	5·4	0·4	0·6	0·2
	98	Negapatam do.	163,091	2·9	0·9	1·1	0·3
	99	Mannárgudi do.	162,241	1·7	0·1	0·5	0·1
	100	Tiruturaipúndi do.	168,103	0·6	0·5	1·1	0·1
	101	Patukóta do.	244,717	2·3	0·1	0·8	0·1
	102	M. T. Tanjore	54,745	6·6	1·2	3·6	5·4
	103	M. T. Kumbakónam	50,098	6·9	0·3	5·5	3·7
	104	M. T. Máyavaram	23,044	5·2	1·1	5·2	3·6
	105	M. T. Negapatam	53,776	5·8	1·3	4·1	5·7
	106	M. T. Mannárgudi	19,409	4·2	0·5	2·3	5·1
		Total ...	2,130,383	4·3	0·6	1·5	0·7
Madura.	107	Madura Taluk	138,486	0·5	2·4	6·8	0·3
	108	Melúr do.	132,537	0·5	1·3	1·7	0·2
	109	Tirumangalam do.	203,693	0·4	1·9	7·0	0·4
	110	Periyakulam do.	215,677	0·4	1·5	6·5	0·5
	111	Dindigul do.	290,601	0·1	0·9	6·3	0·2
	112	Palni do.	158,200	0·5	1·1	2·7	0·4
	113	Sattenandal Villages	1,161	...	...	2·5	...
	114	M. T. Madura	76,847	1·1	1·3	5·9	5·2
	115	M. T. Dindigul	14,182	2·9	4·8	2·9	2·0
	116	M. T. Periyakulam	16,446	0·1	0·4	6·0	3·9
	117	M. T. Palni	13,315	0·4	0·5	3·7	1·1
	118	Zemindaries	33,237	1·7	0·5	2·1	0·2
		Total ...	1,294,382	0·6	1·5	5·5	0·7

Districts.	No.	Circles of Registration.	Population for which returns were received.	Ratio per mille of population.			
				Cholera.	Small-pox.	Fevers.	Bowel-complaints.
Tinnevelly.	119	Ootapidáram Taluk	253,516	0·2	0·3	5·5	0·7
	120	Tenkarai do.	283,110	6·7	0·08	2·2	0·7
	121	Tinnevelly do.	130,193	8·2	0·2	1·4	0·6
	122	Srívilliputtur do.	163,608	0·03	0·2	1·7	0·4
	123	Sankaranainarkoil do.	181,064	0·2	0·3	1·5	0·2
	124	Nángunéri do.	174,347	11·2	0·5	3·5	0·7
	125	Ambásamudram do.	165,152	6·7	0·09	2·6	0·4
	126	Sátúr do.	150,886	0·5	0·5	4·1	0·6
	127	Tenkási do.	140,405	4·3	0·3	3·2	0·6
	128	M. T. Tinnevelly	23,221	9·9	0·3	1·5	6·4
	129	M. T. Palamcottah	17,964	10·0	0·06	1·3	2·9
	130	M. T. Tuticorin	16,281	0·7	0·2	8·3	9·4
		Total ...	1,699,747	4·3	0·3	2·9	0·8
Kurnool.	131	Rámallakótah Taluk	74,369	1·7	4·5	22·5	0·7
	132	Pattikonda do.	105,438	0·3	0·9	25·0	0·4
	133	Nandikótkur do.	72,741	0·2	2·4	21·2	0·4
	134	Nandyál do.	78,282	0·03	5·6	19·1	0·6
	135	Koilkuntla do.	76,296	0·01	2·9	29·8	0·5
	136	Sirvél do.	57,197	...	2·6	26·1	0·5
	137	Cumbum do.	109,851	1·1	0·2	18·4	0·4
	138	Márkápur do.	84,048	0·8	0·1	16·2	0·1
	139	M. T. Kurnool	20,329	1·3	6·3	16·0	1·3
		Total ...	678,551	0·6	2·4	22·1	0·5
Cuddapah.	140	Badvél Taluk	82,445	0·3	0·2	19·5	0·5
	141	Proddutur do.	90,653	2·6	1·8	14·9	0·4
	142	Sidhout do.	59,076	0·9	0·9	16·7	0·3
	143	Pullampet do.	134,366	8·3	1·0	13·1	0·4
	144	Cuddapah do.	128,471	2·7	1·3	17·2	0·3
	145	Jammalamadugu do.	91,958	1·1	1·1	23·1	0·4
	146	Pulivendla do.	95,617	0·7	2·2	19·7	0·4
	147	Ráyachóti do.	92,541	1·0	0·7	12·2	0·7
	148	Kadiri do.	116,252	0·1	0·6	17·0	0·9
	149	Váyalpád do.	104,462	0·3	0·1	14·0	0·8
	150	Madanapalle do.	106,215	0·05	0·9	14·6	1·7
	151	M. T. Cuddapah	18,982	5·0	0·8	8·4	1·8
		Total ...	1,121,038	2·0	0·9	16·2	0·7
Bellary.	152	Bellary Taluk	95,477	1·1	2·2	3·4	0·6
	153	Hospet do.	84,986	1·8	1·1	16·3	0·6
	154	Kúdligi do.	74,690	1·0	1·5	4·7	2·3
	155	Hadagalli do.	75,572	3·1	3·7	3·3	4·6
	156	Harpanahalli do.	70,620	1·7	2·4	9·2	2·8
	157	Alúr do.	65,586	3·7	0·3	2·1	0·5
	158	Adóni do.	99,644	2·6	0·7	3·1	0·5
	159	Ráyadrug do.	83,799	0·3	2·0	11·7	0·3
	160	M. T. Bellary	53,460	2·1	1·0	10·6	1·2
	161	M. T. Adóni	22,441	10·4	2·3	7·4	0·1
	162	Zemindaries	10,532	5·9	5·7	20·2	0·5
		Total ...	736,807	2·2	1·7	7·4	1·2
Anantapur.	163	Anantapur Taluk	86,909	1·2	0·6	1·6	0·2
	164	Gooty do.	110,597	0·6	0·3	1·7	0·5
	165	Tadpatri do.	98,964	2·1	1·3	0·9	0·4
	166	Penukonda do.	73,023	0·4	0·9	11·0	0·7
	167	Dharmavaram do.	97,106	3·4	0·4	4·3	0·3
	168	Hindupur do.	73,270	0·01	0·04	5·0	1·2
	169	Madakasíra do.	55,113	...	0·3	3·1	1·0
	170	M. T. Anantapur	4,907	13·4	...	2·2	0·6
		Total ...	599,889	1·4	0·6	3·7	0·6
North Arcot.	171	Chittoor Taluk	171,907	1·4	0·4	8·6	0·2
	172	Chendragiri do.	79,919	2·7	0·3	6·6	0·6
	173	Palmanér do.	41,815	0·7	0·07	9·9	0·2
	174	Gudiyátam do.	137,956	2·4	0·3	10·1	0·4
	175	Vellore do.	129,258	7·8	0·7	9·2	0·5
	176	Pólúr do.	111,877	0·9	1·7	8·4	0·7
	177	Wandiwash do.	148,100	0·8	1·3	2·7	0·8

Districts.	No.	Circles of Registration.	Population for which returns were received.	Ratio per mille of population. Cholera.	Small-pox.	Fevers.	Bowel-complaints.
N. Arcot—*cont.*	178	Arcot Taluk	147,388	2·1	1·5	4·5	0·8
	179	Wálajápet do.	188,790	3·7	2·1	4·6	1·2
	180	M. T. Vellore	40,958	4·2	1·6	6·6	2·4
	181	M. T. Wálajápet	10,387	2·7	0·2	5·4	0·4
	182	M. T. Gudiyatám	16,690	30·3	1 5	4·5	0·9
	183	M. T. Tirupati	13,232	5·5	...	5·9	1·1
	184	Zemindaries	584,596	1·7	1·4	9·2	0·6
		Total ...	1,822,873	2·7	1·2	7·6	0·7
Salem.	185	Salem Taluk	267,547	1·6	2·1	7·7	2·7
	186	Atúr do.	158,554	4·1	0·6	11·0	0·4
	187	Námakal do.	254,577	1·5	0·6	7·1	0·5
	188	Tiruchengód do.	191,328	2·0	0·7	9·0	0·6
	189	Hosúr do.	131,770	0·2	0·2	8·6	0·3
	190	Kistnagiri do.	120,929	2·1	0·4	6·0	0·4
	191	Dharampuri do.	135,826	0·7	0·2	7·2	0·4
	192	Tirupatúr do.	133,070	1·8	0·2	11·0	0·2
	193	Uttankarai do.	109,456	0·5	0·1	13·5	0·5
	194	M. T. Salem	59,631	8·2	5·2	5·8	1·9
	195	M. T. Vániyambádi	15,933	1·4	0·1	8·2	0·7
	196	M. T. Tirupatúr	14,278	0·7	0·07	8·2	5·2
		Total ...	1,592,899	1·9	0·9	8·6	0·5
Coimbatore.	197	Coimbatore Taluk	228,837	0·04	0·5	8·1	0·4
	198	Erode do.	185,805	2·4	0·1	5·2	0·9
	199	Satyamangalam do.	151,313	0·8	0·4	10·5	0·5
	200	Polláchi do.	172,909	0·4	0·2	7·0	0·3
	201	Palladam do.	213,391	0·6	0·7	6·3	0·5
	202	Bhaváni do.	94,123	0·6	0·2	10·2	0·6
	203	Kollegál do.	77,522	...	0·3	10·8	1·4
	204	Udamalpet do.	112,572	0·7	0·1	5·2	0·6
	205	Karúr do.	167,950	0·8	0·08	4·0	0·2
	206	Dhárápuram do.	195,252	1·4	1·0	3·3	0·6
	207	M. T. Coimbatore	38,967	1·3	0·3	5·1	3·1
	208	M. T. Erode	9,864	6·3	0·4	3·9	3·2
	209	M. T. Karúr	9,205	5·2	1·1	5·1	3·3
		Total ...	1,657,690	0·9	0·4	6·6	0·7
Nilgiris.	210	Nilgiri Taluk	46,756	...	0·2	13·6	0·4
	211	Wellington Cantonment	1,725	...	5·2	11·5	2·8
	212	South-East Wynaad	25,440	...	1·0	10·0	1·0
	213	M. T. Ootacamund	12,335	...	0·08	6·7	2·6
	214	M. T. Coonoor	4,778	...	0·4	9·2	4·8
		Total ...	91,034	...	0·5	11·9	1·2
S. Canara.	215	Mangalore Taluk	216,950	1·3	1·7	5·8	2·2
	216	Kásaragód do.	243,881	2·3	1·1	7·4	2·1
	217	Uppinangadi do.	110,367	0·6	1·0	12·0	2·4
	218	Udipi do.	237,432	1·3	1·2	3·9	1·4
	219	Kundapur do.	115,113	0·07	0·5	10·1	2·7
	220	M. T. Mangalore	32,099	2·1	9·5	4·0	5·3
		Total ...	955,842	1·5	1·5	7·0	2·3
Malabar.	221	Chirakal Taluk	246,283	1·4	0·8	8·7	1·6
	222	Kóttayam do.	141,194	1·6	1·7	10·3	0·9
	223	Kurumbranád do.	261,024	1·6	0·5	10·8	1·2
	224	Calicut do.	148,877	0·6	0·3	9·2	2·1
	225	Ernád do.	296,143	2·3	0·3	8·4	2·5
	226	Ponáni do.	392,654	5·1	1·2	4·4	3·5
	227	Walawanád do.	308,102	0·5	0·9	7·5	2·1
	228	Pálghat do.	306,115	0·8	0·8	7·3	0·9
	229	Wynaad do.	88,091	0·2	0·01	15·5	0·6
	230	Cochin do.	1,463	1·3	2·0	2·0	1·3
	231	Anjengo do.	2,534	8·6	...	1·3	1·9
	232	Tangachéri do.	1,665	29·4	...	3·0	1·2
	233	M. T. Tellicherry	24,581	12·1	2·6	3·3	1·2
	234	M. T. Calicut	57,085	16·9	2·0	2·8	5·4
	235	M. T. Pálghat	56,339	1·0	0·2	6·5	1·7
	236	M. T. Cochin	15,698	2·6	...	3·8	3·4
	237	M. T. Cannanore	26,386	18·3	1·7	1·9	0·4
		Total ...	2,354,234	2·6	0·8	7·9	2·0

NOTE.—In this statement the ratios are worked on the total population including Europeans and Eurasians.

Daily Record of Meteorological Observations and of Cholera Deaths at NEGAPATAM during the Prevalence of the Disease in the year 1888.

Month and date.	Rainfall in inches.	Temperature of air in the shade. Highest maximum.	Lowest minimum.	Range.	Moisture of air per cent., 100 being saturation. 10 H.	16 H.	Wind. Direction. 10 H.	16 H.	Velocity, miles per diem.	Deaths from cholera recorded on each day.
JANUARY.										
1	...	80·7	74·4	6·3	74	80	N.E.	N.E.	147	1
2	...	81·1	74·7	6·4	74	73	N.E.	N.E.	143	3
3	...	81·3	70·1	11·2	80	76	N.E.	N.E.	135	2
4	0·03	82·1	75·1	7·0	80	84	N.E.	N.E.	141	2
5	...	82·4	75·5	6·9	82	78	N.E.	E.	49	2
6	0·20	81·9	74·7	7·2	76	78	N.E.	E.	117	1
7	0·11	81·7	73·7	8·0	78	74	N.E.	N.E.	198	2
8	0·43	81·1	72·7	8·4	84	78	N.E.	N.E.	145	...
9	0·06	81·5	75·3	6·2	62	64	N.E.	N.E.	164	3
10	...	80·3	67·2	13·1	71	60	N.N.E.	N.E.	198	1
11	...	78·8	67·1	11·7	76	74	N.	N.E.	102	3
12	...	79·8	67·2	12·6	78	68	N.E.	N.E.	141	4
13	...	79·9	67·1	12·8	74	72	N.E.	N.E.	160	3
14	...	80·5	67·1	13·4	77	70	N.E.	N.E.	75	4
15	...	81·5	69·7	11·8	60	60	E.	E.	100	4
16	...	80·5	66·9	13·6	61	65	E.	E.	82	2
17	...	82·5	67·5	15·0	71	57	N.E.	N.E.	116	8
18	...	80·1	65·9	14·2	69	61	N.E.	N.E.	162	4
19	...	80·7	67·8	12·9	76	62	N.N.W.	N.E.	151	2
20	...	79·7	65·8	13·9	75	68	N.	N.E.	128	4
21	...	81·4	66·9	14·5	75	74	N.	N.E.	146	6
22	...	81·3	72·1	9·2	74	74	N.N.W.	N.E.	146	4
23	0·01	80·7	71·8	8·9	82	69	N.E.	N.E.	129	4
24	...	80·8	69·2	11·6	66	68	N.E.	E.	111	6
25	...	80·1	65·8	14·3	71	74	N.	E.	70	5
26	...	83·3	67·7	15·6	76	69	N.E.	E.	54	...
27	...	83·7	67·9	15·8	74	74	S.E.	S.E.	67	2
28	...	88·0	69·8	18·2	74	56	S.	S.	93	3
29	...	83·7	69·8	13·9	81	73	E.	S.E.	64	2
30	...	83·5	75·3	8·2	74	73	E.	S.E.	61	...
31	...	82·7	72·2	10·5	69	62	N.E.	N.E. by E.	116	...
FEBRUARY.										
1	...	82·5	74·9	7·6	65	62	N.E.	N.E.	141	4
2	...	83·3	68·7	14·6	68	67	N.E.	E.N.E.	158	4
3	...	83·7	74·7	9·0	59	61	N.E.	N.E.	106	1
4	...	82·9	67·7	15·2	64	67	N.E.	N.E.	51	1
5	...	82·7	67·8	14·9	64	64	N.E.	N.E.	114	6
6	...	82·5	67·1	15·4	59	62	N.E.	N.E.	76	6
7	...	81·9	66·8	15·1	66	89	N.E.	E.	95	6
8	...	82·4	66·6	15·8	74	64	N.E.	E.	56	1
9	...	84·5	66·5	18·0	83	56	E.	S.E.	51	3
10	...	84·8	66·5	18·3	58	61	S.E.	S.E.	85	1
11	...	84·4	68·4	16·0	63	59	S.E.	S.E. by E.	88	2
12	...	85·1	70·7	14·4	63	64	S.E.	S.E. by S.	84	7
13	...	84·9	74·3	10·6	60	63	S.E.	S.E. by E.	82	3
14	...	85·4	72·3	13·1	70	68	E.	E. by S.	87	4
15	...	84·5	70·7	13·8	62	68	S.E.	S.E.	83	8
16	...	85·1	67·6	17·5	70	65	S.E.	S.E.	57	4
17	...	85·7	68·7	17·0	67	68	S.S.E.	S.E. by S.	100	5
18	...	89·6	72·0	17·6	72	58	S.S.E.	S. by E.	70	4
19	...	86·7	74·3	12·4	73	60	S.E.	S.E. by S.	93	7
20	...	86·0	75·9	10·1	68	64	E.	E.N.E.	19	5
21	...	86·3	74·3	12·0	61	61	E.S.E.	E.	33	2
22	...	85·9	74·9	11·0	68	65	N.E.	E.N.E.	31	4
23	...	85·3	72·2	13·1	59	60	N.E.	N.E. by E.	38	10
24	...	84·9	72·3	12·6	65	68	N.E.	E.N.E.	27	7
25	...	85·1	76·2	8·9	60	65	E.N.E.	N.E.	37	7
26	...	85·7	73·2	12·5	62	65	N.E.	E.	43	6
27	...	85·3	73·1	12·2	60	60	E.N.E.	N.E by E.	89	7
28	...	85·9	69·7	16·2	63	62	N.E.	E.	27	4
29	...	86·1	69·8	16·3	70	64	N.N.E.	E.	73	...

Daily Record of Meteorological Observations and of Cholera Deaths at NEGAPATAM during the Prevalence of the Disease in the year 1888—continued.

Month and date.	Rainfall in inches.	Temperature of air in the shade.			Moisture of air per cent., 100 being saturation.		Wind.			Deaths from cholera recorded on each day.
							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
MARCH.										
1	...	86·4	77·1	9·3	66	52	E.	N.E. by E.	55	2
2	...	87·3	70·3	17·0	71	66	E.	E.S.E.	68	2
3	...	86·7	69·9	16·8	76	64	S.E.	E. by S	28	3
4	...	86·3	70·3	16·0	61	59	S.E.	N.E.	76	3
5	...	85·7	72·7	13·0	57	68	E.	S.E.	50	1
6	...	85·7	75·7	10·0	52	57	S.E.	E.	27	...
7	...	86.4	68·1	18·3	52	56	E.	E.	72	...
8	...	86.7	69·5	17 2	63	64	E.	S.E.	50	...
9	...	87·6	72·5	15·1	71	65	E.	S.E.	54	3
10	...	88·9	72·7	16·2	72	73	S.E.	S.E.	30	2
11	...	89·4	75·7	13·7	69	70	S.E.	S.E.	85	1
12	...	88·5	74·5	14·0	66	64	S.E.	S.E.	54	1
13	...	89·2	77·3	11·9	61	65	E.	E. by S.	189	2
14	...	88·4	72·8	15·6	61	61	S.E.	E.S.E.	89	2
15	...	90·0	71·1	18·9	55	53	S.E.	S.E.	123	3
16	...	89·5	74·8	14·7	68	61	S.E.	S.E by S.	109	5
17	...	90·1	75·7	14·4	65	66	S.S.E.	S.E.	154	6
18	...	90·2	78·9	11·3	67	62	S.E.	E.S.E.	133	5
19	...	88·6	71·7	16·9	60	61	E.	E.	46	1
20	...	89·0	72·9	16·1	65	68	N.E.	E. by N.	66	2
21	...	89·2	77·9	11·3	61	61	E.	E. by N.	70	2
22	...	89·0	76·8	12·2	63	60	E.S.E.	E.	72	...
23	...	89·4	73·1	16 3	66	67	S.E.	S.E by E.	106	...
24	...	97·3	79·4	17·9	71	62	S.E.	S.E by S.	149	...
25	...	96·0	75·1	20·9	57	42	S.	S.	98	...
26	...	91·2	79·3	11·9	70	69	S.E.	S.E by E.	168	...
27	...	91·4	80·3	11·1	69	63	S.E.	S.E by S.	156	...
28	...	91·5	78·3	13·2	68	63	S.E.	S.E.	67	...
29	...	91·5	80·2	11·3	70	71	S.E.	S.E.	146	...
30	...	90·1	74·2	15·9	67	63	S	S.E.	107	2
31	...	93·8	76·7	17·1	64	48	S.W.	S.E.	146	...
APRIL.										
1	...	91·9	81·8	10·1	72	71	S.	S.E.	130	...
2	...	91·5	80.4	11·1	65	63	S.E.	S.E.	160	...
3	...	90·6	74·2	16·4	65	66	S.E.	S.E.	120	1
4	...	91·4	75·5	15·9	68	67	S.E.	S.E.	119	1
5	...	91·2	79·9	11·3	66	74	S.E.	S.E.	147	2
6	...	92·6	81·8	10·8	68	68	S.E.	S.E.	173	...
7	...	92·0	80·8	11·2	70	78	S.E.	S.E.	165	...
8	...	92·2	81·0	11·2	65	63	S.W.	S.E.	126	...
9	...	91·8	79·4	12·4	53	70	S.W.	S.E.	129	...
10	...	93·8	76·8	17·0	58	78	S.W.	S.E.	92	...
11	...	92·5	78·6	13·9	58	73	S.W.	S.E.	138	...
12	...	93·0	81·9	11·1	70	70	S.E.	S.E.	128	...
13	...	92·8	78·1	14·7	75	76	S.E.	E.	109	...
14	0·05	90·6	77·9	12·7	75	72	N.E.	S.E.	54	...
15	1·09	91·5	77·2	14·3	72	57	S.	S.E.	40	...
16	...	91·4	78·9	12·5	62	70	S.E.	S.E.	62	...
17	...	95·0	80·8	14·2	63	63	S.W.	S.W.	112	...
18	...	90·2	80·2	10·0	72	74	S.W.	S.E.	126	...
19	...	90·6	79·8	10·8	73	68	S.E.	S.E.	130	...
20	...	92·0	78·8	13·2	60	66	S.E.	S.	81	...
21	...	92·5	79·8	12·7	73	68	S.E.	S.E.	134	...
22	...	91·5	79·4	12·1	75	86	S.E.	S.W.	117	...
23	0·04	93·6	75·9	17·7	69	70	S.S.E.	S.E.	75	...
24	...	95·0	79·4	15·6	63	70	S.W.	S.E.	88	...
25	...	94·4	79·6	14·8	60	65	S.W.	S.E.	107	...
26	...	92·5	80·3	12·2	50	67	S.E.	S.E.	134	...
27	...	95·2	79·2	16·0	56	55	S.W.	S.E.	104	...
28	...	92·6	79·4	13·2	59	70	S.W.	S.E.	140	...
29	...	92·1	81·6	10·5	63	70	S.	S.E.	152	...
30	...	99·5	83·3	16·2	64	62	S.W.	S.E.	166	...

Daily Record of Meteorological Observations and of Cholera Deaths at NEGAPATAM during the Prevalence of the Disease in the year 1888—continued.

Month and date.	Rainfall in inches.	Temperature of air in the shade.			Moisture of air per cent., 100 being saturation.		Wind.			Deaths from cholera recorded on each day.
							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
JULY.										
1	...	96·8	79·3	17·5	56	65	W.	S.E.	183	...
2	...	97·1	79·4	17·7	56	48	S.W.	W.	147	...
3	...	96·5	80·2	16·3	65	43	S.W.	W.	144	...
4	...	96·6	79·3	17·3	76	40	S.W.	S.W.	209	...
5	...	96·2	79·6	16·6	54	45	W.	S.	289	2
6	...	95·5	79 3	16·2	61	51	S.W.	S.W.	144	...
7	...	91·9	75·9	16·0	55	62	S.W.	S.W.	104	...
8	0·08	94·6	73·3	21·3	73	62	S.W.	S.W.	152	...
9	0·38	94·5	77·3	17·3	57	53	S.W.	S.W.	148	...
10	...	95·6	76·7	18·9	58	54	S.W.	S.	140	...
11	...	94·8	75·5	19·3	57	49	S.W.	S.W.	213	...
12	...	94·0	79·0	15·0	58	55	W.	S.W.	182	...
13	...	95·4	78·8	16·6	50	68	S.W.	S.E.	206	...
14	...	97·1	76·5	20·6	60	56	W.	S.W.	156	...
15	...	95·4	74·1	21·3	56	59	S.W.	S.W.	112	...
16	...	96·8	78·2	18·6	49	61	S.W.	S.W.	127	...
17	...	96·5	77·2	19·3	56	79	S.W.	S.	178	...
18	...	96·4	79·3	17·1	58	65	W.	W.	162	...
19	...	96·5	79·6	16·9	55	69	W.	S.	173	...
20	...	96·0	77·8	18·2	59	59	S.W.	S.	180	...
21	...	94·0	77·0	17·0	65	76	S.W.	S.	128	...
22	...	94·2	79·2	15·0	63	66	S.W.	W.	125	...
23	...	92·5	79·6	12·9	55	73	S.W.	S.	193	...
24	...	96·6	79·8	16·8	61	82	S.W.	S.W.	149	...
25	...	98·1	79·8	18·3	58	61	S.W.	S.W.	136	...
26	...	96·2	79·0	17·2	65	48	W.	W.	204	...
27	...	98·1	77·7	20·4	59	50	S.W.	W.	151	...
28	0·25	96·5	75·9	20·6	61	51	W.	S.W.	144	...
29	0·76	96·5	73 9	22·6	59	71	N.W.	S.W.	211	...
30	0·18	95 8	75·9	19 9	70	80	N.W.	S.W.	177	...
31	0·81	94·4	73·6	20·8	74	70	S.W.	S.	130	...
DECEMBER.										
1	0·28	83·5	75·2	8·3	87	83	N.E.	N.E.	121	...
2	0·98	81·7	74·4	7·3	87	91	N.W.	N.E.	104	...
3	0·34	83·5	71·5	7·0	89	89	N.E.	N.E.	197	...
4	4·77	76·5	73·5	3·0	94	93	Calm.	N.	80	...
5	0·12	80·9	73·6	7·3	82	76	N.E.	N.E.	127	...
6	0·08	82·5	75·2	7·3	73	55	N.E.	N.E.	213	...
7	...	80·7	72·7	8·0	82	71	N.W.	N.E.	206	...
8	...	81·5	72·2	9·3	72	68	N.	N.E.	194	...
9	...	79·7	70·9	8·8	77	78	N.N.W.	N.	145	...
10	...	81 3	67·2	13·1	67	74	N.N.W.	N.	230	...
11	...	79·8	65·8	14·0	62	63	N.E.	N.E.	229	...
12	...	77·9	67·5	10·2	66	63	N.W.	N.W.	209	...
13	0·05	77·7	67·9	9·8	52	70	N.W.	N.W.	219	...
14	0·78	76·2	67·9	8·3	95	87	N.W.	N.E.	520	...
15	0·45	78·3	73·5	4·8	86	89	S.E.	Calm.	246	...
16	...	84·4	70·1	14·3	78	77	S.E.	S.E.	39	...
17	...	84·5	75·9	8·6	81	81	E.	S.E.	82	1
18	0·18	82·7	73·1	9·6	84	82	N.E.	N.E.	101	...
19	...	82·4	72·8	9·6	80	74	N.	N.E.	195	5
20	...	80·3	71·5	8·8	65	64	N.E.	N.	197	4
21	...	82·1	71·1	11·0	76	74	N.	N.E.	174	1
22	...	81·9	71·9	10·2	76	70	N.W.	N.	207	4
23	..	82·5	71·1	11·4	79	76	N.W.	N.E.	193	1
24	0·09	74·8	71·5	3·3	93	96	N.	N.W.	173	6
25	0·07	80·4	69·5	10·9	75	75	N.E.	N.E.	228	7
26	...	81·1	69·2	11·9	71	60	N.	N.E.	227	3
27	...	82·5	70·2	12·3	69	62	N.W.	N.E.	175	2
28	...	80·7	66·8	13·9	65	69	N.E.	N.E.	180	5
29	...	81·3	68·7	12·6	74	72	N.	N.E.	167	3
30	...	81·4	73·2	8·2	74	89	N.	N.E.	168	2
31	...	80·2	64·9	15·3	67	65	N.W.	N.E.	179	2

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							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
JANUARY.										
1		85·5	59·7	25·8	61	64	S.	S.W by S.	97	...
2		84·8	61·3	23·5	64	57	S.	S.W by S.	85	3
3		86·1	60·7	25·4	62	62	E.	S.E by E.	110	1
4		87·5	63·7	23·8	67	61	N.E.	E. by S.	124	2
5		87·5	64·7	22·8	78	61	S.E.	S. by W.	109	3
6		89·3	62·7	26·6	57	57	E.	E. by S.	87	1
7		85·5	64·7	20·8	66	61	S.E.	S.S.W.	111	2
8		88·0	61·7	26·3	66	54	E.	E.S.E.	98	...
9		86·7	63·2	23·5	62	64	S.W.	S. by E.	147	5
10		85·0	62·7	22·3	58	55	E.	S.E. by E.	145	3
11		85·3	59·7	25·6	61	50	N.E.	E.S.E.	112	12
12		86·7	58·9	27·8	60	62	E.	S.E. by E.	86	18
13		86·1	61·7	24·4	69	59	E.	S.E. by E.	85	...
14		85·5	61·7	23·8	68	61	N.E.	E.S.E.	75	8
15		85·5	59·7	25·8	64	54	E.	E. by S.	73	...
16		86·5	61·5	25·0	58	55	S.E.	S.E.	87	16
17		86·3	63·6	22·7	54	47	N.E.	E. by S	88	12
18		87·1	61·6	25·5	57	59	E.	S.E. by E.	95	11
19		87·5	56·6	30·9	58	43	S.E.	S.E. by S.	97	5
20		84·3	56·6	27·7	58	57	E.	E. by S.	110	11
21		87·5	59·6	27·9	54	46	N.E.	S.E.	74	6
22		88·0	59·1	28·9	58	51	E.	E.S.E.	87	...
23		91·0	60·6	30·4	66	43	N.E.	E. by N.	84	12
24		88·0	61·6	26·4	66	57	S.E.	S by W.	75	10
25		90·8	58·6	32·2	69	50	E.	S.E.	158	4
26		91·1	58·6	32·5	73	46	E.	S.E. by E.	74	13
27		92·0	60·8	31·2	66	45	S.W.	S. by W.	63	13
28		92·5	65·6	26·9	63	52	S.W.	S. by W.	34	12
29		93·3	66·6	26·7	72	54	W.	S. by W.	50	...
30		91·8	67·6	24·2	67	54	N.E.	E.S.E.	184	9
31		90·5	64·6	25·9	54	51	E.	S.E. by S.	85	8
FEBRUARY.										
1		89·0	61·6	27·4	56	49	N.E.	E.S.E.	160	1
2		89·5	57·8	31·7	59	56	E.	S.S.E.	122	4
3		91·3	56·6	34·7	58	63	N.E.	E.S.E.	85	5
4		89·5	59·6	29·9	58	50	S.W.	S. by W.	77	2
5		91·3	58·6	32·7	54	47	S.E.	S.E. by S.	75	...
6		92·5	56·6	35·9	53	46	S.	W.S.W.	59	15
7		91·5	57·6	33·9	74	48	E.	S. by E.	100	3
8		93·7	56·6	37·1	54	36	E.	S. by E.	84	2
9		93·3	57·6	35·7	46	35	N.E.	E.S.E.	135	4
10		92·3	59·8	32·5	64	38	E.	S.S.E.	61	2
11		94·5	64·6	29·9	61	33	E.	S.S.E.	72	3
12		93·5	62·4	31·1	42	32	S.E.	S.E. by S.	86	...
13		93·3	60·6	32·7	56	37	E.	E.S.E.	62	3
14		94·5	62·1	32·4	65	32	S.E.	E. by S.	72	1
15		96·1	62·6	33·5	63	36	S.S.W.	S.S.E.	160	1
16		90·5	64·4	32·1	60	42	N.E.	E.S.E.	71	4
17		97·5	66·6	30·9	57	43	W.	S.W. by W.	74	3
18		97·0	70·6	26·4	67	45	S.W.	S. by W.	49	1
19		97·5	71·4	26·1	62	41	S.E.	S.	37	...
20		96·5	68·1	28·4	60	48	S.W.	S. by E.	137	6
21		94·1	59·8	34·3	57	39	E.	E. by S.	250	3
22		93·5	65·6	27·9	54	39	S.E.	S.E.	97	1
23		95·5	64·8	30·7	57	36	E.	S.E. by E.	196	5
24		95·3	63·6	31·7	62	39	S.W.	S.W.	98	3
25		94·0	63·6	30·4	60	45	S.E.	S.S.E.	196	3
26		94·2	62·6	31·6	56	44	E.	S.S.E.	122	...
27		95·5	61·6	33·9	44	47	S.W.	S.W.	171	2
28		96·5	63·6	32·9	53	42	S.E.	S. by E.	136	3
29		95·9	64·2	31·7	56	38	N.E.	E.S.E.	109	1

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							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
MARCH.										
1		95·7	68·5	27·2	60	42	E.	S.E. by S.	126	...
2		97·7	70·3	27·4	61	28	E.	N.E.	159	...
3		99·4	66·0	33·4	78	32	E.S.E.	N.E. by E.	110	3
4		99·2	67·5	31·7	54	35	E.	E. by N.	141	...
5		97·0	66·1	30·9	51	37	S.W.	E.	125	...
6		96·4	68·0	28·4	62	42	E.N.E.	E.	141	...
7		95·4	68·5	26·6	63	43	N.E.	S.W. by S.	134	...
8		94·8	69·6	25·2	55	46	S.S.E.	E.	136	...
9		96·1	74·7	21·4	70	49	W.S.W.	S.E. by E.	154	1
10	0·03	96·3	75·6	20·7	64	78	S.E.	S.E. by S.	105	1
11		95·7	74·0	21·7	65	48	W.	N.W.	64	...
12		97·7	74·5	23·2	52	42	W.S.W.	E.	94	...
13		98·7	72·5	26·2	56	40	N.E.	E. by N.	134	...
14		97·7	70·5	27·2	55	38	N.E.	E.	123	...
15		99·4	71·5	27·9	58	39	S.W.	S.E. by S.	126	1
16		99·8	73·4	26·4	57	42	S.W.	N.E. by E.	104	1
17		99·9	71·6	28·3	54	41	S.W.	S.S.E.	63	...
18		99·5	74·8	24·7	62	42	E.S.E.	E. by S.	140	...
19		100·2	69·6	30·6	57	36	N.E.	E. by S.	142	...
20		100·2	70·6	29·6	61	40	N.E.	E.	131	...
21		99·9	71·0	28·9	62	30	N.E.	N.E.	124	...
22		101·2	66·3	34·9	25	22	S.S.W.	E. by S.	129	...
23		102·4	70·0	32·4	52	25	N.E.	N.E. by E.	129	...
24		100·8	71·0	29·8	57	36	S.W.	S.S.E.	112	...
25		101·7	75·6	26·1	58	40	S.W.	S.E. by S.	64	...
26		103·9	76·5	27·4	56	41	S.S.W.	N.E. by N.	153	...
27		101·3	74·6	26·7	62	37	E.N.E.	E. by N.	159	...
28		102·8	74·2	28·6	61	44	W.S.W.	E.	130	...
29		102·7	76·6	26·1	63	41	W.N.W.	E.N.E.	155	1
30		104·7	73·5	31·2	63	34	S.S.W.	E.N.E.	83	1
31		103·3	77·5	25·8	63	49	S.W.	S.E.	84	...
APRIL.										
1		101·8	78·0	23·8	56	39	S.S.W.	S.	45	...
2		102·5	75·5	27·0	57	34	E.	E.	99	...
3		99·6	72·5	27·1	53	45	S.W.	S.S.E.	104	...
4		101·2	72·7	28·5	65	47	W.S.W.	S.E.	76	...
5		103·8	77·0	26·8	60	41	S.S.W.	E.S.E.	68	...
6		102·4	76·7	25·7	63	41	S.W.	E.	74	...
7		100·6	77·4	23·2	59	46	W.S.W.	S.W.	97	...
8		101·3	78·0	23·3	59	45	S.S.W.	W.S.W.	51	...
9		103·9	76·6	27·3	64	46	S.W.	E.S.E.	56	...
10		102·9	79·6	23·3	67	51	W.S.W.	N.W.	70	...
11	0·06	101·7	79·7	22·0	70	83	S.S.W.	E.	67	1
12		100·4	78·6	21·8	68	52	S.S.W.	E.S.E.	55	...
13		104·5	77·4	27·1	59	46	N.E.	E.	115	2
14	0·03	88·7	75·9	12·8	84	67	E.N.E.	E.	114	...
15	0·02	95·6	75·2	20·4	74	60	E.	S.S.W.	63	...
16	0·01	100·6	75·6	25·0	48	34	S.S.W.	S.W.	80	...
17		101·5	78·8	22·7	55	51	S.S.W.	S.S.W.	93	...
18		103·3	77·8	25·5	62	51	W.S.W.	E.N.E.	75	...
19	0·01	99·9	79·6	20·3	67	87	N.W.	S.E.	58	...
20	0·20	100·5	71·6	28·9	63	53	N.W.	E.	59	...
21		100·3	76·8	23·5	68	50	E.N.E.	E.	142	...
22		100·9	75·7	25·2	66	55	E.	E.	121	...
23		99·8	77·8	22·0	71	63	S.W.	E.N.E.	105	2
24		103·3	76·8	26·5	67	52	W.	N.E.	79	...
25		103·2	78·1	25·1	73	48	W.S.W.	S.W.	79	...
26		100·7	79·7	21·0	77	62	S.W.	N.N.E.	55	...
27		103·9	78·1	25·8	69	55	W.S.W.	N.E.	62	...
28		104·3	78·8	25·5	70	48	W.S.W.	S.W.	77	...
29	0·10	104·7	77·2	27·5	58	31	N.W.	W.S.W.	58	...
30		107·7	80·6	27·1	52	23	W.	W.N.W.	98	...

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							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
MAY.										
1	0·68	104·7	80·6	24·1	54	56	W.S.W.	S.E.	90	...
2	...	100·0	77·4	22·6	63	41	S.W.	N.E.	53	...
3	...	105·6	76·6	29·0	47	29	W.	S.W.	51	...
4	0·04	104·9	78·7	26·2	55	56	W.	E.N.E.	80	...
5	...	104·3	77·4	26·9	62	36	S.S.W.	E.N.E.	49	...
6	...	102·4	78·4	24·0	57	38	S.S W.	S.S.E.	55	...
7	...	102·5	80·0	22·5	56	40	S.S.W.	S.S.W.	69	...
8	...	102·3	80·8	21·5	55	37	S.S.W.	N.E.	77	..
9	...	103·6	79·6	24·0	56	37	S.S.W.	E.N.E.	83	...
10	0·01	103·6	79·3	24·3	54	36	N.W.	E.	82	...
11	0·43	79·9	75·4	4·5	91	84	N.E.	N.E.	93	...
12	0·43	86·9	69·6	17·3	82	76	S S.W.	N.E.	77	...
13	0·27	90·9	73·7	17·2	65	63	S.W.	S.S.W.	48	...
14	...	94·5	74·5	20·0	61	53	S.W.	S.S.W.	80	...
15	...	97·1	74·5	22·6	59	42	S.W.	W.S.W.	112	...
16	...	99·2	76·2	23·0	59	55	S.W.	S.W.	106	...
17	...	99·6	76·8	22·8	57	61	W.	S.S.W.	79	...
18	0·11	97·2	75·2	22·0	67	62	W.S.W.	W.S.W.	59	...
19	0·49	93·9	75·5	18·4	67	94	S.W.	E.	92	...
20	...	96·8	72·7	24·1	59	34	N.W.	N.W.	84	...
21	...	98·9	72·4	26·5	59	44	N.N.W.	W.	78	...
22	...	100·7	77·0	23·7	65	57	W.	S.W.	62	...
23	...	102·2	75·8	26·4	54	49	N.N.W.	S.E.	48	...
24	...	99·7	78·1	21·6	67	51	S.	S.E.	36	...
25	...	103·7	79·5	24·2	60	41	W.	E.	76	...
26	...	101·5	77·6	23·9	68	44	W.S.W.	N.W.	62	...
27	...	95·7	76·6	19·1	60	58	S.	S.S.W.	72	...
28	0·65	82·8	70·8	12·0	86	83	S.W.	S.S.W.	70	...
29	...	92·6	72·9	19·7	74	60	S.W.	S.S.W.	34	...
30	...	96·1	74·5	21·6	67	51	S.W.	S.W.	96	1
31	...	98·9	76·4	22·5	65	39	W.	W.N.W.	86	...
JUNE.										
1	...	100·1	77·2	22·9	53	45	S.W.	S.S.W.	86	...
2	...	102·7	77·4	25·3	58	39	W.	W.	107	...
3	0·60	91·4	70·6	20·8	71	57	S.W.	W.S.W.	71	...
4	...	96·6	73·6	23·0	58	62	N.W.	N.N.W.	66	...
5	...	97·4	75·5	21·9	56	45	W.N.W.	S.W.	103	...
6	1·09	97·9	73·5	24·4	68	57	S.W.	S.W.	91	...
7	...	92·9	72·0	20·9	65	57	S.S.W.	S.W.	101	...
8	0·01	94·0	73·9	20·1	62	53	S.W.	S.S.W.	154	...
9	...	96·7	74·9	21·8	63	59	W.S.W.	S.S.W.	173	..
10	0·42	94·0	74·5	19·5	70	97	S.W.	W.	137	...
11	0·03	91·5	73·3	18·2	75	63	W.S.W.	S.W.	80	...
12	0·37	91·7	73·4	18·3	73	66	S.W.	S.S.W.	68	2
13	...	95·8	73·0	22·8	68	55	W.S.W.	S.S.W.	106	1
14	...	97·6	73·6	24·0	63	54	W.	S.W.	116	2
15	0·05	96·6	73·7	22·9	65	98	S.S.W.	N W.	99	...
16	0·03	91·0	73·3	17·7	70	60	S.W.	W.S.W.	111	...
17	...	92·8	73·8	19·0	69	58	S.W.	S.S.W.	136	2
18	...	94·7	73·5	21·2	63	56	S.W.	W.	143	1
19	0·01	95·4	73·7	21·7	64	55	W.	W.S.W.	93	...
20	...	97·0	75·1	21·9	69	65	W.S.W.	S.	103	...
21	0·70	93·9	72·1	21·8	65	65	N.N.W.	W S.W.	61	...
22	...	94·5	73·2	21·3	64	62	W.	W.N.W.	60	...
23	0·43	94·9	72·1	22·8	74	57	W.	N.W.	47	...
24	0·12	95·4	74·3	21·1	76	59	W.S.W.	W.N.W.	44	...
25	...	92·0	74·7	17·3	76	71	S.W.	W.S.W.	76	...
26	...	93·6	73·0	20·8	77	96	S.W.	W.S.W.	90	...
27	0·07	95·1	71·0	24·1	72	63	S.	S.W.	72	...
28	...	94·9	73·6	21·3	69	45	S.W.	S.W.	143	...
29	...	95·0	73·4	21·6	54	52	S.W.	S.S.W.	171	...
30	...	92·9	74·2	18·7	70	62	S.W.	S.S.W.	120	...

Daily Record of Meteorological Observations and of Cholera Deaths at SALEM during the Prevalence of the Disease in the year 1888—continued.

Month and date.	Rainfall in inches.	Temperature of air in the shade.			Moisture of air per cent., 100 being saturation.		Wind.			Deaths from cholera recorded on each day.
							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
SEPTEMBER.										
1	0·20	94·4	70·2	24·2	61	45	S.W.	W.S.W.	65	...
2	0·52	94·7	70·0	24·7	65	43	S.W.	W.S.W.	45	...
3	0·08	94·9	73·5	21·4	63	59	W.	W.N.W.	39	...
4	...	96·8	71·7	25·1	59	40	W.N.W.	W.	61	...
5	...	96·0	72·5	23·5	60	41	W.S.W.	S.W.	88	...
6	...	93·7	74·5	19·2	64	51	W.N.W.	W.	76	4
7	0·01	94·7	74·3	20·4	63	51	W.N.W.	W.N.W.	45	1
8	0·02	96·2	72·2	24·0	66	44	W.N.W.	N.W.	35	...
9	...	97·5	74·0	23·5	64	43	W.S.W.	S.W.	66	...
10	...	96·7	74·5	22·2	59	48	N.W.	W.N.W.	60	...
11	2·05	92·7	69·3	23·4	66	59	W.S.W.	W.N.W.	58	...
12	0·95	91·5	68·5	23·0	77	56	S.	S.E.	29	...
13	0·03	92·7	71·7	21·0	73	55	W.	N.W.	35	...
14	...	91·2	72·5	18·7	68	61	W.S.W.	W.	70	...
15	...	92·7	73·0	19·7	72	57	S.W.	W.S.W.	60	...
16	0·25	87·7	72·6	15·1	87	65	S.W.	W.	71	...
17	...	91·2	69·6	21·6	71	53	W.	S.	63	...
18	...	93·5	70·2	23·3	69	52	S.	S.W.	79	...
19	...	93·7	72·1	21·6	61	52	W.N.W.	S.E.	59	1
20	...	94·9	73·6	21·3	63	59	W.	S.E.	45	...
21	0·50	85·7	71·6	14·1	78	72	S.W.	W.N.W.	40	...
22	0·02	92·0	70·8	21·2	68	70	N.E.	E.N.E.	38	...
23	0·03	93·4	71·4	22·0	70	86	W.	S.E.	23	...
24	0·04	93·6	70·8	22·8	72	64	S.S.E.	S.S.W.	44	...
25	...	93·7	71·6	22·1	70	63	W.	W.	33	...
26	0·50	92·7	70·2	22·5	68	65	S.W.	W.S.W.	23	...
27	0·53	90·3	69·4	20·9	68	63	W.N.W.	S.W.	41	1
28	...	90·7	71·7	19·0	70	61	W.S.W.	N.W.	19	...
29	...	90·9	74·6	16·3	74	69	W.S.W.	W.	61	...
30	...	92·5	73·6	18·9	70	63	S.W.	W S.W.	43	...
OCTOBER.										
1	...	92·7	74·5	18·2	68	61	S.W.	W.N.W.	45	...
2	0·55	91·7	71·5	20·2	80	63	S.W.	N.W.	39	...
3	0·12	90·7	72·1	18·6	73	62	W.S.W.	S.W.	24	...
4	...	92·0	73·0	19·0	65	60	W.S.W.	W.	40	...
5	0·15	90·2	71·7	18·5	76	64	W.N.W.	S.W.	39	...
6	0·05	88·7	70·7	18·0	74	59	W.	W.N.W.	50	...
7	...	93·7	71·5	22·2	66	60	W.	N.W.	44	...
8	0·59	88·7	74·8	13·9	72	92	S.W.	S.	19	...
9	0·10	91·5	71·5	20·0	69	61	E.	N.E.	77	...
10	...	92·7	72·0	20·7	70	60	N.E.	E.	56	...
11	...	91·7	72·5	19·2	65	55	S.	N.E.	51	...
12	...	92·7	71·3	21·4	58	54	E.	E.S.E.	65	...
13	...	93·0	69·5	23·5	54	49	E.	S.E.	75	...
14	...	93·5	70·0	23·5	61	50	E.	S.E.	83	...
15	...	93·7	69·7	24·0	54	62	E.N.E.	N.E.	86	...
16	0·22	79·7	72·6	7·1	90	74	S.	E.S.E.	43	...
17	0·05	92·7	68·6	24·1	63	52	S.W.	W.	37	...
18	...	93·7	70·4	23·3	67	53	E.	S.E.	36	...
19	...	93·8	67·6	26·2	79	51	N.E.	E.N.E.	52	...
20	...	92·3	69·6	22·7	66	62	E.	E S.E.	55	...
21	...	92·7	69·6	23·1	55	54	E.	E.N.E.	84	...
22	...	94·2	69·6	24·6	51	49	E.	N.E.	73	...
23	...	93·5	69·1	24·4	56	51	E.	E.S.E.	123	...
24	...	91·7	69·6	22·1	61	79	S.E.	E.N.E.	76	...
25	0·05	81·5	71·1	10·4	76	82	E.	N.	57	...
26	0·61	79·7	71·6	8·1	89	82	S.E.	E.	41	...
27	0·66	88·7	69·6	19·1	88	65	N.W.	S.W.	15	...
28	0·35	84·7	70·6	14·1	78	76	S.E.	E.S.E.	26	...
29	0·12	87·7	68·1	19·6	83	70	N.W.	E.	41	2
30	...	88·1	69·6	18·5	77	71	N.W.	N.W.	38	...
31	0·01	83·7	72·4	11·3	79	79	S.W.	W.	35	1

Daily Record of Meteorological Observations and of Cholera Deaths at SALEM during the Prevalence of the Disease in the year 1888—continued.

Month and date.	Rainfall in inches.	Temperature of air in the shade.			Moisture of air per cent., 100 being saturation.		Wind.			Deaths from cholera recorded on each day.
							Direction.		Velocity, miles per diem.	
		Highest maximum.	Lowest minimum.	Range.	10 H.	16 H.	10 H.	16 H.		
NOVEMBER.										
1	0·05	83·4	Information not available.		79	75	W.	S.W.	38	...
2	...	83·9			77	69	W.S.W.	N.W.	30	1
3	0·43	87·7			84	69	W.	S.S.W.	19	...
4	2·25	87·9			80	74	S.W.	S.W.	34	...
5	0·10	87·7			74	79	S.	S.W.	35	...
6	...	89·6			68	68	S.	S.S.E.	40	...
7	...	90·7			73	77	S.E.	E.	40	1
8	...	89·7			80	77	S.S.W.	S.	60	...
9	1·80	85·5			73	90	S.E.	S.	39	...
10	0·03	89·5			74	61	E.N.E.	S.E.	33	3
11	0·70	89·3			73	76	E.N.E.	N.E.	57	...
12	...	89·7			72	69	E.	N.E.	73	...
13	0·04	85·7			83	83	N.	S.E.	40	...
14	0·01	87·7			72	79	S.E.	E.	30	1
15	1·02	87·5			75	75	E.	E.S.E.	23	...
16	...	88·7			78	74	S.E.	E.	37	...
17	...	85·7			66	61	S.	S.S.E.	79	...
18	...	86·5			65	49	E.S.E.	S.E.	32	...
19	...	86·7			69	53	S.S.W.	S.E.	38	1
20	...	87·3			68	57	S.S.E.	S.	38	...
21	...	88·7			71	63	E.	E.N.E.	37	...
22	...	88·4			81	65	E.	E.S.E.	54	...
23	...	88·2			72	73	S.	S.S.W.	60	3
24	0·05	79·9			86	82	E.	S.E.	35	1
25	0·42	84·2			91	80	S.E.	S.	34	...
26	0·15	84·7			82	84	W.	S.S.W.	72	1
27	0·03	82·7			82	80	E.S.E	S.	29	2
28	...	86·7			71	72	E.	S.E.	49	1
29	...	89·7			69	64	S.	S.S.W.	47	...
30	...	87·7			75	87	S.E.	S.	43	1
DECEMBER.										
1	...		Information not available.		66	59	E.	S.E.	43	...
2	...				82	66	E.	S.E.	56	...
3	...				61	76	S.S.W.	S.	63	2
4	0·11				89	95	E.	S.E.	58	...
5	0·04				87	85	E.N.E.	S.E.	40	...
6	...				79	72	E.	E.N.E.	59	1
7	...				74	68	N.E.	S.E.	41	1
8	...				69	62	E.N.E.	E.	40	4
9	...				68	62	S.E.	E.N.E.	30	...
10	...				60	57	N.E.	E.	41	8
11	...				55	36	E.N.E.	E.	70	3
12	...				65	49	N.E.	S.E.	38	12
13	...				42	43	E.	N.N.W.	28	3
14	...				68	84	N.	N.N.W.	27	2
15	0·50				87	84	E.	S.E.	82	...
16	...				74	72	N.E.	N.E.	78	...
17	...				68	69	S.E.	N.E.	85	23
18	...				75	72	E.	N.E.	21	9
19	...				61	89	S.E.	N.E.	39	7
20	...				66	78	E.	E.N.E.	41	8
21	...				63	63	S.E.	E.	107	9
22	...				57	65	E.	S.E.	63	8
23	...				57	57	S.E.	E.N.E.	69	...
24	...				61	57	W.	N.E.	68	16
25	...				66	55	E.	N.E.	114	1
26	...				58	56	N.E.	E.	82	8
27	...				58	55	W.	N.E.	77	9
28	...				60	57	S.E.	E.N.E.	90	6
29	...				66	60	E.	S.E.	55	6
30	...				66	65	E.	N.E.	58	...
31	...				61	57	E.	E.N.E.	116	12

SECTION VIII.

ABSTRACT OF CANTONMENT SANITARY REPORTS—MILITARY.

Cantonment.	Sanitary Works.	Water-supply.	Conservancy and Sanitary Condition.	Drainage.	Climate and General Health.
Bangalore ...	2,025 feet of V and 155 feet of box drains were constructed.	Obtained from Ulsoor, Miller's and Shoolay tanks; quality bad.	Was well attended to. Sanitary condition of latrines and bazaars was fair.	Fair	Small-pox prevailed throughout the year. Three cases of cholera also occurred.
Bellary ...	*Nil*	Generally good	Was attended to by the municipality. Latrines and bazaars were kept in good sanitary condition.	Bad	Was favorable. 20·96 inches of rain fell. Prices of food were moderate.
Berhampore ...	*Nil*	Good; obtained from two wells.	Of the bazaars unsatisfactory. Sewage, &c., were carted away to a distance from the lines. Sanitary condition of latrines satisfactory.	Unsatisfactory	Cholera prevailed in the town and troops were prevented from going into it. One case occurred in the lines which recovered. Failure of rain was much felt and prices of food ran high.
Calicut ...	*Nil*	Fairly good; obtained from wells.	Sewage, &c., were removed and thrown into the sea. Sanitary condition of latrines and station fair.	Good	Climate was favorable. 104·5 inches of rain fell against an average of 102. Prices of food were moderate.
Cannanore ...	Drains, well and tanks were cleaned and a new drain constructed.	Obtained chiefly from wells; of good quality.	Sewage, refuse and night-soil were carted away to a distance by the municipality and buried. Sanitary condition of latrines and bazaars satisfactory.	In the cantonment satisfactory ...	Cholera prevailed among the civil population, who were forbidden the barracks; none among the troops. 138 inches of rain fell during the year against an average of 119.
Kamptee ...	*Nil*	Good; obtained from numerous wells carefully protected, and river.	Satisfactory. Latrines and bazaar were kept in good sanitary condition. Sewage, rubbish, &c., were carted away to a distance and buried.	Fairly good	Was favorable. No epidemics. 72 inches of rain fell against an average of 55. Prices of food were moderate.
Madras (Fort St. George).	.....	.....	.....	.....	.....

ABSTRACT OF CANTONMENT SANITARY REPORTS—MILITARY—*continued.*

Cantonment.	Sanitary Works.	Water-supply.	Drainage.	Conservancy and Sanitary Condition.	Climate and General Health.
Malapuram ...	Surface drains were made and two new wells are to be sunk.	Good; obtained from a specially reserved spring well.	Satisfactory	Sweepings, sewage, &c., were taken outside of the station and buried. The latrines were kept in good order, but the sanitary condition of two bazaars was unsatisfactory.	Unfavorable. Cholera prevailed among the native population; none among the troops. 101·7 inches of rain fell against an average of 98·3. Food was abundant and cheap.
Mangalore ...	*Nil*	Is obtained from a tank and wells; quality good.	Unsatisfactory. Surface only, to carry off storm-water.	Refuse and sewage from private houses were removed to a distance and buried. Sanitary condition of cantonment and latrines satisfactory.	Favorable. 122·1 inches of rain fell against an average of 123·6.
Moulmein ...	*Nil*	Good; from wells	Satisfactory	Sewage, rubbish, night-soil, &c., were carted away and buried. Sanitary condition of latrines and bazaars satisfactory.	Climate favorable to health. Cholera prevailed epidemically in the town among the civil population; none among the troops, with whom communication was stopped. About 185 inches of rain fell. Prices of food were moderate.
Pallavaram ...	*Nil*	Is obtained from covered wells; good.	Satisfactory	Was well attended to. Sewage and night-soil were removed by scavengers and deposited a mile away from the station. Latrines and bazaars were kept in fairly good order.	Climate was favorable to health. No epidemics. Prices of food were moderate.
Poonamallee ...	*Nil*	Is obtained from wells and filtered before use.	In the centre of station fairly good; towards the outskirts of the cantonment indifferent.	Was fair. Sewage is disposed of by means of open drains. Its conveyance to a suitable distance is not attainable. The latrines and bazaars were kept in a fair sanitary condition.	Climate was favorable to health. No cholera among the troops; a few cases occurred among the civil population.
Port Blair ...	*Nil*	Good; obtained from wells ...	Satisfactory	Was fairly well attended to. Sanitary condition of latrines and bazaars satisfactory.	Was favorable. 128·2 inches of rain fell; average 115·9. Prices of food were moderate.
Quilon ...	*Nil*	Good; obtained from wells ...	Satisfactory	Was well attended to. Sewage, rubbish, &c., were carried away to a distance and either buried or thrown into the canal. Sanitary condition of bazaars and latrines was satisfactory.	Health favorable. No epidemics. A few cases of cholera occurred among civil population. 101·6 inches of rain fell, being about the average. Prices of food moderate.
Raipur ...	*Nil*	From a well; good	Satisfactory	Satisfactory. Sweepings, sewage, &c., were buried in trenches or marshes. Latrines and bazaars were kept in good order.	Climate was conducive to health. Three cases of small-pox occurred among the drummers. Average rainfall 117·1 inches. Prices of food were moderate.
Rangoon ...	*Nil*	Good; obtained from wells ...	Same as last reported; chiefly surface.	Was fairly well attended to. Sanitary condition of bazaars and latrines satisfactory.	Was favorable. 99·2 inches of rain fell. Food was plentiful and cheap.
St. Thomas' Mount.	*Nil*	Good; from wells	Fair; a new scheme of drainage is under consideration.	Fairly good. Sewage, sweepings, rubbish, &c., were carted away to a distance and buried. Bazaars and latrines were kept in sanitary condition.	Health was favorable. No epidemics among the troops. 50 cases of cholera occurred among the civil population. 67·4 inches of rain fell. Price of food was fairly cheap.
Samulcottah ...	*Nil*	Good; from wells	No regular system: side-cuttings exist.	Fairly well attended to. Sweepings, sewage, &c., were carried away to a distance and buried. Sanitary condition of latrines and bazaars was good. More latrines for the civil population in the cantonment are required.	Climate was conducive to health. No epidemics. Food was abundant and cheap.
Secunderabad ...	Drains were cleaned and urinals constructed.	Is obtained for the British troops from three large wells pumped into reservoirs and distributed to the buildings by gravitation; quality good. For Native troops from wells, of a fair quality.	Fairly good. Mostly surface ...	Was fairly well attended to. Sweepings, &c., and house sewage were carted away to a distance and buried. Sanitary condition of latrines was satisfactory, but not so of the bazaar owing to defective drainage and large number of private privies.	Rainfall deficient; only 23 inches fell against an average of 33 inches. Prices of food rose in consequence. General health was on the whole fairly good.
Seetabuldee ...	*Nil*	Good; obtained from a reserved well. A scheme for the supply of water solely from the main reservoir is under consideration.	Satisfactory	Was well attended to. Sewage, refuse, &c., were carted away beyond municipal limits and buried. Latrines and bazaar were kept in good condition.	Was satisfactory. No epidemics. 39·5 inches of rain fell against an average of 44·2 inches. Prices of food were at average rates.
Sambulpore ...	Two latrines and a slaughter-house were constructed.	Fair; obtained from six wells.	Fair	Refuse, sweepings, &c., were carted to a distance and buried. Sanitary condition of latrines and bazaars satisfactory.	Fairly good. Prices of food moderate.
Thayetmyo ...	Drains well cleaned; tunnels were constructed and repaired and rank vegetation removed.	Is obtained from wells; somewhat hard.	Good	Satisfactory; sewage, refuse, &c., were removed in carts and burnt. Latrines and bazaars were well conserved.	On the whole fairly good. One death from cholera occurred among the European troops. 31 inches of rain fell against an average of 35 inches. Prices of food were moderate.

ABSTRACT OF CANTONMENT SANITARY REPORTS—MILITARY—*continued.*

Cantonment.	Sanitary Works.	Water-supply.	Drainage.	Conservancy and Sanitary Condition.	Climate and General Health.
Trichinopoly ...	An open masonry drain was constructed and a new system of drainage for the 17th Regiment M.I. is under consideration.	Is obtained from numerous wells; good and abundant.	Good	Satisfactory. Latrines and bazaar were well attended to and kept clean. Sewage, sweepings, &c., were carted away to a field and buried.	Was favorable. Cholera appeared, but not epidemically. 20 cases and 13 deaths occurred among the troops scattered over a number of months. 31 inches of rain fell against an average of 34·1 inches. Food was plentiful and cheap.
Trichoor ...	Masonry drains are under construction.	Good; obtained from wells ...	Is being improved	Satisfactory. Improved since last report. Sanitary condition of latrines and bazaar fairly good. Sewage, rubbish, &c., were carted away to a distance and buried.	Was favorable. No epidemics. Food was cheap.
Vellore ...	A few drains and a tank were cleaned.	Fairly good and abundant; from tanks and wells.	Fairly satisfactory	Was carefully attended to by the municipality. Latrines and bazaar were kept in fair order. Sewage, sweepings, &c., were removed by a contractor and sold as manure.	Was unhealthy during the part of the year. The heavy rains produced fevers, diarrhœa, dysentery, &c. 42·4 inches of rain fell against an average of 41·1 inches. Price of food was on the whole cheap.
Vizagapatam ...	A few drains were built and the existing ones cleaned.	Good; from wells	Satisfactory	Attended to by the municipality. Sanitary condition of latrines and bazaars fairly satisfactory. Sewage, sweepings, &c., were carried to a distance of 2 miles and buried.	Was favorable. No epidemics. 30·6 inches of rain fell against 40 inches. Failure of rain raised the prices of food.
Vizianagrum ...	A masonry parapet wall was erected round a well.	Obtained from wells; good, but insufficient.	Surface: good masonry drains are much required.	Was fairly well attended to. Sewage and other refuse, &c., are removed and buried. There are no public latrines. Open country around is resorted to for purposes of nature. The bazaars were kept in fairly good order.	Was favorable. A few cases of cholera occurred in the cantonment; 4 cases and 3 deaths occurred among the sepoys. Only 28·4 inches of rain fell against an average of 46·4. Prices of food rose in consequence.
Wellington ...	*Nil*	Very good; obtained from springs.	Fairly good	Fairly good generally, but the condition of the latrines was unsatisfactory; of bazaars fair. Sewage, sweepings, &c., were collected and removed to a distance, where they were buried.	Was favorable. Some small-pox prevailed in the bazaar: 28 cases and 6 deaths. 48·6 inches of rain fell against an average of 50·1 inches. Prices of food were moderate.

SECTION IX.

SANITARY WORKS—CIVIL.

MUNICIPALITIES.

53. Excluding the town of Madras, which has an Act of its own, 55 towns in the mofussil were administered by the District Municipalities Act IV. of 1884 during 1888, being one more than the number in 1887. The town of Bezvada, with a population of 9,336, was constituted a municipality from the 1st April 1888.

54. *Sanitary Works.*—In the abstracts of the sanitary reports received from the several municipalities given in the succeeding pages are shown in detail the sanitary works executed by each municipality during the year under notice. No new works of any importance were undertaken. As usual, the improvements consisted in the sinking of wells, in the repairing and cleansing of tanks and wells, in the repair and construction of latrines, drains, roads, dust-bins, markets and slaughter-houses, &c.

55. *Water-supply, Drainage and Conservancy.*—The abstracts alluded to above represent the condition of each municipality in these respects. The great desiderata appear to be an improved water-supply and a good system of drainage. In some towns, however, the water-supply is fair and in some again masonry drains do exist, but they are faulty in construction and not laid down on any systematic plan. To effect any radical reform in this direction large sums of money (which the municipalities can ill-afford) and efficient engineering agencies who can undertake the preparation of schemes on a large scale, are absolutely necessary. If in any instance the latter be available, the want of funds to employ them is a great impediment. However, as has been observed by Government, it is hoped that these obstacles will be overcome to some extent by the recent resolution of the Government of India, which authorises the grant of loans to local bodies for the purposes of sanitary improvement. It is in large towns like municipalities governed by a corporation that sanitary improvements should be established on a firm basis, so that they may form the centres from which people in other towns and villages interested in sanitation may take an example in effecting sanitary reforms.

56. The system of conservancy generally was essentially the same as that detailed in former reports. The arrangements made in the majority of the towns were on the whole good and fairly well carried out. In some towns they were indifferent and unsatisfactory, notably so in Coonoor and Tirupati. The unsatisfactory state of things in the former was brought to the special notice of Government, and it is hoped that the orders passed on the subject will be productive of good. The condition of the latter in regard to its conservancy is described by the Deputy Sanitary Commissioner, who visited Tirupati during the year, thus: "There "is one public urinal, for which no buckets have been provided. There are no public "latrines. Portions of backyards are set apart for private resort, holes being left in "the walls so that pigs may enter and clean up. People defæcate anywhere, and "the whole town is pervaded with the odour of pig's dung and human excreta."

57. Private scavengering made progress during the year under review as compared with its predecessor. It was undertaken by municipal agencies in 37 towns, being one more than in 1887, and 16,071 private dwellings, against 15,668 in 1887, were daily cleansed, showing a forward step towards house conservancy. In 19 towns there was an increase in the number of private privies under municipal management; in 10 there was a decrease, and in 8 the numbers were the same as in

1887. The greatest advance made in this direction was in Calicut and Conjeeveram, where the numbers were increased by 270 and 99 respectively. In the 17 other towns the increase ranged from 1 in each—Anantapur, Parlákimedi and Kurnool—to 45 in Rajahmundry. The largest decrease in the numbers was in Pálghat (129) and Máyavaram (45); the decrease in the 8 other towns ranged from 1 in Erode to 32 in Nellore. The municipalities which had the largest number of private privies under their control were Mangalore (2,373), Srírangam (1,995), Bellary (1,634), Tuticorin (1,291), Tanjore (1,026) and Negapatam (1,002).

58. The conservancy establishment in the several towns was of varying strength according to the circumstances and requirements of each. Appended is a statement of the strength in each municipality, of which the following is an abstract, showing the aggregate establishment and the material at work during the year:—

Establishment.	Number.	Material.	Number.
Inspectors	147	Carts	1,053
Overseers	55	Dust-bins	8,005
Maistries	78	Public latrines	915
Peons	225	Private latrines	16,071
Sweepers	1,894		
Toties	1,539		
Tank watchers	141		

59. The total estimated income of the 55 municipalities, exclusive of Madras, during the year 1888-89 amounted to Rs. 19,88,130 against Rs. 19,61,310, indicating an incidence of Rs. 1-5-10 per head of population against Rs. 1-5-9 in the previous year. The amount set apart for sanitation was also greater than that in the preceding year, viz., Rs. 6,81,294 against Rs. 6,28,622.

60. Except in some few towns, such as Ongole (10·9), Pálghat (12·3), Anantapur (12·6), Calicut (13·9) and some others, where the percentages of the sanitary allotment to income were low, the majority of the municipalities contributed very fairly out of their revenues towards sanitation. Three towns Trichinopoly (56·7), Cuddapah (56·4) and Vellore (54·7) contributed more than 50 per cent. In six towns the percentages were between 40 and 50, in nineteen they were between 30 and 40, in eighteen between 20 and 30 and in nine below 20, which must be considered as inadequate; and in keeping with the inadequacy of the grant, the sanitary improvements made in these nine towns were not much.

61. Although the allotments made by the Municipal Councils of Cuddapah and Vellore are large, it is to be regretted that the expenditure during the nine months ending with December 1888 is not in proportion to the sanctioned grants. In Cuddapah, out of an allotment of Rs. 49,894, only Rs. 10,644, and in Vellore, out of Rs. 40,577, only Rs. 11,267 were spent, leaving Rs. 39,250 and Rs. 29,310 respectively to be spent in the next three months of the year.

62. Of the total sanitary grant of Rs. 6,81,294, Rs. 4,33,187 were spent during nine months of the year leaving a balance of Rs. 2,48,107 or more than one-third to be spent in three months. But taking the transactions of 1887-88 which are for the full year, it is observed that out of an allotment of Rs. 6,28,622, only Rs. 5,59,307 were spent, thus allowing a sum of Rs. 69,315 to lapse unutilized. In fifteen towns the expenditure exceeded the sanctioned grant more or less, in thirty-eight it fell short in sums varying from Rs. 25 in Cannanore to Rs. 17,740 in Trichinopoly. In Chidambaram the difference was but a trifle, only Rs. 3. The greatest defaulters in this respect were Trichinopoly, Vellore, Masulipatam, Tinnevelly, Madura and Tanjore.

63. In a statement appended to this section is shown in detail under each item of sanitation the expenditure during the nine months ending with December 1888, of which the following is an abstract as well as that of the transactions for the entire year 1887-88. Conservancy had the largest share of the allotment.

64. The subjoined statement shows the details of the conservancy establishment employed by each municipality:—

	1887-88. For the full year.		1888-89.	
	Amount sanctioned.	Amount spent.	Amount sanctioned.	Amount spent in 9 months ending with December 1888.
	Rs.	Rs.	Rs.	Rs.
For conservancy	3,88,146	3,76,888	4,03,010	2,96,669
For improvement of town sites	56,346	46,706	43,938	46,960
For improvement of water-supply, cleansing, repairing and construction of tanks and wells ...	59,382	39,577	1,24,992	41,050
For sanitary arrangements during fairs and festivals	4,490	4,621	5,040	5,030
For construction and repair of markets and slaughter-houses	40,636	40,682	34,442	15,781
For other sanitary objects	79,622	50,833	69,872	27,697
Total ...	6,28,622	5,59,307	6,81,294	4,33,187

Statement showing the Conservancy Establishment in each Municipality of the Madras Presidency during 1888.

Municipalities.	Population as per Census of 1881.	Inspectors.	Supervisors.	Overseers.	Maistries.	Peons.	Sweepers.	Toties for cleaning public latrines.	Toties for private scavengering.	Number of latrines scavengered by the municipality.	Carts.	Latrines.				Dust-bins.	Tank watchers.
												Pucka built.	Brick wall enclosures.	Mud wall enclosures.	Tatty.		
Coonoor ...	4,778	1	...	1	1	...	12	3	16	70	5	4	5	...	...	39	...
Anantapur ...	4,907	1	...	...	...	2	16	8	3	120	5	1	4	3	...	57	...
Bimlipatam ...	8,582	1	...	2	...	2	37	2	...	...	2	2	...	...	...	30	1
Ongole ...	9,200	1	...	...	...	1	16	4	4	185	3	...	2	3	1	66	1
Karúr ...	9,205	2	...	...	2	...	24	7	...	...	6	3	...	5	5	53	...
Bezváda ...	9,336	1	2	...	...	5	24	15	...	...	19	4	...	...	7	54	...
Erode ...	9,864	1	...	...	...	2	19	10	2	86	13	1	2	10	...	86	...
Wálajápet ...	10,387	2	...	...	4	...	12	9	3	84	6	7	...	...	...	853	7
Ootacamund ...	12,335	2	...	4	6	...	34	19	19	247	26	47	...	...	...	105	...
Tirupati ...	13,282	1	...	...	1	1	12	...	...	...	10	1	...	...	...	145	1
Palni ...	13,315	1	...	...	1	4	8	4	...	...	9	...	...	4	...	22	3
Anakápalle ...	13,341	...	...	1	2	...	22	15	...	...	3	2	...	12	5	61	1
Dindigul ...	14,182	1	...	...	...	3	14	18	...	...	17	2	...	16	...	49	2
Tirupatúr ...	14,278	...	...	...	2	...	32	8	...	...	11	...	...	5	1	52	1
Parlákimedi ...	15,365	2	...	...	...	2	35	2	1	14	3	2	...	...	6	200	1
Cochin ...	15,698	1	...	4	1	...	2	6	33	250	6	2	...	10	6	4	...
Vániyambádi ...	15,933	...	...	...	2	...	39	5	...	...	15	...	...	4	1	200	5
Tuticorin ...	16,281	1	...	...	...	6	15	21	...	1,291	13	...	...	....	10	42	2
Periyakulam ...	16,446	1	...	...	...	2	8	2	...	...	8	...	...	3	...	67	1
Gudiyátam ...	16,690	1	...	...	5	...	13	3	1	5	12	...	...	3	...	100	7
Palamcottah ...	17,964	1	...	...	...	2	7	7	9	250	14	1	4	...	...	98	2
Chicacole ...	18,309	...	1	...	...	4	36	2	16	167	6	1	4	...	...	25	2
Cuddapah ...	18,982	2	...	...	...	6	29	27	...	...	16	16	16	4	2	168	1
Mannárgudi ...	19,409	2	...	1	3	...	30	4	...	...	15	2	...	1	2	90	4

Statement showing the Conservancy Establishment in each Municipality of the Madras Presidency during 1888—cont.

Municipalities.	Population as per Census of 1881.	Inspectors.	Supervisors.	Overseers.	Maistries.	Peons.	Sweepers.	Toties for cleaning public latrines.	Toties for private scavengering.	Number of latrines scavengered by the municipality.	Carts.	Latrines.				Dust-bins.	Tank watchers.
												Pucka built.	Brick wall enclosures.	Mud wall enclosures.	Tatty.		
Guntúr ...	19,646	...	...	5	...	5	39	35	...	...	30	18	...	...	...	44	4
Srírangam ...	19,773	3	...	...	1	10	11	13	21	1,995	21	...	7	1	2	83	...
Chidambaram ...	19,387	1	...	...	...	4	20	5	2	43	10	...	1	...	4	275	4
Kurnool ...	20,329	1	...	...	...	9	36	13	2	64	7	37	...	...	...	255	...
Adóni ...	22,441	2	...	...	...	4	25	16	13	578	6	6	...	6	...	105	7
Vizianagrum ...	22,577	1	...	5	7	...	76	31	6	...	16	...	24	...	...	45	4
Máyavaram ...	23,044	3	...	...	...	6	15	14	...	165	23	2	...	...	6	165	5
Tinnevelly ...	23,221	3	...	1	...	6	36	11	1	25	15	1	6	1	1	110	1
Berhampore ...	23,599	4	...	3	2	2	77	21	26	520	19	...	5	8	5	120	3
Rajahmundry ...	24,555	2	...	...	...	7	46	21	40	900	11	6	6	6	8	153	2
Tellicherry ...	24,581	2	...	...	1	...	20	11	17	290	14	10	...	...	21	30	1
Ellore ...	25,092	4	...	...	...	...	14	30	4	...	9	...	10	5	1	80	1
Cannanore ...	26,386	2	...	1	1	1	18	19	2	127	10	11	...	...	...	19	...
Nellore	27,505	2	...	...	6	1	40	19	15	828	17	...	16	1	10	142	...
Vizagapatam ...	30,291	14	...	...	7	...	108	53	6	130	10	4	42	...	10	180	1
Cocanada ...	30,441	1	...	2	...	11	44	30	8	112	8	8	...	2	2	...	6
Mangalore ...	32,099	1	8	...	...	...	21	2	29	2,378	7	5	...	...	...	88	...
Masulipatam ...	35,056	7	...	...	...	...	41	...	8	222	21	6	...	...	...	...	1
Pálghat ...	36,339	2	...	...	1	1	36	13	5	121	15	4	...	...	4	75	...
Conjeeveram ...	37,275	4	...	...	...	...	40	4	2	132	22	*1	9	...	...	376	3
Coimbatore ...	38,967	2	...	...	1	8	78	25	...	...	29	17	8	6	3	112	1
Vellore ...	40,958	5	...	...	...	9	32	42	5	150	41	21	4	...	...	480	6
Cuddalore ...	43,545	6	...	...	...	...	48	18	3	50	25	12	...	...	6	274	3
Kumbakónam ...	50,098	6	...	...	...	6	24	15	13	250	36	...	16	...	5	456	2
Bellary ...	53,460	12	...	...	...	19	66	16	57	1,634	48	12	...	10	...	288	2
Negapatam ...	53,776	5	...	...	1	16	95	15	80	1,002	41	...	15	...	...	607	7
Tanjore ...	54,745	6	...	...	6	24	80	35	30	1,026	66	...	27	...	...	206	11
Calicut ...	57,085	1	...	...	...	...	...	15	11	308	9	6	...	...	5	...	...
Salem ...	59,631	4	...	...	13	...	79	87	50	257	58	7	4	25	12	208	3
Madura ...	76,847	2	...	2	...	15	85	51	...	...	64	5	...	†1	...	83	...
Trichinopoly ...	84,449	13	...	2	1	19	46	95	...	...	102	2	14	57	2	280	21
Total ...	1,455,660	147	11	34	78	225	1,894	976	563	16,071	1,053	299	251	212	153	8,005	141

* Movable corrugated iron latrine. † Horbury's patent.

ABSTRACT OF SANITARY REPORTS OF MUNICIPALITIES.

Municipalities.	Area in square miles.	Average population per mile.	Sanitary Works.	Water-supply.	Drainage.	Conservancy.	General Health.
Coimbatore.	8	1,298·9	Certain tanks and wells were repaired and cleaned (Rs. 786) and the market was repaired (Rs. 166).	Indifferent. No improvement since last report. Is obtained from public and private wells and tanks.	Very defective. No improvement since last report.	Indifferent from want of proper supervision. System is the same as last reported. There are thirty-four public latrines, seventeen of which are pucka built.	Was good. No epidemics prevailed.
Conjeeveram.	9	4,141·6	A tank was deepened and cleaned (Rs. 20); a market and platforms to bazaars were constructed (Rs. 210); dust-bins were erected (Rs. 200); surface drains were cut (Rs. 100); bye-lanes for private scavengering were opened (Rs. 34), and a latrine was constructed (Rs. 481); and Rs. 54 were spent in improving town sites.	Is obtained from tanks, wells, river, springs and irrigation channel. Quantity sufficient, quality suspicious.	No regular system. Side-cuttings exist to carry off rain water. Drainage from houses flow into the backyards where they sink in the ground or run into cesspools in the streets. A few houses also have cess-pools.	No change in system since last report. Sweepings, &c., are collected and annually sold by auction. Night-soil is buried. There are ten public latrines which are kept clean and freely used. Private scavengering is in force.	Unsatisfactory. Cholera prevailed.
Bellary.	26	2,066·1	Materials for a new latrine were purchased (Rs. 746) and urinals and latrines repaired (Rs. 135).	Is obtained from Mainwaring's tank and wells. The wells have no parapet walls, platforms or drains.	No regular system. Sweepings refuse streets drains exist to carry off storm water. Cess-pools abound into which house drainage flows.	System same as last reported. Sweepings, refuse, &c., are carted to four depôts and eventually sold as manure. The depôts are situated too near the town. There are twenty-one public latrines, eleven pucka built and the others mud-wall enclosures, are freely resorted to, but insufficient in number. Private scavengering is in force.	Slightly better than the previous year. Cholera and malarial fever prevailed.
Adóni.	8	7,480·8	A well, the market and slaughter-house were improved (Rs. 296); a latrine was repaired (Rs. 14), and another improved (Rs. 349).	Is obtained from wells and springs deficient in quantity.	There is no regular system to carry off rain water in some streets. Every nearly has a cess-pool.	The main streets were fairly well attended to; the lanes require more attention; sweepings, &c., are collected and removed by contractors to their fields. There are twelve public latrines freely resorted to. Private scavengering is in force.	Unsatisfactory. Cholera, small-pox, measles and dysentery prevailed.
Anantapur.	9	646·2	Pits were dug for depositing night-soil (Rs. 56); wells were cleaned (Rs. 62); Rs. 461 were spent in repairing latrines, slaughter lines, &c., and Rs. 127 in certain minor improvements.	Is obtained from eleven wells and a tank. Some of the wells are not properly conserved.	No regular system. ment since last re house nearly has a c	The town was kept fairly clean. System same as last reported. Sweepings, &c., are collected and sold and night-soil buried. There are eight public latrines freely resorted to and kept decently clean. Private scavengering is in force.	Was satisfactory. Cholera appeared at the latter part of the year.

ABSTRACT OF SANITARY REPORTS OF MUNICIPALITIES—*continued.*

Municipalities.	Area in square miles.	Average population per square mile.	Sanitary Works.	Water-supply.	Drainage.	Conservancy.	General Health.
Erode.	11	896·7	Temporary wells were sunk in the bed of a channel (Rs. 55); two wells were deepened (Rs. 31), and Rs. 110 were spent in certain repairs.	Ample from wells and a channel. Some of the wells require platforms and drains.	No regular system. Side drains into which house drainage flow exist to carry off storm-water. Two new drains were built, defective in plan and form no part of a regular system.	System same as last reported. A dozen moveable dust-bins were erected for easy removal of rubbish. Sweepings, rubbish, &c., are collected and either burnt or stored in depôts for sale. Private scavengering is in force.	Satisfactory.
Karûr.	4	2,301·2	A well was sunk (Rs. 20); a latrine was built (Rs. 5); three latrines were repaired (Rs. 110); slaughter-house and butcher's stall were repaired (Rs. 101), and Rs. 24 were spent in some other minor repairs.	Sources same as last reported—river and public and private wells; sufficient in quantity.	Defective. No regular system. Three streets are provided with drains, but they form no part of a regular system.	Was well attended to. System same as last reported. Ten corrugated iron dust-bins were constructed. There are thirteen latrines, three pucka built, five mud-wall enclosures and five of tatty: all are in good order and freely used.	Was generally good.
Cuddapah.	19	999·0	Latrines, cholera sheds, dust-bin and market stalls were constructed (Rs. 905), and (Rs. 4,347) were spent in improvements to water-supply.	Is obtained from Boga springs and wells.	Principally natural. There are a few drains but badly constructed. Side channels exist to carry off rain water. Every house nearly has a cess-pool into which house drainage flows.	Was fairly well attended to. System same as last reported. Sweepings, rubbish, &c., are carted away to a distance and annually sold. There are thirty-eight latrines of various kinds. The night-soil depôt is well situated outside of the town. Private scavengering was introduced.	Was on the whole good, though cholera prevailed somewhat.
Berhampore.	5	4,719·8	Slaughter-house was repaired (Rs. 18).	Unsatisfactory. No improvement since last report. Is obtained principally from tanks subject to much pollution. A few wells are also used for drinking.	Unsatisfactory. The principal streets have drains, but not on a regular system. Cess-pool arrangements are bad. House drainage flows into cess-pools.	Was attended to by an establishment employed for the purpose. Sweepings, house refuse, &c., are carted away to a distance and burnt. There are eighteen public latrines; five pucka, eight of mud-walls and five of tatty; arrangement imperfect. Night-soil is buried away from the town. Private scavengering is in force.	Was on the whole satisfactory. Small-pox prevailed somewhat.
Chicacole.	3	6,100·6	A latrine and a market were constructed (Rs. 427); a market and slaughter-house were repaired (Rs. 119); tanks and wells were cleaned (Rs. 5), and Rs. 81 were spent on drainage and digging a channel.	Indifferent; obtained from three wells and two tanks fed by open channels from river subject to much contamination.	Cut-stone drains exist in twenty-four streets, but are not properly attended to. In other parts drainage consists of side-cuttings into which house drainage also flows.	System same as last reported. Dust-bins exist, but seldom used. There are three latrines, two of brick and mortar and one temporary of tatty for females. The former are freely resorted to, but not so the latter. Broken-down houses are often used as latrines. Private scavengering is in force.	Fairly good. Cholera and small-pox prevailed to a slight extent.
Parlâkimedi.	3	5,121·8	Pucka latrines were under construction; channels were dug to carry off dirty water (Rs. 151) and ten cinerators were erected.	Good and abundant from four wells and two tanks.	Natural. Some streets have stone drains. House drainage either flows into the backyards or runs into street drains.	Was well attended to. Street sweepings, &c., are burnt and the ashes sold as manure. There are six tatty and two pucka latrines conveniently situated and carefully attended to. Private scavengering is in force.	Satisfactory. Sanitary condition of the town was greatly improved.
Cocanada.	5	6,088·2	Some prickly-pear was removed (Rs. 41) and Rs. 2,462 were spent in improvements to water-supply which consisted in repairing water channels and cisterns, cleansing tanks and wells, constructing drains to tanks, &c.; culverts and latrines were repaired (Rs. 343); masonry side drains were constructed (Rs. 342) and streets improved (Rs. 102).	Unsatisfactory. No improvement since last report.	No regular system. Consists of one main drain in the centre of the town.	System same as last reported. Rubbish is used for raising low-lying ground which is objectionable. Private scavengering is in force.	Was good. No epidemic.
Ellore.	9	2,788	Cistern to two wells and a drain to another were constructed (Rs. 22). A drain was built and side channels excavated (Rs. 336) and a tank and some latrines were repaired.	Was indifferent. No improvement since last report. Obtained from numerous wells, a tank, river, and the Kistna canal, all subject to pollution.	Indifferent and defective. No improvement since last report. A survey for a proper system of drainage for the entire town is under contemplation as well as a new pattern of cess-pools with removeable receptacles.	Indifferent. System same as last reported. There are eighty dust-bins, seventy-two cess-pools in bad condition and one tatty and sixteen walled latrines very offensive owing to defective flooring.	Was fairly food. Cholera prevailed in a mild form. Some improvements were made in sanitation, but much has still to be done.
Rajahmundry.	12	2,046·2	Rs. 612 were spent in improvements to water-supply; the vegetable market was improved (Rs. 103); side drains were cleared and deepened (Rs. 73); six dust-bins were put up (Rs. 72) and eight tatty latrines were erected (Rs. 75).	No improvement since last report; obtained chiefly from the river subject to much pollution. A tank and eight wells are also set apart for drinking and guarded.	Same as last reported. Natural cess-pools exist, which are very indifferently kept.	Fair. The sweepings, refuse, &c., are collected and burnt and night-soil buried outside the town. There are 153 dust-bins and 26 latrines of various kinds; they are freely resorted to. Private scavengering is in force.	Was on the whole satisfactory.
Guntûr.	13	1,511·2	A tank was deepened (Rs. 2,033); and another constructed (Rs. 300); two wells were sunk (Rs. 452), and tanks and wells were cleaned and latrines repaired (Rs. 143).	Same as last reported; obtained from tanks and wells; abundant and fairly good.	Natural. No regular system. Drainage from houses flows into streets, either sinking in the ground or running into cess-pools.	System as last reported. There are eight latrines for males and ten for females. The town is to be extended. Rs. 16,890 were spent in the purchase of land for the purpose.	Was satisfactory.
Masulipatam.	4	8,764·0	Conduits were built and repaired (Rs. 2,060); a sluice, urinals, and latrines were constructed (Rs. 798); tanks and wells were cleaned (Rs. 90); latrines, drains, markets and slaughter-houses were repaired (Rs. 762), and prickly-pear removed (Rs. 269).	Is obtained from wells and the river Kistna brought into the town in open and covered channels subject to pollution in its course.	No improvement since last report. No regular system. Side-cuttings exist to carry off rain water. Drainage from houses flows into the streets and cess-pools.	Was fairly well attended to. No change in system since last report. Sweepings, refuse, &c., are removed to the swamp and burnt. There are only three latrines—good structures—but much neglected; they are not freely used. People resort to waste grounds and overgrown vegetation for purposes of nature, and pigs do the work of the scavengers. Private scavengering is in force.	Was on the whole satisfactory. Cholera appeared in a mild form.

ABSTRACT OF SANITARY REPORTS OF MUNICIPALITIES—*continued.*

Municipalities.	Area in square miles.	Average population per square mile.	Sanitary Works.	Water-supply.	Drainage.	Conservancy.	General Health.
Bezvada.	4	2,334	Four wells were sunk (Rs. 556); seven bamboo latrines erected (Rs. 212), fifty dust-bins were purchased, and a well and two latrines repaired (Rs. 147).	Is obtained from the Kistna, canals and wells. River water is preferred.	Naturally good. A few artificial drains exist. House drainage flows into streets and form cess-pools, emitting a disagreeable odour.	This town was made a municipality in April 1888. The conservancy establishment was increased, and every effort is made to keep the town clean. The street sweepings and night-soil are removed and deposited to the north of the town, but not sufficiently far away. There are four pucka and seven temporary bamboo latrines; they are freely resorted to, but insufficient.	Was unsatisfactory. Cholera prevailed epidemically.
Kurnool.	5	4,065·8	Silt from a water-supply channel was removed (Rs. 13), a cart-stand was improved (Rs. 178), and latrines were constructed (Rs. 212).	Same as last reported. Unsatisfactory.	No system. Side channels exist in the main streets and cess-pools abound.	Was fairly well attended to. System same as last reported. There are thirty-seven public latrines—mostly simple walled enclosures. Night-soil is buried, which as well as the sweepings, rubbish, &c., are periodically sold as manure. Private scavengering is in force.	Was on the whole fair. Cholera and small-pox however prevailed somewhat.
Dindigul.	2	7,091	Tanks and wells were cleaned (Rs. 50), the fort tank was repaired (Rs. 10), and parapet walls erected to certain wells (Rs. 205). Rs. 490 were expended in conducting experiments connected with the water-supply scheme of the town. Markets and slaughter-houses were improved and repaired (Rs. 716), and moveable dust-bins were purchased.	Unsatisfactory and inadequate from two tanks and four wells. Measures are being taken to obtain a better and ample supply.	Natural drainage good. Some U and V shaped drains exist, but on no regular system. Drainage of houses fair. Some have cess-pools.	Fairly well attended to. Street sweepings, rubbish, &c., are collected and stored in two depôts outside the town and sold as manure. There are eighteen public latrines, simple mud-wall enclosures with tile coping; they are freely resorted to.	Was on the whole good. Some cholera and small-pox however prevailed.
Madura.	4	19,211·7	Nothing of importance. Certain drains were repaired (Rs. 202).	Is obtained from wells on the bed of Vaigai pumped up and carried into the town by pipes. Drinking-water wells exist in the town also and river water too is used.	Very defective and unsatisfactory. No regular system. Such drains as exist are not properly cleaned and attended to; they are used for defœcating purposes owing to the paucity of latrines.	Indifferent. System same as last reported. There are only five public latrines against nine in the previous year. Much requires to be done to improve the sanitary condition of the town. More latrine accommodation, dust-bins and a regular system of drainage are pressing wants.	With the exception of the prevalence of some cholera and small-pox, was on the whole fairly satisfactory.
Palni.	8	1,664·4	Nothing of importance. Certain wells and market sheds were repaired (Rs. 81).	Sources same as last reported, viz., rivers, a tank and wells. The tank water is subject to pollution.	Naturally good. There are some masonry drains, but on no regular system.	System same as last reported. Generally was fairly well attended to; but the arrangements for the removal of night-soil not good. There are four double latrines, cleaned chiefly by pigs.	Was good. A few cases of cholera occurred.
Periyakulam.	27	60	Several streets and roads were repaired (Rs. 622); Rs. 220 were spent in improvements to water-supply; five corrugated iron dust-bins were purchased (Rs. 40) and drains repaired (Rs. 93).	Principally from river. Five wells also are used for drinking only; two are provided with parapet walls, the others are kept in a filthy condition. River water is subject to much pollution; burning and burial grounds exist along both banks.	Naturally good. No regular system. The river forms the main drain.	Was fairly well attended to. No change in system since last report. There are three latrines, but not much used; the people go to any place for purposes of nature and buffaloes act as scavengers.	Was good. The sanitary condition of the town is capable of much improvement.
Calicut.	13	4,391·1	Rs. 355 were spent in thatching certain markets and repairing market stalls.	Is obtained from tanks guarded against pollution and from public and private wells. Most of the latter are small and shallow and exposed to pollution.	No regular system—principally side-cuttings; a few masonry drains exist in some parts of the town.	The sweepings, refuse, &c., are removed and used for filling up hollows and low-lying places. There are six pucka-built and five sentry-box latrines; they are kept clean and are freely resorted to. Private scavengering is in force.	Was unsatisfactory. Cholera prevailed largely.
Cannanore.	4	6,596·5	Roads were repaired (Rs. 1,227) and drains cleaned (Rs. 56). Rs. 85 were spent in repairing markets, slaughter-house, &c., and Rs. 12 in repairing latrines and dust-bins.	Is obtained from wells abundant, but quality suspicious.	Naturally good. Some defective stone drains exist in parts of the town. No improvement since last report in this respect.	Was fairly well attended to. System same as last reported. There are several good pucka latrines well attended to and kept clean. Eighteen dust-bins exist; all are masonry fixed ones. Private scavengering is in force.	Unsatisfactory. Cholera prevailed largely.
Cochin.	1	15,698	Three markets were repaired (Rs. 19); latrines and urinals were constructed (Rs. 84); a swamp was reclaimed (Rs. 631); latrines, urinals, drains, dust-bins, &c., were repaired (Rs. 857) and Rs. 16 were spent in petty improvements to water-supply.	Unsatisfactory. The richer class of people obtain their water from the Alwayé and the poorer depend for their supply on tanks and wells subject to pollution. No improvement since last report.	Defective. No improvement since last report.	Street sweepings, rubbish, &c., are carted away, partly burnt and partly used for reclaiming a swamp which is objectionable. There are twenty latrines, most of them wooden structures over tidal water. Night-soil is either thrown in the backwater or buried near the sea. Private scavengering is in force.	Unsatisfactory. Cholera prevailed.
Pálghat.	9	4,087·6	Dust-bins were purchased and repaired (Rs. 96); tanks and wells cleaned (Rs. 94) and tanks repaired (Rs. 85).	Is obtained from wells, tanks and river. The water is of good quality, but the tanks are subjected to all kinds of pollution.	Natural. Aided in some places by side-cuttings.	Was fairly well attended to. The refuse, &c., are collected and sold annually. There are eight public latrines, three of which are Crawford privies, four tatty and one pucka built. Most of the people resort to fields and open grounds. The conservancy of private dwellings is bad. Private scavengering has been started.	Was on the whole good.

Abstract of Sanitary Reports of Municipalities—*continued.*

Municipalities.	Area in square miles.	Average population per square mile.	Sanitary Works.	Water-supply.	Drainage.	Conservancy.	General Health.
Tellicherry.	4	6,602·5	Tanks and wells were cleaned (Rs. 503); a market was constructed (Rs. 3,000); Rs. 538 were spent on drainage and Rs. 75 in repairing latrines.	Good and plentiful, obtained from numerous wells and a tank.	Natural. No improvement since last report. Good. Surface drains are much needed.	Was fairly well attended to. Sweepings, &c., are burnt and the ashes sold as manure. Night-soil is buried. There are thirty-one public latrines, twenty-one of which are sentry-box ones. Private scavengering is in force.	On the whole good. Some cholera prevailed.
Nellore.	25	1,100·2	Nothing of importance. Rs. 305 were spent in certain repairs.	Unsatisfactory. No improvement since last report. Is obtained from wells, channels and tanks subject to pollution.	Defective. There are a few imperfect street drains. No improvement since last report.	Some attempt has been made in improving the cleanliness of the town. There is still much to be done. Sweepings, rubbish, &c., are collected and sold. Night-soil is buried. There are twenty-seven public latrines freely resorted to; more are required. Private scavengering is in force.	Was fairly good. Some cholera prevailed.
Ongole.	4	2,300	Rs. 60 were spent in improvement to village sites. Tanks and wells were repaired and cleaned (Rs. 227) and dust-bins repaired (Rs. 47).	Defective; obtained from a tank and seven wells reserved for drinking purposes only.	No regular system. Side channels exist.	Indifferent. The sweepings, &c., are carted to depôts and annually sold. There are six latrines, which are freely used. Private scavengering is in force.	Was on the whole fairly good.
Coonoor.	9	630·8	Sluices, cisterns, channels, market, latrines and drains were repaired (Rs. 640); dust-bins were purchased (Rs. 44) and Rs. 2,083 were spent in construction and repair of slaughter-house.	Was unsatisfactory. No improvement since last report. Is obtained from wells and channels subject to much pollution. The wells have no platforms or drains.	Very unsatisfactory. No system. Mostly natural; a few masonry drains also exist.	Very unsatisfactory. Establishment insufficient. There are nine public latrines, four pucka-built and five brick-wall enclosures. More are required. Night-soil is carted away to estates beyond municipal limits. Private scavengering is in force.	Health of the town as well as its sanitary condition was most unsatisfactory. Fever prevailed largely.
Ootacamund.	11	1,111·2	Rs. 1,472 were spent in improvements to Hobart's park and cattle-shed. Rs. 969 in improvements to water-supply and Rs. 55 in miscellaneous improvements. The check channel, main and brewery sewers were repaired and cleaned (Rs. 518) and slaughter-house and market repaired (Rs. 319).	Abundant but defective. Is obtained chiefly from two reservoirs, Dodabetta and Marlimund; the former is brought into the town by open channel subject to pollution and the latter by iron pipes. Wells also are used—from those protected water is good, from unprotected dangerous.	Unsatisfactory. Open drain exist in some parts of the town.	Was fairly well attended to. System same as reported formerly. There are 47 public and 247 private latrines properly attended to. Sweepings, &c., are removed and buried away from the town. Private scavengering is in force.	Was good.
Gudiyattam.	1	16,690	Nothing of importance. Rs. 156 were spent in improvements to water-supply.	Is obtained from springs dug in the river bed; sufficient in quantity; a tank is also used subject to pollution, the gathering ground being paddy fields.	Same as last reported. Side channels exist.	Indifferent. Contract system still in force. There are three public latrines which are freely resorted to.	Was on the whole fair.
Tirupati.	...	...	*Nil*	Is obtained from tanks and wells; insufficient and defective.	Unsatisfactory. No regular system. Drainage from houses flow into cess-pools.	Very unsatisfactory on the contract system. There are no public latrines and pigs act as scavengers. Private scavengering is in force.	Was on the whole fair. Cholera however appeared at the latter part of the year.
Vellore.	4	93,727	A well was improved (Rs. 61); silt from a tank removed (Rs. 43), and several roads were repaired (Rs. 2,094).	Is obtained from rivers, tanks and wells. Unsatisfactory in respect to its safety from pollution. The feeding channels of the tanks are subject to much contamination and burial grounds exist near some of the wells.	No regular system. A drainage scheme for the entire town is under preparation. Some drains exist, but they are no part of any system.	Fair, but supervision indifferent. Sweepings, refuse and night-soil are carted away by contractors outside of the town and sold as manure. There are twenty-one pucka built latrines and four urinals which are freely used and kept in good order. More are required. The municipality undertake partly private scavengering. The system will be extended.	Was unsatisfactory. Fever and bowel complaints were prevalent and cholera appeared at the beginning and end of the year.
Wálajápet.	1	10,387	Nothing of importance. A drain was constructed (Rs. 125) and Rs. 217 were spent in some minor repairs.	Is obtained from wells and six tanks reserved for drinking and watched against pollution.	Masonry drains on no regular system exist in the main road and side channels in the streets.	Was not well attended to. Sweepings, refuse, &c., are carted away beyond municipal limits and sold once or twice a year. There are seven latrines and two urinals. They are not freely used. Private scavengering is in force.	Was fairly good. Sanitary condition of town unsatisfactory.
Salem.	3	1,987·7	Several wells were deepened, cleaned and repaired (Rs. 866) and five springs dug (Rs. 5). A slaughter-house was repaired (Rs. 40); steps to causeway were put (Rs 30); Rs. 416 were spent in repairs to the municipal dispensary, latrines, &c., and Rs. 16 on some minor works.	No improvement since last report. Is obtained from tanks, wells and river; insufficient during hot weather; quality unsatisfactory. Sources subject to pollution.	No regular system. Same as last report. Unsatisfactory. A few masonry drains exist, defective in construction.	Was fairly well attended to on the contract system. No change since last report. The sweepings, &c., are removed by contractors outside municipal limits. There are forty-eight public latrines—seven pucka-built, twenty-nine mud-wall enclosures and twelve of tatty. They were kept fairly clean. Private scavengering is in force.	Unsatisfactory. Cholera and small-pox prevailed.
Tirupatúr.	3	4,759·3	Nothing of importance.	Is obtained from wells and tanks.	Defective. No improvement since last report.	Was fairly well attended to. No change in system since last report. There are six small latrines, five mud-wall enclosures and one of tatty, all dilapidated and little used.	Was satisfactory.
Vániyambádi.	1	15,933	A well was sunk (Rs. 29); a well and spring were cleaned (Rs. 12); a latrine was constructed (Rs. 13) and basket—dust-bins purchased (Rs. 56).	No improvement since last report. Unsatisfactory. From tanks, wells and rivers subject to pollution.	Same as last reported. Indifferent. No regular system.	Was attended to by an inadequate staff of thirty-nine sweepers and two maistries. Rubbish, streets sweepings, &c., were removed to the outskirt of the town. There are four public latrines—mud-wall enclosures. More are required; they are freely used.	Excepting the prevalence of some cholera and small-pox general health was on the whole satisfactory.

ABSTRACT OF SANITARY REPORTS OF MUNICIPALITIES—*continued.*

Municipalities.	Area in square miles.	Average population per square mile.	Sanitary Works.	Water-supply.	Drainage.	Conservancy.	General Health.
Chidambaram.	2	9,918·5	A pucka latrine was built (Rs. 165); Rs. 35 were spent in the repair and construction of leaf latrines and Rs. 713 in repairs connected with the water-supply.	Is obtained from tanks and wells. Unsatisfactory. Two tanks are reserved for drinking only.	Same as last reported. No system. Side channels are dug to carry off rain water.	No change in system since last report. Establishment inadequate. Sweepings, &c., are collected and stored outside of the town and eventually sold. There are six public latrines—five of tatty and one brick enclosure; they are freely resorted to. Night-soil is buried among the sweepings. Private scavengering is in force.	Was on the whole good.
Cuddalore.	12	3,628·7	Tanks, wells, market and slaughter-house repaired (Rs. 190); leaf latrines and dust-bins were erected (Rs. 74) and prickly-pear removed (Rs. 117).	Is obtained from rivers, wells and Mount Capper; of fair quality.	Unsatisfactory. There is no regular system. A few masonry drains exist, but they form no part of a system and are in a ruinous state.	Indifferently attended to. No proper supervision. System same as last reported. There are eighteen latrines—twelve pucka built and six of tatty—generally kept in a filthy condition. Private scavengering is in force.	Was unsatisfactory. Cholera and small-pox prevailed.
Mangalore.	9	3,566·5	A well was sunk (Rs. 80) and drains flushed (Rs. 141). Markets and slaughter-houses were improved and repaired (Rs. 789); some drains were constructed (Rs. 319) and others repaired (Rs. 80).	Is obtained from a tank and numerous wells.	Fairly good. No cess-pools ...	Was well attended to. System same as last reported. There are six public latrines freely resorted to. Night-soil with the ashes of sweepings are mixed outside the town and sold as manure. Private scavengering is in force.	Was unsatisfactory. Cholera and small-pox prevailed.
Kumbakónam.	3	16,699·3	Rs. 6,210 were spent in improvement of town sites; sundry bazaars were constructed (Rs. 442); the vegetable market and two tatty latrines were repaired (Rs. 114) and a drain was extended (Rs. 70).	Unsatisfactory. Is obtained from rivers, a tank and wells and springs dug in the bed of rivers.	No regular system. Mostly by side-cuttings. A regular scheme of drainage for the entire town is under consideration.	The sweepings, rubbish, &c., are carted away to a depôt on the outskirts of the town. There are twenty-one—sixteen masonry and five thatched latrines—walled enclosures; they are insufficient, consequently nuisances are committed outside around them. Private scavengering is in force.	With the exception of an epidemic outbreak of cholera was on the whole fairly good.
Mannárgudi.	4	4,852·2	Roads and tunnels were constructed and repaired (Rs. 2,435) and tanks and wells were cleaned (Rs. 287).	Ample; obtained from rivers, tanks and wells.	Natural; no regular system. Cess-pools exist and they are kept clean.	Was fairly well attended to. System same as last reported. Sweepings, rubbish, &c., are collected and burnt and the ashes sold as manure. There are public latrines—two brick and one mud-wall enclosure; they are not freely used; people resort to fields. Night-soil is buried near the latrines.	Was on the whole good. Cholera prevailed about the beginning of the year.
Mayavaram.	3	7,681·3	Rs. 284 were spent in improvements to water-supply and Rs. 1,388 in repairs to streets, roads, tunnels, &c.	Unsatisfactory. No improvement since last report. Obtained from the Cauvery, tanks and wells, all subject to pollution.	Defective. No regular system ...	Fairly well attended to. System same as last reported. Private scavengering is in force.	Was on the whole good.
Negapatam.	7	7,698·5	Rs. 2,879 were spent in improvements to water-supply and Rs. 115 in repairing a market. A cinerator was constructed (Rs. 136) and 19 dust-bins were purchased (Rs. 185).	Is obtained from tanks, wells, and rivers. The water of three wells were on analysis pronounced to be good and of two condemned; their use was discontinued.	Unsatisfactory. No regular system. A scheme for draining the entire town has been drawn out.	Was fairly well attended to. No change in system since last report. There are 15 public latrines; all pucka built and regularly cleaned. Private scavengering is in force.	Was on the whole fairly satisfactory.
Tanjore.	8	6,843·1	Rs. 1,024 were spent in the improvement of several village-sites. A well was sunk (Rs. 140) and a tank was repaired (Rs. 1,527). A market was improved (Rs. 312) and slaughter-house and drains repaired (Rs. 71).	Same as last reported. Unsatisfactory. Is obtained from tanks, rivers and wells.	No improvement since last report. Masonry drains exist in the Fort only.	Fair. Contract system. The night-soil, refuse, sweepings, &c., are removed to a distance from the town and used as manure. There are 27 public latrines, simple enclosures; they are freely used. Private scavengering is in force.	Was on the whole good. Cholera prevailed in the beginning and end of the year.
Pahamcottah.	1	17,964	Some roads were made (Rs. 585); embankments constructed (Rs. 219), and a tunnel repaired (Rs. 7).	Unsatisfactory. Is obtained from a channel, tanks and wells. Channel subject to all kinds of pollution. Well water fairly good.	Natural. No regular system. A few masonry drains and side cuttings exist.	Fairly well attended to. No change in system since last report. There are 98 dust-bins, 100 cess-pools and 5 latrines which are kept clean and freely used. Private scavengering is in force.	Was on the whole fair. Cholera broke out in December.
Tinnevelly.	1	23,221	Wells and channels were repaired (Rs. 76); temporary latrines during festival were put up (Rs. 62); drains were constructed in two streets (Rs. 305), and a moveable dust-bin purchased (Rs. 11).	Very unsatisfactory. Is obtained from rivers, tanks, wells and channels subject to much pollution.	Generally defective. Some masonry drains exist, but they are very filthy and offensive.	Was attended to by an establishment maintained for the purpose at a cost of Rs. 3,410. System same as last reported. There are nine public latrines, being walled enclosures; they are kept clean.	Was unsatisfactory. Cholera prevailed.
Tuticorin.	3	5,427	Some roads were made and repaired (Rs. 2,157) and hollow places filled (Rs. 138). Rs. 1,656 were spent in improvements to water-supply. A moveable dust-bin was purchased (Rs. 10) and a tatty latrine renewed (Rs. 59).	Is insufficient and very unsatisfactory. No improvement since last report. Is obtained from wells and a tank filled by an open channel subject to pollution.	Defective. No regular system. No improvement since last report.	Indifferent. System same as last reported. There are 10 public latrines, simple tatty enclosures indifferently looked after. Open spaces in and about the town are also resorted to. Pigs act as scavengers. Private scavengering is in force.	Unsatisfactory. Cholera prevailed.
Srirangam.	7	2,824·7	Nothing of importance. Three markets for selling vegetables were erected (Rs. 139) and latrines repaired (Rs. 8).	Very unsatisfactory. No improvement since last report. Sources are wells, rivers Cauvery and Coleroon and channel, all subject to much pollution.	Unsatisfactory. No system. Side cuttings exist, but not well attended to. Sewage is stored up in large cess-pools.	Was fairly well attended to. System same as last reported. There are ten latrines—seven walled enclosures, one of mud and two of tatty. They are well looked after and freely used. Private scavengering is in force.	Generally good. Some cholera prevailed in the beginning of the year.

ABSTRACTS OF SANITARY REPORTS OF MUNICIPALITIES—*continued.*

Municipalities.	Area in square miles.	Average population per square mile.	Sanitary works.	Water-supply.	Conservancy.	General health.
6	3	4	5	6	7	8
Vizianagram	4,515·4		A well was improved (Rs. 84); a channel repaired (Rs. 20) and some new drains were built, and several others repaired (Rs. 739).	In the same unsatisfactory state as last reported. Obtained from tanks and wells subject to much pollution. Three tanks are said to be reserved in name only.	On no regular system. Some streets have masonry drains which run into a main drain with a defective ending in paddy-fields.	Was satisfactory.
Vizagapatam	1,009·7		Temporary latrines were erected (Rs. 125); V-shaped drains were constructed (Rs. 65); Rs. 182 were spent in improvements to water-supply and Rs. 234 in repairs to markets, slaughter-houses, &c.	Unsatisfactory. No improvement since last report. Obtained from deep wells.	Defective. No improvement since last report. Drains built on no regular principle.	Was on the whole good.
Bimlipatam	2,145·5		New drains were constructed (Rs. 214) and others repaired (Rs. 60). Rs. 201 were spent on improvements to water-supply and several roads and buildings repaired (Rs. 1,872).	Good and ample from wells chiefly and three tanks.	Satisfactory. Natural drains exist.	Was good, and sanitary condition satisfactory.
Anakapalli	12	1,111·7	Two latrines were constructed (Rs. 210); masonry drains were built (Rs. 46), and latrines repaired (Rs. 16).	No improvement since last report. Is obtained from wells and a tank fed by a river channel. Sources subject to much pollution.	Same as last reported. Defective. A few V-shaped drains exist.	Was on the whole good. No epidemic.
Tricholinopoly	10	8,444·9	Rs. 4,203 were spent in improvements to water-supply. Certain stalls were erected (Rs. 2,348); latrines were constructed (Rs. 149); drains built (Rs. 394) and a slaughter-house and latrine repaired (Rs. 833).	Very unsatisfactory. A few good wells exist, but the chief sources are rivers, tanks and the channel, all subject to much pollution.	Unsatisfactory. A few scheme for the drainage of the entire town was drawn but not carried out. Cess-pools abound which are occasionally cleaned.	On the whole good. Cholera appeared in the beginning of the year.

Statement showing the Estimated Income and Allotment for Sanitary Purposes and Vaccination in each Municipality during the year 1888-89.

Municipalities.	Population as per census of 1881.	Estimated income, 1888-89.	Rate per cent. of sanitary allotment to available income.	1888-89.* Sanitary allotment. Amount sanctioned.	Sanitary allotment. Amount expended in nine months ending with Dec. 1887.	Conservancy. Amount sanctioned.	Conservancy. Amount expended.	Improvement of town sites. Amount sanctioned.	Improvement of town sites. Amount expended.	Improvement of water-supply including cleansing, repairing and construction of tanks and wells. Amount sanctioned.	Improvement of water-supply including cleansing, repairing and construction of tanks and wells. Amount expended.	Sanitary arrangements during fairs and festivals. Amount sanctioned.	Sanitary arrangements during fairs and festivals. Amount expended.	Construction and repair of markets and slaughter-houses. Amount sanctioned.	Construction and repair of markets and slaughter-houses. Amount expended.	Other sanitary objects, including construction and repair of dust-bins, latrines, drains, &c. Amount sanctioned.	Other sanitary objects, including construction and repair of dust-bins, latrines, drains, &c. Amount expended.	Amount allotted for vaccination.
		Rs.		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Anantapur ...	4,907	16,050	18·6	3,100	2,098	2,430	1,734	400	254	200	52	...	...	...	...	70	58	210
Adoni ...	22,441	27,820	22·9	6,380	6,223	5,780	4,553	...	...	...	513	...	...	...	220	600	937	190
Bellary ...	53,460	85,150	30·8	31,364	21,319	29,064	20,018	...	...	760	58	...	...	300	11	1,250	1,232	450
Conjeeveram ...	37,275	31,950	31·4	10,040	6,219	6,460	4,491	50	53	460	29	1,180	1,112	880	209	1,000	334	410
Coimbatore ...	38,907	40,390	30·6	12,360	8,613	9,210	7,021	...	...	500	786	...	...	400	166	2,250	640	280
Erode ...	9,864	16,190	17·9	2,900	1,887	2,180	1,616	40	1	70	87	110	72	120	42	380	69	190
Karur ...	9,205	16,720	23·1	3,870	2,291	2,770	2,030	...	...	240	45	...	...	50	101	810	115	130
Cuddapah ...	18,982	88,520	56·4	40,894	10,644	7,530	5,312	...	...	42,264	4,417	...	...	...	598	100	317	197
Berhampore	23,599	22,060	28·7	6,525	4,612	6,175	4,594	...	...	100	...	...	...	40	18	210	...	185
Chicacole ...	18,302	22,140	16·6	3,675	2,535	3,075	1,961	...	...	50	38	...	...	...	...	200	...	130
Parlakimedi ...	15,365	14,390	19·0	2,730	1,751	1,980	1,428	...	...	50	11	...	...	400	430	150	106	190
Cocanada ...	30,441	45,310	24·2	10,945	8,591	7,445	5,125	300	216	2,700	2,462	...	...	100	...	700	312	110
Ellore ...	25,092	22,610	28·9	6,540	4,379	5,470	3,845	...	...	160	173	...	...	500	...	400	788	190
Rajahmundry ...	24,555	30,180	36·9	11,130	8,430	9,120	7,395	...	...	770	612	...	...	700	103	410	361	300
Bezwada ...	9,336	18,890	36·3	6,861	4,196	4,112	2,642	...	...	1,485	591	80	...	...	...	1,184	963	150
Guntur ...	19,646	30,090	32·9	12,880	26,502	8,410	6,411	...	16,970	4,390	2,981	...	...	...	...	80	140	300
Masulipatam ...	35,056	39,880	29·7	11,857	10,932	8,192	5,174	...	...	2,465	2,740	...	...	250	86	950	2,932	300
Kurnool ...	20,329	36,150	21·4	7,751	6,531	6,841	6,232	...	...	160	13	...	...	...	...	750	286	220
Dindigul ...	14,182	21,280	34·0	7,250	4,313	3,640	2,613	...	...	2,200	818	...	...	1,210	716	200	166	250
Madura ...	76,847	1,25,180	31·5	56,300	27,707	23,900	17,123	...	...	29,000	7,984	2,000	2,398	500	...	900	202	500
Palni ...	13,315	12,000	43·6	5,240	3,205	2,600	1,939	1,950	964	50	24	170	4	50	57	420	217	150
Periyakulam ...	16,446	9,170	83·9	3,110	2,508	1,840	1,322	1,130	692	50	320	...	...	...	12	90	162	140
Calicut ...	57,085	62,180	13·9	8,628	7,264	8,428	6,900	...	...	...	...	...	...	200	355	...	...	550
Cannanore ...	26,386	26,260	38·5	10,100	8,099	6,110	4,964	2,870	1,986	300	...	100	1,051	510	85	210	13	310
Cochin ...	15,698	19,860	36·3	7,210	4,731	5,040	3,839	...	...	20	16	...	...	500	19	1,650	857	200
Palghat ...	36,339	53,260	12·3	6,570	3,823	4,510	3,133	...	...	300	96	30	25	...	...	1,730	569	400
Tellicherry ...	24,581	55,640	34·7	19,360	9,711	7,260	5,414	...	...	800	503	...	...	10,200	3,000	1,100	794	760
Nellore ...	27,505	32,210	22·8	7,361	4,915	6,395	4,610	...	...	183	75	...	...	...	...	783	230	363
Ongole ...	9,200	23,240	10·9	2,590	1,956	2,190	1,571	50	60	300	278	...	...	...	...	50	2	130
Gudiyatam ...	16,690	15,870	35·9	5,706	3,012	3,728	2,241	...	...	352	156	...	25	726	3	900	587	125
Tirupati ...	13,232	12,080	23·4	2,830	2,099	2,530	2,099	...	...	300	...	...	...	...	...	50	...	220
Vellore ...	40,058	74,110	54·7	40,577	11,267	11,187	7,774	...	...	400	104	...	...	...	803	28,990	2,586	480
Walajapet ...	10,387	14,590	19·2	2,810	1,853	2,710	1,788	...	...	50	65	...	...	...	...	50	...	140
Coonoor ...	4,778	25,260	34·9	8,826	7,174	5,840	4,406	...	...	350	151	...	...	2,486	2,497	150	120	300
Ootacamund ...	12,335	65,490	33·2	21,847	18,059	18,320	15,125	1,771	1,727	902	709	...	...	742	319	112	119	310
Salem ...	59,031	66,290	36·9	24,525	16,391	20,345	14,985	...	...	1,735	901	...	...	300	56	2,145	449	532
Tirupatur ...	14,278	14,370	18·9	2,730	1,721	2,580	1,716	...	...	100	3	...	...	...	...	50	2	130
Vaniyambadi ...	15,933	9,730	29·1	2,849	1,733	2,600	1,733	...	...	50	...	...	...	...	...	100	...	130
Chidambaram ...	19,837	15,940	27·9	4,460	3,503	3,028	2,308	...	...	852	714	50	15	230	191	300	275	250
Cuddalore ...	43,545	37,430	28·2	10,580	6,620	8,940	5,893	...	...	590	174	...	...	20	16	1,030	537	230
Mangalore ...	32,099	47,620	23·4	11,150	7,014	6,680	5,150	...	...	1,070	221	...	...	2,440	789	960	854	300
Kumbakonam ...	50,098	60,410	40·6	24,630	15,559	12,480	8,768	9,850	6,211	1,000	3	...	...	100	555	1,100	22	330
Mannargudi ...	19,400	23,120	40·8	9,456	5,156	2,926	2,171	5,230	2,530	1,000	348	250	104	...	...	50	3	320
Mayavaram ...	23,044	29,360	35·9	10,540	6,342	6,120	4,524	...	...	370	284	150	146	...	8	3,900	1,880	300
Negapatam ...	53,776	78,580	29·2	21,535	16,067	17,040	12,752	...	...	3,835	2,879	200	...	200	115	260	321	580
Tanjore ...	54,745	59,810	41·7	24,995	14,027	15,681	10,723	2,000	1,024	3,010	1,893	...	...	1,100	323	3,204	64	410
Palamcottah ...	17,964	20,480	21·2	4,350	3,291	2,870	2,481	1,300	810	...	...	...	...	130	...	50	...	210
Tinnevelly ...	23,221	30,460	41·2	12,550	3,953	4,200	3,500	...	...	7,100	76	100	62	500	...	650	315	210
Tuticorin ...	16,281	26,350	43·9	11,574	7,149	4,435	3,128	3,750	2,295	3,149	1,657	...	...	50	...	190	69	205
Srirangam ...	19,773	21,220	30·7	6,520	4,251	5,710	4,085	...	...	...	...	...	...	200	142	10	8	150
Trichinopoly ...	84,449	90,980	56·7	55,062	40,882	26,093	19,640	12,647	10,883	7,130	4,293	...	...	7,498	3,502	1,694	2,564	750
Anakapalli ...	13,341	11,660	29·4	3,440	2,294	2,630	1,876	...	...	...	...	...	...	...	...	810	418	160
Bimlipatam ...	8,582	15,350	33·7	5,180	4,199	2,250	1,714	600	284	250	282	...	...	...	...	2,080	1,939	200
Visagapatam ...	30,291	43,120	29·6	12,780	8,971	8,880	7,298	...	...	1,180	182	...	...	800	234	1,920	1,257	350
Vizianagrum ...	22,577	22,280	24·0	5,360	4,615	4,960	3,772	...	...	200	202	...	...	...	...	200	640	270
Total ...	1,455,660	19,88,130	34·3	6,81,294	4,33,187	4,03,010	2,96,669	43,938	46,960	1,24,992	41,050	5,040	5,030	54,442	15,781	69,872	27,697	16,387

**Amount expended is only for nine months ending with December 1888.

DISTRICT LOCAL FUND BOARDS.

65. There was no change in the number or constitution of the District Local Fund Boards during the year. They numbered 21 as in 1887, corresponding with the number of districts or collectorates. For the purposes of administration under Act V of 1884, the districts in the Presidency are divided into three grades, viz., Unions, Taluk and District Boards who have to provide, among other things, for the sanitation of towns and villages. The functions of the first extend to villages, of the second to sub-divisions of districts, and of the third to the entire district. There were in all 85 Taluk Boards and 237 Union Panchayats.

66. As in the municipalities, so also in rural areas outside municipal limits, no works of any importance were undertaken during the year, but various minor improvements were carried out which are detailed in the abstracts of sanitary reports given in the pages which follow,—and these consisted, as usual, in improvements to water-supply and village sites and in the construction and repair of markets, slaughter-houses, dust-bins, latrines and drains. The sources of water-supply were the same as in former years, viz., tanks, wells, irrigation channels, rivers and streams. Some of these are set apart for drinking purposes only and guarded from pollution by the employment of watchmen. There was no change in the system of drainage since last reported upon. It consisted chiefly of side cuttings to carry off storm water. In some few towns masonry drains exist, but they form no part of a regular system. Sewage and waste water from houses either flow into the side cuttings or drains, or are caught in cess-pools, or allowed to run into backyards where they sink in the soil. Conservancy, chiefly surface cleansing, was attended to in 704 cusbah towns and large villages, near the sub-divisions where supervision can be more easily exercised, against 672 in 1887. Special establishments were maintained in them according to the circumstances of each and the street sweepings, filth, rubbish, &c., were collected and removed to a distance; in the majority of instances they were used as manure in fields and sometimes buried or burnt. In villages where no establishment is employed the owners of houses attended to the conservancy. In nine districts the number of conserved villages was the same as in 1887, in one it increased by 6, in another by 4, in two by 2 and in six by 1. In Coimbatore the number decreased by 2, while Nellore, which in 1887 stood conspicuous in having no villages conserved, had scavengering establishments employed in 14 villages in 1888.

67. Since the constitution of local self-government sanitation in rural tracts has become to be generally appreciated, and this is manifest from the desire evinced by the authorities to remedy defects pointed out and to carry out the recommendations made by the Sanitary Inspecting officers. A pure water-supply, a good system of drainage, and effective conservancy including domestic cleansing are the chief elements of sanitation that demand the most serious attention, and, as has been remarked by the Government of India, the powers conferred by legislation on Local Boards in these respects are very considerable and ample scope is given to them for raising funds by methods of local taxation for local improvements. If only the powers thus vested in them be properly directed and the provisions of the law relating to sanitary matters be persistently enforced, and if the money set apart for sanitary purposes year after year be fully utilized and remedial measures systematically adopted, much good will result and the difficult problem of the sanitation of our rural towns and villages will in the end be satisfactorily solved.

68. The total sanitary grant made by all the District Boards for the year 1888-89 amounted to Rs. 4,85,357 against Rs. 4,48,010 in 1887-88. Taken as a whole the allotment seems to be fair. Individually considered too a fair contribution of the revenues was made by each district, except four towards sanitation. The four districts in which the allotments were inadequate are Malabar, Nellore, Ganjam and South Canara. Of the total sanitary allotment Rs. 2,61,862 were spent during the nine months ending December 1888, leaving Rs. 2,23,495 or less than one half to be expended in the remaining three months of 1888-89. It is not likely that the whole of this amount would have been spent during that period;—past experience shows that some portion of it would be allowed to lapse unutilized. Taking the figures for 1887-88, which are for the whole year, we find that out of sanctioned allotment of Rs. 4,48,010 only Rs. 3,71,776 were spent, leaving a balance of Rs. 76,234 unexpended, which is to be regretted. In every district except five—Ganjam, Godávari, Chingleput, Anantapur and Nílgiri, which utilized their sanitary allotments very nearly to their full extent, and the three last even somewhat in excess,—portions of the sanctioned grant were, in varying sums, allowed to lapse unexpended. In this respect Nellore, as must be expected from its marked apathy and indifference to sanitation, as noticed by the District Medical and Sanitary Officer, stands pre-eminent.

69. In the statement appended the details of allotment and expenditure for nine months ending with December 1888 under each head of sanitation are given. The following table is an abstract of it, which also shows the results for the entire year 1887-88. As in the municipalities the largest assignment was made for conservancy.

	1887-88. (For the full year.)		1888-89.	
	Amount sanctioned.	Amount spent.	Amount sanctioned.	Amount spent in 9 months ending with Dec. 1888.
	Rs.	Rs.	Rs.	Rs.
For conservancy	1,92,408	1,70,484	2,10,041	1,40,674
For improvement of town sites	41,648	31,491	52,008	18,291
For improvement of water-supply, cleansing, repairing and construction of tanks and wells ...	87,476	71,378	1,02,463	51,414
For sanitary arrangements during fairs and festivals.	14,343	10,924	13,604	5,221
For construction and repair of markets and slaughter-houses	59,107	44,439	63,724	12,056
For other sanitary objects	53,028	43,060	43,517	34,206
Total ...	4,48,010	3,71,776	4,85,357	2,61,862

Districts.	Area in square miles.	Average population per square mile.	Sanitary works.	Water-supply.	Drainage.	Conservancy.	General health.
Anantapur.	5,094	116·8	Several roads were repaired, village sites improved and prickly-pear removed (Rs. 557); wells, tanks and channels were cleaned, repaired and otherwise improved; several tanks and wells were cleaned, repaired and improved (Rs. 545), and Rs. 2,244 were spent in the construction and repair of market sheds, latrines, side drains, channels and dust-bins.	Is obtained from tanks, wells and channels of fair quality. Forty-two wells are set apart for drinking only and guarded.	No change since last report. Defective. Cess-pools abound but seldom cleaned.	System same as last reported. Fifteen towns and villages were conserved. The sweepings, rubbish, &c., are carted away to a distance and sold as manure. There are thirty-eight public latrines; they are kept fairly clean and are freely used.	Was on the whole satisfactory. Cholera prevailed in some taluks.
Bellary.	5,711	113·8	Prickly-pear was removed, hollows filled in, a channel was cut and another improved, roads, dams erected and other improvements to village sites effected (Rs. 482); tanks and wells were repaired, a stone reservoir and parapet wall to a tank were constructed (Rs. 922); three latrines were constructed (Rs. 470), and four others repaired (Rs. 82); dust-bins were put up and repaired (Rs. 105) and Rs. 1,072 spent on other sanitary objects.	Is obtained chiefly from river and wells set apart for drinking only and guarded from pollution.	No improvement since last report. No regular system.	Twenty towns and villages were conserved. The sweepings, refuse, &c., were collected, and either sold as manure or removed to a distance outside. Latrine accommodation insufficient, but such as there is, is freely used.	Was unsatisfactory. Fever and cholera prevailed epidemically.
Chingleput.	2,833	333·2	Several streets were repaired; prickly-pear removed and village sites otherwise improved (Rs. 1,679); wells were sunk and ponds dug; several wells, tanks and ponds were repaired and cleaned (Rs. 1,061), and Rs. 316 were spent on sanitary arrangements during fairs and festivals.	Is obtained from tanks, wells and channels. The two former sources are guarded from pollution; quality said to be generally good.	Same as last reported. No regular system. Natural and by side cuttings. House drainage flows into the backyards. A few cess-pools exist.	Was fairly attended to in fourteen towns and villages, the sweepings and rubbish, &c., of which were daily carted away to a distance, stored and periodically sold as manure. Only in three of the conserved towns public latrines exist; they are kept in fair condition and are freely resorted to.	Was unsatisfactory. Cholera prevailed.
Coimbatore.	7,824	204·4	Prickly-pear was removed (Rs. 2,537); the market wells with seventeen others were repaired (Rs. 1,627) and five new ones sunk; dust-bins were erected (Rs. 86); roads and latrines were repaired (Rs. 1,996) and some other minor works carried out.	Sources same as last reported; rivers, channels, jungle streams, tanks and wells.	No regular system. Side channels exist.	Thirty-two towns and villages were conserved; their sweepings, refuse, &c., were either burnt or used as manure. There are many latrines, mostly of mud and tatty enclosures; they are not freely used. People resort to streets and lanes.	With the exception of the prevalence of cholera and small-pox, was on the whole satisfactory.
Cuddapah.	8,786	136·2	Village sites were improved (Rs. 284); tanks, wells, &c., were constructed, cleaned and repaired and water supply otherwise improved. Rs. 1,100 were spent on other Sanitary works consisting of repairs to latrines, drains, side channels and clearing of rank vegetation.	Obtained chiefly from wells and rivers.	Unsatisfactory. No improvement since last report.	Partly on the contract and partly on the amani system. The sweepings, rubbish, &c., are collected and deposited outside of the town and annually auctioned. Eighty-six villages were conserved during the year. The public latrines are of mud walls with stone coping; they are freely used and kept tolerably clean.	With the exception of cholera in an epidemic form, general health was on the whole good.
Ganjam.	3,168	461·3	Several wells were repaired (Rs. 430); a tank constructed (Rs. 90), and dust-bins and latrines erected (Rs. 91).	Same as last reported. Is obtained from tanks, wells, and rivers subject to pollution.	No regular system. Stone drains were laid down in some of the principal streets, but they are useless, being unconnected with each other and the levels imperfect. Cess-pools abound.	Twenty-nine towns and villages were conserved. The staff in some is inadequate. The street sweepings, refuse, &c., were removed to depôts at a distance and either sold as manure or burnt. In non-conserved villages they are stored by the ryots in their backyards and open spaces.	Unsatisfactory. Cholera and small-pox prevailed.
Godávari.	5,588	298·2	Several tanks and wells were constructed and repaired (Rs. 3,764); village sites improved (Rs. 250), and market sheds erected (Rs. 749).	Is obtained from the Godávari, tanks and wells of fair quality.	No regular system	Eighty-six towns and villages were conserved against sixty-three last year. The sweepings, refuse, &c., were collected and thrown in the fields. There are no public latrines.	Was on the whole favorable, though cholera and small-pox prevailed to some extent.
Kistna.	845·4	176·6	Several tanks and wells were constructed and repaired and other expenditure incurred in connection with water-supply (Rs. 6,162); roads were made, hollow places filled in, prickly-pear removed and village sites otherwise improved (Rs. 2,378); Rs. 684 were spent on other sanitary objects, such as construction of latrines, dust-bins, &c.	Is reported to be good; obtained chiefly from the river, jungle streams, tanks and wells. A few tanks are set apart for drinking only and guarded from pollution.	Natural. No change since last report. House drainage, fair; in some places leading to the streets.	Somewhat improved since last report. System the same. Sweepings, refuse, &c., are collected and either removed to a distance or stored by the ryots in their compounds or on allotted sites to be eventually sold as manure. Thirty-five villages were conserved. There are four pucka and six tatty latrines in good condition and freely resorted to.	Unsatisfactory. Cholera and small-pox prevailed.

ABSTRACTS OF SANITARY REPORTS OF LOCAL FUND CIRCLES—*continued.*

Districts.	Area in square miles.	Average population per square mile.	Sanitary works.	Water-supply.	Drainage.	Conservancy.	General health.
Kurnool.	7,528	87·4	Certain village sites were improved and roads repaired (Rs. 995); two wells were sunk (Rs. 130) and several others repaired (Rs. 652); trench latrines were constructed (Rs. 66); dust-bins were put up (Rs. 140), and latrines repaired (Rs. 10).	Generally unsatisfactory. Is obtained from springs and wells.	No regular system. A portion of a correct system has been carried out in Nándyál, and it is in contemplation to introduce the same in another village. Cess-pools abound.	Twenty-four towns and villages were conserved. The sweepings, rubbish, &c., were collected daily and either stored for sale or burnt. Night-soil is buried at a distance from the towns.	Was unfavorable. Cholera and small-pox prevailed.
Madura.	839	247·4	Tanks and wells were repaired, cleaned and guarded from pollution and a new well sunk (Rs. 1,115); several village sites were improved and prickly-pear removed, &c., &c., (Rs. 1,697) and markets repaired (Rs. 493).	Is obtained from tanks, wells and rivers. In large villages tanks and wells are reserved for drinking only and guarded. Quality is said to be good.	No regular system. Natural, by side channels.	Was attended to in seventy-nine towns and villages, the sweepings, &c., of which were carted away to the outskirts and periodically sold by auction. The refuse from other villages is either taken by the ryots to their fields or stored in the backyards of their huts. Public latrines exist in only three villages and they are not freely used. People resort to vacant places.	Was unsatisfactory. Cholera and small-pox prevailed.
Malabar.	5,734	384·2	Some wells were sunk and parapet walls put up to others.	Is obtained chiefly from wells subject to pollution. Rivers and tanks are also used in some parts. Thirty-two wells and one tank are set apart for drinking only.	Defective. No regular system. Side channels exist. House drainage flows into backyards and either sinks into the soil or is received into cess-pools.	Staff was strengthened since last report. Seventeen towns and villages were conserved; the sweepings, refuse, &c., of which were carried outside and either buried or burnt and eventually sold as manure. There are only two latrines—one pucka and one of tatty—quite insufficient.	Was unsatisfactory. Cholera prevailed largely.
Nellore.	8,710	135·8	Prickly-pear was removed (Rs. 213); a well was sunk (Rs. 100); four others were repaired (Rs. 246) and a tank cleaned (Rs. 127).	Wells, tanks and rivers. No employment since last report. Some wells have parapet walls and fences.	No system. Principally by side cuttings, rough stone drains exist in some places.	Very indifferent. Rubbish, filth, &c., are stored everywhere. Management of sweepers very unsatisfactory.	Fairly good. Cholera and small-pox prevailed somewhat.
Nilgiris.	986	79·0	A village site was cleaned (Rs. 26) and Rs. 200 were spent in improvement to water-supply.	Is obtained from springs of good quality.	Same as last reported. Natural ...	Very unsatisfactory in Gúdalúr and Devála. In the former, staff employed is inadequate; in the latter, no sweepers are employed.	Was on the whole fair.
Arcot.	7,351	244·0	Prickly-pear was removed (Rs. 236); several tanks and wells were repaired and cleaned (Rs. 711) and Rs. 2,703 were spent in guarding sources of water supply. Rs. 1,483 were spent in construction and repair of markets. A latrine was built (Rs. 23) and Rs. 1,473 were spent on other sanitary objects.	Sources same as last reported. Quality varies in some towns while in others it is bad. Supposed to be guarded from pollution, but in name only.	Said to be fair in some parts and in others bad. Open to much improvement which is difficult to effect. In smaller villages there is no drainage. Cess-pools exist.	System same as last reported. Has improved in larger towns. Village sanitation very backward. Conservancy establishments were maintained in twenty-eight towns and villages. Latrines exist in Unions. Number insufficient, and they are not freely used. People resort to paddy fields, waste places, and cover of rank vegetation.	Was unsatisfactory in the earlier part of the year. Cholera prevailed largely.
North Salem.	7,650	201·3	Village sites were improved (Rs. 1,013) and prickly-pear removed (Rs. 246); several wells were sunk (Rs. 1,565) and tanks and wells repaired and cleaned (Rs. 3,899); several dust-bins were erected (Rs. 1,867); four latrines were built (Rs. 108) and a latrine, side drains, and slaughter-house repaired (Rs. 119).	Is obtained chiefly from tanks and wells well protected from pollution.	Surface. Indifferent and much neglected. No improvement since last report. Cess-pools abound and seldom looked after.	Thirty-seven towns and villages were conserved. The sweepings, &c., were removed to a distance. There are thirteen public latrines insufficient in number and very indifferently looked after. Pigs do the work of scavengers.	Was unsatisfactory. Cholera prevailed.
South Arcot.	4,859	360·4	Prickly-pear was removed; streets were levelled and side channels cut (Rs. 1,946); several wells and tanks were repaired and cleaned and a spring dug (Rs. 797); roads were repaired (Rs. 446); dust-bins were built (Rs. 25); and tunnels, culverts and a parapet wall to a tank were constructed (Rs. 513).	Sources same as last reported. Rivers, tanks and public and private wells. Twenty tanks are reserved for drinking and guarded. Quality said to be good.	No improvement since last report. No regular system. Side channels exist. House drainage flow into backyards and soak in the ground.	Thirty-three towns and villages were conserved against thirty-two last year and kept fairly clean. Sweepings, refuse, &c., from these were carted outside of them and sold by auction. There are seven public latrines. They are freely used.	Is reported to have been on the whole good. Cholera and small-pox prevailed.
South Canara.	3,893	267·2	Village sites were improved (Rs. 88); two wells were sunk (Rs. 300) and others cleaned and repaired (Rs. 228); a market was built (Rs. 256) and another repaired (Rs. 272); two latrines were erected (Rs. 24) and others repaired (Rs. 38), and eleven dust-bins were constructed (Rs. 82).	Is obtained chiefly from wells. Rivers and tanks are also used.	Same as last reported. Natural. No regular system.	Was fair in eighty-eight towns in which conservancy establishments were maintained. No change in system since last report, except in Udipi and Kásaragód, where they are pucka, temporary latrines exist in the conserved towns, but not freely used.	Was unsatisfactory. Cholera and small-pox prevailed.
Tanjore.	3,629	531·6	Several streets were repaired (Rs. 782); dust-bins were constructed and purchased (Rs. 122) and Rs. 1,870 were spent in improvements to water-supply.	Is ample, obtained from rivers, channels, springs, wells and tanks. Drinking sources are watched against pollution.	No regular system. A new drain was constructed in Tiruvadi town.	System same as last reported. Forty-six towns and villages were conserved. The sweepings, rubbish, &c., are either deposited in depôts or burnt and periodically sold as manure. There are four public latrines.	With the exception of the prevalence of cholera was generally good.

ABSTRACTS OF SANITARY REPORTS OF LOCAL FUND CIRCLES—*continued.*

Districts.	Area in square miles.	Average population per square mile.	Sanitary works.	Water-supply.	Conservancy.	Drainage.	General health.
Vizagapatam	3,453	496·8	Rs. 6,147 were spent in improvements to water-supply. Several wells were sunk and others repaired and several tanks and wells were cleaned and repaired. Rs. 1,168 were spent in improvement to village sites.	Generally unsatisfactory. Is obtained from wells and tanks subject to pollution.	System same as last reported. The sweepings, refuse, &c., are generally heaped and used in the fields after a shower of rain. In some they are stored in depôts. Latrines are freely used, but the majority resort to fields.	Chiefly natural. In large towns and villages drains are being constructed as funds admit.	With the exception of an epidemic of cholera, was on the whole fairly satisfactory.
Trichinopoly	3,644	313·4	Some prickly-pear was removed and village streets repaired (Rs. 204); tanks and wells were repaired, cleaned and guarded from pollution (Rs. 677) and a well constructed (Rs. 88); markets were repaired and sheds erected (Rs. 477) and Rs. 1,523 were spent in the construction of four dust-bins, repairs to latrines and other several minor sanitary objects.	Is obtained from rain and river-fed tanks and wells. Nineteen wells and nine tanks are reserved and guarded. Quality said to be good.	Is fairly well attended to in some of the twelve conserved villages and in others require improvement. The conservancy staff and latrine accommodation were increased since last report. Street sweepings, &c., were collected and sold as manure. There are thirty-six public latrines, some of which are in bad repair. Owing to the distance of some they are not freely used.	Same as last reported. Side channels exist; cess-pools abound.	Was on the whole good. Some cholera prevailed.
Tinnevelly	5,376	306·4	Prickly-pear was removed; streets, roads, &c., were repaired and several village-sites improved (Rs. 1,505). Rs. 3,367 were spent in improvements to water-supply, such as repairing tanks and wells, sinking new wells, constructing sluices and steps and Rs. 4,225 were spent on other sanitary objects, as construction and repair of latrines, dust-bins, &c.	Same as last reported. Obtained from wells, tanks, rivers and channels; the two latter sources are subject to pollution. A few tanks are reserved for drinking and watched in the hot weather only.	Establishment was increased. Eighty-four towns and villages were conserved, the sweepings, refuse, &c., of which were carted away to selected spots and sold as manure. In non-conserved villages they are removed by the people themselves and used as manure. There are eleven pucka built and a few temporary tatty latrines freely resorted to.	No regular system. Side channels exist. House drainage run into streets or backyards and sink in the ground. Cess-pools abound but seldom cleaned out.	Was unfavorable. Cholera prevailed largely.

Statement showing the Estimated Available Income and Allotment for Sanitation and Vaccination during the year 1888-89 *in the District Boards of the Madras Presidency.*

District Boards.	Population per Census of 1881.	Area in square miles.	Number of villages in the circle.	Number of villages conserved.	Available income—one-third land-cess.	Rate per cent. of sanitary allotment to available income.	1888-89.* Sanitary allotment. Amount sanctioned.	Sanitary allotment. Amount expended for nine months ending with Dec. 1888.	Conservancy. Amount sanctioned.	Conservancy. Amount expended.
					Rs.		Rs.	Rs.	Rs.	Rs.
Anantapur ...	594,892	5,094	899	15	28,333	42·1	11,930	7,801	6,060	4,361
Bellary	650,374	5,711	1,182	20	42,426	60·8	25,793	12,759	11,450	7,530
Chingleput ...	944,106	2,833	2,002	14	50,906	27·5	13,804	9,753	8,378	6,064
Coimbatore ...	1,599,654	7,824	1,444	30	65,573	73·6	48,316	19,092	9,794	7,165
Cuddapah ...	1,102,056	8,726	1,240	86	60,000	28·9	17,390	11,438	13,130	8,839
Ganjam	1,463,647	3,168	6,893	29	61,333	15·9	9,770	6,482	6,810	5,440
Godávari	1,666,454	5,588	2,246	63	1,11,966	39·9	44,750	18,136	9,340	5,723
Kistna	1,493,778	8,454	1,821	35	1,27,373	26·9	34,260	18,798	17,920	9,271
Kurnool	658,222	7,528	771	24	47,096	51·9	24,470	12,821	10,360	6,000
Madura	2,080,691	8,395	3,969	79	1,00,000	33·0	33,070	17,819	18,950	13,001
Malabar	2,203,117	5,734	427	17	73,566	9·5	7,040	3,430	4,000	2,105
Nellore	1,183,531	8,710	1,686	14	73,333	13·8	10,104	3,249	2,370	1,194
Nilgiris	73,921	935	8	6	2,666	48·0	1,280	720	860	684
North Arcot ...	1,769,936	7,251	3,965	28	91,363	37·2	33,980	17,483	16,744	10,593
Salem	1,548,928	7,650	3,971	37	55,066	67·3	37,080	20,029	14,946	9,717
South Arcot ...	1,751,366	4,859	2,848	33	85,366	42·6	36,418	20,093	13,100	8,552
South Canara ...	927,415	3,893	1,277	18	36,083	16·9	6,104	3,827	2,132	1,736
Tanjore	1,929,232	3,629	3,546	45	1,16,000	23·8	27,610	21,153	18,850	16,149
Tinnevelly ...	1,642,281	5,376	1,494	84	83,333	38·0	31,690	18,110	11,720	8,576
Trichinopoly ...	1,110,811	3,544	1,483	12	46,140	32·1	14,848	7,002	7,597	4,032
Vizagapatam ...	1,715,677	3,453	8,758	15	77,340	20·2	15,650	11,873	5,530	3,942
Total ...	28,109,869	118,355	51,930	704	14,35,262	33·8	4,85,357	2,61,862	2,10,041	1,40,674

1888-89 * —*continued.*

District Boards.	Improvement of village sites. Amount sanctioned.	Improvement of village sites. Amount expended.	Improvement of water-supply, including cleansing, repairing, and construction of tanks and wells. Amount sanctioned.	Improvement of water-supply, including cleansing, repairing, and construction of tanks and wells. Amount expended.	Sanitary arrangements during fairs and festivals. Amount sanctioned.	Sanitary arrangements during fairs and festivals. Amount expended.	Construction and repair of markets and slaughter-houses. Amount sanctioned.	Construction and repair of markets and slaughter-houses. Amount expended.	Other sanitary objects, including construction and repair of latrines, dust-bins, drains, &c. Amount sanctioned.	Other sanitary objects, including construction and repair of latrines, dust-bins, drains, &c. Amount expended.	Amount allotted for vaccination.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Anantapur ...	350	557	810	545	230	94	3,200	1,335	1,280	909	4,150
Bellary	1,670	482	3,285	922	1,220	183	4,183	1,912	3,985	1,730	7,370
Chingleput ...	2,506	1,679	1,860	1,081	550	316	...	...	510	613	6,720
Coimbatore ...	2,540	2,537	5,627	3,401	750	212	27,812	4,636	1,793	1,141	10,060
Cuddapah ...	1,060	285	1,330	1,195	285	51	...	...	1,585	1,068	8,710
Ganjam	1,000	...	1,000	520	210	...	...	...	750	522	7,100
Godávari	1,800	250	19,530	5,039	1,040	180	5,670	749	7,370	6,189	10,720
Kistna	5,300	2,378	7,890	6,163	1,070	302	...	...	2,080	684	11,950
Kurnool	6,477	995	3,835	762	890	52	1,000	45	1,908	4,967	6,720
Madura	2,510	1,697	3,190	1,115	710	270	5,660	493	2,050	1,243	10,000
Malabar	150	...	2,140	844	450	127	...	300	300	54	8,230
Nellore	4,000	218	2,000	474	204	268	...	...	1,530	1,100	9,770
Nilgiris	120	26	200	10	..	...	...	...	100	...	1,180
North Arcot ...	1,088	236	5,437	3,414	917	311	6,830	1,433	2,964	1,496	10,270
Salem	2,053	1,259	6,686	5,279	510	221	7,700	74	5,185	3,479	9,884
South Arcot ...	3,700	1,948	16,695	7,971	1,045	538	155	...	1,723	1,084	6,730
South Canara ...	414	88	960	528	743	558	720	602	1,135	315	5,584
Tanjore	1,720	782	4,770	1,871	940	903	...	...	1,330	1,448	7,870
Tinnevelly ...	8,870	1,506	7,740	3,367	1,300	435	...	...	2,060	4,226	8,700
Trichinopoly ...	1,180	204	2,478	766	...	...	544	477	3,099	1,523	3,930
Vizagapatam ...	3,550	1,169	5,000	6,147	540	200	250	...	780	415	8,480
Total ...	52,008	18,291	1,02,463	51,414	13,604	5,22 1	63,724	12,056	43,517	34,206	1,64,128

* Amount expended is for nine months ending with December 1888.

ABSTRACT OF THE SANITARY ESTIMATE OF VILLAGES IN EACH OF THE REGISTRATION CIRCLES FROM WHICH REPORTS WERE RECEIVED.

Districts.	Taluks or Registration Circles.	Water-supply.	Drainage.	Conservancy and domestic cleansing.
Anantapur.	Anantapur	Sources same as last reported. Considered to be good and sufficient. Generally no provision made to prevent pollution. Except in a few big villages, wells have no parapet walls or platforms.	No improvement since last report. Natural and by side cuttings.	Is attended to by the owners of houses, and the accumulated sweepings are removed by the Village Madigas. Private privies are scarce. People resort to fields and waste lands.
	Gooty and Tadpatri.	Same as last reported.		
	Penukonda ...			
	Dharmavaram ...			
	Hindupur			
	Madakasíra			
Bellary.	Bellary	From river channels, wells, ponds and pits in beds of streams.	None	Unsatisfactory. Houses kept unclean. Cattle penned in, and manure stored close to, them.
	Ádóni	From wells and jungle streams. Wells generally have no parapet walls.	Natural. Fairly good. House drainage flows into the streets or numerous cess-pools.	Only one town, Sandur, has an establishment, the streets of which are cleaned daily and night-soil made into poudrette. There are no public latrines.
	Ráyadrug	Sources same as last reported. Subject to pollution and not conserved.	None. House drainage flows into sink-pits.	Unsatisfactory.
	Álúr	From wells and springs. Not good and insufficient ...	Same as Ráyadrug	None. Houses are kept clean; cattle however are picketed in them.
	Hospet	Same as last reported. Tanks and channels subject to pollution.	Natural and artificial. Unsatisfactory. No improvement since last report.	Conservancy establishments are maintained in six towns. Sweepings, &c., are carried to a distance and sold. Refuse, &c., from private houses are removed by the owners and used as manure. In Hospet town five public latrines exist. Night-soil buried at a distance. No private privies. People resort to plains and fields.
	Kúdligi	Is obtained from wells, streams and springs dug in sandy beds.	No improvement since last report. House drainage runs into sink-pits.	None.
	Harpanahalli ...	From tanks, wells and the river Tungabudra	No regular system. Unsatisfactory ...	Only one town, Harpanahalli, is conserved. Sweepings stored and sold annually. Buffaloes act as scavengers. Refuse, &c., from houses are stored in the vicinity and annually removed. There are no private privies.
	Hadagally	River Tungabudra, streams and wells. Sufficient ...	No system. House drainage flows into cess-pits or backyards.	Practically none. Houses are either periodically whitewashed or smeared with a mixture of cowdung and earth. Cattle manure stored in pits away from houses.
Chingleput.	Saidápet	Same as last reported	Same as last reported	Same as last reported.
	Chingleput	Sources same as last reported. Some wells have parapets, platforms and drains.	Masonry drains exist in some and side channels in others. House drainage flow into backyards.	System same as last reported. Two towns are conserved, sweepings, &c., of which are mostly sold. In other places conservancy is looked after by the owners of houses who make use of the refuse, &c., as manure. Public latrines exist.
	Madurántakam ...	Same as last reported	Natural. House drains discharge into backyards.	Same as in Chingleput.
	Conjeeveram ...	From river channels, tanks and wells. Most wells have parapet walls, but few platforms. No sources are set apart for drinking only.	Natural	Do.
	Tiruvallúr	Same as in Conjeeveram	None. Side channels exist. House drains run into the streets or backyards.	System same as in Chingleput. Only one town is conserved.
	Ponnéri	Good and sufficient. Obtained from tanks and wells ...	Natural in streets and artificial in houses, discharging into the streets and backyards.	Same as in Chingleput.
Coimbatore.	Coimbatore ...	No change since last report	Same as last reported	Same as last reported.
	Palladam	Mainly from wells provided with parapet walls. Tanks, rivers and river channels are also used. Good and sufficient.	Natural	Five villages are conserved. No system elsewhere. The street sweepings, &c., are removed by the villagers and utilized as manure. Only five public latrines exist.
	Erode	From rivers, wells, tanks, channel and jungle streams. Fairly good. Wells are set apart for drinking in a few villages and protected by parapet walls or hedges.	Do.	No system. Sweepers are employed in two villages. Domestic cleansing same as last report.
	Dhárápuram ...	Sources same as last reported; good and sufficient ...	Drains exist in Dhárápuram town and are in good order.	No change since last report.
	Satyamangalam ...	From the Bhávání river and its channels and a well. Good and abundant.	No system. Drainage water flows into the Bhávání. No cess-pools.	The streets are cleaned by sweepers and the rubbish collected and occasionally burnt. Domestic cleansing is attended to by house-owners. It is contemplated to build a rubbish depôt for the town.
	Karúr	Sources same as last reported	Same as last reported	Domestic cleansing is attended to by house-owners and the sweepings stored in backyards for manurial purposes. No latrines or dust-bins. Only two villages were conserved. The sweepings and night-soil incinerated.
	Kollegál	Same as last reported	Do. do.	Sweepers were employed to clean the streets. There are six public latrines.
	Udamalpet	From wells, river and a tank. The people take care not to pollute them.	Do. do.	No system. Latrines exist only in a few villages. People resort to fields for purposes of nature.
	Pollachi	Same as last reported	Natural. Artificial drains discharging into nallahs, rivers, &c., exist in a few places. No cess-pools.	Same as last reported.
	Bhavání	From rivers, streams, tanks, ponds and wells. River water good.	Same as last reported	No system generally. An establishment is maintained in Bhavání town, and the sweepings, &c., sold on contract. In other places the rubbish is used as manure or buried. Domestic cleansing is attended to by house-owners.

ABSTRACT OF THE SANITARY ESTIMATE OF VILLAGES IN EACH OF THE REGISTRATION CIRCLES FROM WHICH REPORTS WERE RECEIVED—*continued.*

Districts.	Taluks or Registration Circles.	Water-supply.	Drainage.	Conservancy and domestic cleansing.
Cuddapah.	Cuddapah	Good and sufficient from wells, rivers and channels. Not protected from pollution.	Same as last reported. Natural. No regular system.	Only four villages are conserved, the sweepings of which and house refuse are collected and sold. In the other villages the streets and houses are cleaned by the owners and the rubbish removed to their fields. There are no cess-pools.
	Jammalamadugu ...	From wells, rivers, channels, springs and pits dug in beds of rivers. Scarce in some villages during hot weather. Well water brackish.	Natural. Unsatisfactory. No improvement since last report. In one town, Jammalamadugu, side channels of stone exist.	Unsatisfactory. Four villages are conserved. Cattle are littered in the houses and the dung and refuse are heaped in the backyards and removed to the fields during cultivating season. House drainage flows into cess-pools which are seldom cleaned.
	Badvél	From wells, rivers and channels; good and sufficient generally, but in some villages scarce during hot season.	Same as last reported. Natural	Four villages are conserved on the contract system. No arrangements made for conservancy in others. Owners of houses store their rubbish, &c., outside and use them as manure. Drainage of houses flows into the streets or cess-pools.
	Pulivendla	From wells, rivers, vankas and river channels. Only a few wells serve for drinking purposes. None analysed. Some wells have parapet walls and platforms.	Side drains exist. Refuse water passes either into the streets or cess-pools.	Two villages were conserved. Street sweepings and night-soil are removed outside the villages and sold. In all other villages, they are stored in heaps by the owners of houses and used as manure.
	Proddutur	Same as last reported. From wells, rivers, streams and channels of doubtful quality.	Unsatisfactory. No regular system ...	Owners of houses remove the refuse sweepings, &c., of their houses and store them in the backyards or unoccupied sites and eventually used as manure. In the conserved villages they are removed by scavengers and stored outside and sold.
	Pullampet	From wells, tanks, rivers and channels. Reported to be good and ample.	Generally natural. Side channels exist in a few villages.	Owners look after the conservancy of their houses. In the streets, except in five villages, there is no conservancy. Drainage of houses flows into cess-pools, occasionally cleaned by owner.
	Váyalpád	From rivers, tanks and wells. Abundant and wholesome.	No regular system. Side cuttings exist in the streets.	Drainage of houses sink into the ground. A few houses have cess-pools which are cleaned out when full. The sweepings, &c., of the streets are removed by sweepers outside the town.
	Kadiri	Abundant. From wells, tanks, rivers and channels ...	Natural	Eight villages were conserved. Sweepings, manure, &c., are allowed to accumulate in front of houses. House drainage sinks into the ground.
	Ráyachóti	Good; from wells and springs in beds of rivers. Some of the sources are guarded against pollution.	Natural and by side channels	In conserved villages sweepings, &c., are collected by sweepers and sold; in all others owners of houses collect the sweepings and use them as manure. Drainage of houses sinks into the ground.
Ganjam.	Sidhout	Good and abundant. From wells principally and streams.	Natural	Same as in Ráyachóti.
	Madanapalle ...	Good, from wells chiefly and streams, channels and tanks. Quantity sufficient generally but scarce in hot weather.	None. Natural	Indifferent. Rubbish, &c., are stored in backyards of houses and around the villages.
	Chicacole	Same as last reported	No information	No change since last report.
	Berhampore ...	Do. do.	Same as last reported	Same as last reported.
	Goomsur	Do. do.	Do. do.	Same as last reported. Four villages were conserved.
Godávari.	.....	Same as reported for 1886	Same as reported for 1886	Same as reported for 1886.
Kistna.	Répalle	From the Kistna, irrigation canals, tanks and wells. Good and sufficient.	None. Natural	Six villages are conserved by an employed establishment. Private houses are attended to by the owners. Sweeping, &c., of the conserved villages are collected and sold; of private houses, stored up in backyards where also house drainage stagnates.
	Bápatla	From wells, tanks and irrigation canals. Quality good, insufficient during summer.	None	Six villages were conserved. Arrangements same as above.
	Palnád	From wells, streams and channels	Natural. Cess-pools exist in houses and streets. The former never emptied.	Four villages were conserved by an employed establishment. Arrangements in others same as at Répalle.
	Narsaraopet ...	From wells, tanks and streams, sufficient; good from wells and tanks.	Natural. No cess-pools. Drainage of houses either run into the streets or stagnates in backyards.	Only two villages were conserved. Arrangements same as at Répalle.
	Gudiváda	From wells and tanks fed by irrigation channels. Sufficient, but not very good.	Chiefly natural. Artificial in two villages.	Three villages were conserved. Arrangements in others same as at Répalle.
	Guntúr	Chiefly from wells and tanks. In some villages from the Kistna, its channels and branches; from tanks and channels good and from wells, inferior.	Natural	Only one village was conserved. In other villages arrangements same as at Répalle.
	Sattenapalle ...	From wells, tanks, rivers and streams. Good and sufficient.	Do.	Three villages were conserved. Arrangement in others same as at Répalle. No public or private latrines. People resort to the fields.
	Bander	From the Kistna, channels, wells and tanks not very good. Scanty in summer.	Chiefly natural. Artificial in two villages.	Four villages were conserved. Private houses cleared by owners themselves; street sweeping, &c., are collected and thrown outside villages.
	Nándigáma	From tanks, wells, streams and the Kistna. Generally good. Scarce in summer.	Same as in Bander	Two villages were conserved. The sweepings, &c., were either burnt or thrown into pits. Arrangement in others same as at Répalle.
	Bezváda	From tanks, the Kistna and its canals. Good and sufficient.	Natural	Only two villages were conserved. Sweepings from streets and private houses are accumulated in the backyards and carried annually to the fields.

ABSTRACT OF THE SANITARY ESTIMATE OF VILLAGES IN EACH OF THE REGISTRATION CIRCLES FROM WHICH REPORTS WERE RECEIVED—*continued.*

Districts.	Taluks or Registration Circles.	Water-supply.	Drainage.	Conservancy and domestic cleansing.
Kistna—*cont.*	Vinukonda	From wells, tanks, streams and rivulets. Sufficient and good.	Natural	Only one village was conserved. Private houses cleaned by owners. Sweepings, &c., are thrown outside the village.
	Vissamapet ...	From wells, tanks and streams. Insufficient in summer.	Do.	Only one village was conserved. Private houses cleaned by owners. Sweepings, rubbish, &c., are accumulated in backyards to be used as manure.
	Nuzvíd	From wells, tanks and streams	Do.	Only two villages were conserved. Arrangement in others same as at Vissamapet.
Kurnool.	Pattikonda	From wells and river Hindry. Three wells are conserved.	No system. House drainage is collected in cess-pools.	Sweepings are removed to the outskirts and sold. Sweepers were employed in four villages. Latrines exist and are freely used.
	Rámallakót	From rivers, tanks and channels. Good and sufficient. Neither wells nor tanks are reserved for drinking.	Same as last reported	System same as last reported.
	Nandikótkur ...	From tanks, wells, the irrigation canal and rivers ...	System same as last reported	Sweepers are employed in two villages and the sweepings removed to the outskirts and sold. Latrines exist and toties are employed to clean them.
	Nandyál	Tanks and wells are the chief sources. Wells used for drinking are guarded against pollution.	Masonry drains exist in the cusbah town. Sink-pits are provided for the houses. A drainage scheme for the entire town is under consideration.	No change in system. Sweepers are employed in six villages and latrines exist in three.
	Kóilkuntla	From wells and rivers. Guarded against pollution ...	Same as Pattikonda	System same as Pattikonda. Latrines exist in two villages and toties clean them.
	Sirvél	Same as last reported	No improvement since last report ...	Three villages are conserved. The household sweepings are carried to the manure depôts and thence removed to the fields once a year. Latrines exist in only one village.
	Cumbum	Sources same as last reported. Abundant. Water in wells is generally wholesome, but that from rivers with one exception is bad.	Same as Pattikonda	The household sweepings are carried daily to the fields. Sweepers are employed in four and latrines exist in two villages. The sweepings are sold.
	Márkápur	Same as last reported	Same as last reported	Same as last reported as regards domestic cleansing. The night-soil at Márkápur is now removed to a distance from the town.

Madura.	Madura	From river and streams, wells and tanks. Pits dug in the beds of rivers or streams are also used. A few wells and a tank are reserved for drinking. Arrangements have been made in the union for obtaining good drinking water. Most wells have parapets and platform.	Same as last reported	Bad. Scavengering establishments were employed in the unions and one village in Madura Taluk and the rubbish taken to depôts and sold. Same as last reported in other respects.
	Palni	From rivers, channels and wells. Some of the wells are protected by parapet walls. In union village steps are taken to protect the sources against pollution.	No system. Side drain exist in a few places and carry off storm water. No cess-pools.	No system, conservancy being attended to by the villagers themselves. Conservancy establishments were employed in three unions and the rubbish in two of them are carted away and deposited in selected places.
	Dindigul	From rivers and wells. Good. Wells were provided with parapets and arrangements made to protect the rivers from pollution.	No information	Scavengering establishments were employed in four unions and conservancy attended to by them.
	Melúr	From tanks and wells. Sufficient and fairly good. Two tanks and six wells are set apart for drinking purposes. A jungle stream also supplies water for bathing, &c.	Same as last reported	No system. Two towns were conserved and the rubbish collected and sold by auction. In the villages, the refuse is used as manure. House sewage in some cases flows into side channels.
	Kodaikánal Division.	From streams, springs and wells. In Upper Palni the streams, &c., are clean, while in the Lower, they are subject to pollution. Parapet walls are provided to a few wells.	Do. do.	No system. A sanitary establishment is employed in Kodaikánal and the place kept fairly clean. The house sweepings are stored in backyards and public grounds and used as manure.
	Ramnad Division. ...	From tanks, wells, rivers and spring dug in their bed. In the 'Unions' tanks are set apart for drinking. In some instances tanks are guarded against pollution. The surroundings are kept clean.	Natural. Side cuttings exist in a few places.	No system. Domestic cleansing is attended to by house-owners and the rubbish, &c., used as manure. Conservancy establishments exist in union villages. No public latrines.
Malabar.	.....	Same as last reported	Same as last reported	Same as last reported.
Nellore.	Kanigiri Taluk ...	Rivers, tank-supply channels, wells and pond. Ample in most villages.	No system	Defective and without system. The houses are generally dirty.
	Darsi Division ...	From wells, rivers, tanks, brooks and ponds	None	No system. Houses are generally very dirty. No attention whatever is paid to conservancy in the division.
	Ongole	From tanks, wells, ponds and rivers. Generally wholesome and sufficient. In some places scarcity is felt during the hot season. Wells used for drinking are protected against pollution. Wells have parapet walls.	No system	Defective and without system. The rubbish, &c., from houses are stored in backyards and in pits, &c., outside the houses and removed to the field as manure. House sewage flows into streets.
	Podili Division ...	From wells, rivers, tanks and ponds chiefly	None in the taluk generally. Side drains exist in Podili.	Defective. Manure heaps are stored in backyards and in front of houses and removed to the field as manure.
	Kandukur Taluk ...	From wells, rivers and ponds	No system	No system. A conservancy establishment is maintained in Kandukur, who keep the place clean.
Nílgiris.	.....	From natural springs and streams. Is good and sufficient. In one village an old well containing very unwholesome water is also used. In South-East Wynaad the water-supply is scanty and foul.	Natural	The houses in the villages are kept clean and the sweepings and night-soil are thrown on waste lands in front of houses and allowed to accumulate and the cattle kraals in many instances are too close to human habitation and kept in a very insanitary condition.

ABSTRACT OF THE SANITARY ESTIMATE OF VILLAGES IN EACH OF THE REGISTRATION CIRCLES FROM WHICH REPORTS WERE RECEIVED—*continued.*

Districts.	Taluks or Registration Circles.	Water-supply.	Drainage.	Conservancy and domestic cleansing.
North Arcot.	Chittoor	From wells, rivers, springs and tanks. Good and sufficient. Wells in villages have generally parapet walls, but no platforms or drains.	Same as last reported	No change since last report.
	Chandragiri ...	Same as Chittoor, except that wells have generally parapet walls and platforms but not drains.	Natural. Side channels exist in Chandragiri.	Same as last reported. Chandragiri and Rénigunta were conserved.
	Palmanér	No change since last report	No change since last report	No change since last report.
	Gudiyátam	Same as Chittoor for the most part. Some wells have parapet walls and drains.	Same as last reported	Three villages were conserved. Same as Chandragiri in other respects.
	Vellore	From wells, tanks, rivers, springs and river channels. In other respects no change since last report.	Do. do.	Same as Chandragiri. Three villages were conserved.
	Pólúr	From tanks, river channels, irrigation tank. Channel wells scarcely used. Same as last reported in other respects.	Do. do.	Same as Chandragiri, viz., one town was conserved.
	Wandiwash ...	Same as last reported	Do. do.	Same as Chandragiri.
	Arcot	Same as last reported. Wells have generally parapet walls only.	No change since last reported	Same as Chittoor. Two towns were conserved.
	Wálájapet	Same as Chittoor	Do. do.	Same as Palmanér. Four towns were conserved.
Salem.	Tirupatúr, Salem, Namákal and Trichengode.	Same as last reported	Same as last reported	Same as last reported.
	Hosur, Krishnagiri and Dharmapuri.	Do. do.	Do. do.	Do.
	Úttankárai	Do. do.	Do. do.	System same as last reported. In villages where there are no sweepers the house-owners remove the sweepings.
	Alúr	From wells, tanks, streams and rivers. Ample wells with parapet walls are set apart for drinking; the other sources being used both for drinking and bathing.	Natural. House-sewage flows into the street gutters.	No system. An establishment is employed in one village, Etapur, and the sweepings used as manure. No latrines.
South Arcot.	.....	From rivers, ponds, river channels, spring channels, tanks and wells. Good and sufficient. About 20 ponds are reserved for drinking and strictly watched.	Same as last reported	Fairly well attended to where conservancy establishments exist. In other respects same as last reported. Four pucka latrines were constructed at Tirukóilúr.
South Canara.	.....	Same as last reported	Do. do.	No change since last report.
Tanjore.	Tanjore	Same as last reported	Same as last reported	Seven villages were conserved, and the sweepings collected in cinerators are used as manure. In other respects same as last reported.
	Kumbakónam ...	Rivers and tanks are the chief sources. Wells and temporary springs are resorted to in summer. A few tanks are conserved and watched over.	Natural	Four villages were conserved. The refuse from houses is collected in backyards and used as manure. House-sewage flows into backyards.
	Máyavaram ...	Sources same as last reported. One tank is conserved; the majority of the tanks are subject to pollution. Several wells have parapets but only some have platforms and drains.	Drainage of streets natural	Same as last reported.
	Mannárgudi ...	From rivers, tanks and wells. About 30 wells are reserved for drinking purposes. Some have parapet walls and platforms.	Same as last reported	Three villages were conserved and the sweepings removed to a distance and utilized as manure. In other respects same as last reported.
	Nannilam	From rivers, tanks and wells. Supply good. Almost all wells have parapets. During the hot season tanks are reserved in a few important villages.	Drainage of streets natural. No cess-pools.	No system except in four villages where conservancy establishments were employed. Three cinerators were constructed during the year.
	Patukóta	Sources same as last reported. Some tanks are reserved for drinking and watched over. The supply from the tanks generally good. Well water for the most part brackish.	No change since last reported	Same as last reported. Arrangements have been made to prevent the accumulation of rubbish and sweepings in villages.
	Negapatam ...	From tanks, rivers, channels, wells and springs dug in river bed. Tanks are not conserved. Well water not generally used for drinking.	No change since last report	No system. Scavengering establishments were maintained in six villages and the sweepings used as manure. House-drainage natural.
	Tiruturaipándi ...	Rivers and tanks are the usual sources. Wells are also used.	No system	No change since last report.
	Shiyáli	Obtained from rivers, tanks and wells. Good. One tank is conserved.	Same as last reported	Same as last reported.
Tinnevelly.	Tenkarai	Same as last reported	Do. do.	Do.
	Tinnevelly	From rivers, channels, tanks and wells. Good and sufficient. Sources not conserved for drinking. Most of the wells have parapet walls, platforms and drains. Tanks are occasionally cleaned out.	Do. do.	Do.
	Otapidáram ...	From wells, tanks, ponds and rivers. Sufficient. Ponds and wells are set apart for drinking and the villagers watch them. Many wells have parapets but only a few platforms and drains.	No system. Side cuttings exist in two villages. Storm water finds its way into low level.	Do.
	Ambásamudram ...	Sources same as last reported. Tanks are set apart for drinking during the hot weather only and protected against pollution. Almost all wells have parapets and many platforms and natural drains.	Natural. Sewage flows into channels, rivers and tanks. No cess-pools.	Several large villages are conserved and the sweepings burnt and sold as manure. Domestic cleansing is attended to by house-owners, and the refuse and night-soil used as manure. House-drainage joins the natural drainage of the streets.

ABSTRACT OF THE SANITARY ESTIMATE OF VILLAGES IN EACH OF THE REGISTRATION CIRCLES FROM WHICH REPORTS WERE RECEIVED—*continued.*

Districts.	Taluks or Registration Circles.	Water-supply.	Drainage.	Conservancy and domestic cleansing.
Tinnevelly—*cont.*	Tenkási	From wells, tanks, rivers, channels and streams. Generally good. Almost all wells have parapet walls, but generally no platforms. The villagers take care that the sources are kept clean.	Same as last reported. Masonry drains exist to a limited extent.	Same as last reported. Domestic cleansing is attended to by house-owners.
	Srívilliputur ...	Same as last reported. Some of the tanks were cleaned out during the year.	Same as last reported	A few villages are conserved, and the sweepings, &c., collected and sold by auction. Houses have artificial drains which discharge into the streets. No cess-pools. Some latrines were constructed.
	Nángunéri	Same as last reported. Most wells have parapets but only a few platforms and drains.	No change since last report	Same as last reported.
	Sankaranainárkoil ...	From wells, tanks, rivers and channels. Several wells have parapet walls, platforms and drains. In other respects same as last reported.	Do. do.	A few villages only were conserved. Latrines exist in unions. In other respects much the same as last reported.
	Sátúr	No change since last report	Natural. Artificial drains exist in a few places.	Same as last reported; no system; no cess-pools. An itinerating staff was employed in Sátúr.
Trichinopoly.	Trichinopoly ...	Same as last reported	Same as last reported	Three villages were conserved. In other respects no change since last reported.
	Musiri	Do. do.	Do. do.	Same as last reported.
	Perambalur ...	Do. do.	Do. do.	Do.
	Udayarpalaiyam ...	Last year's report says that the tanks are not strictly guarded from pollution. In this year's estimate it is observed that they are protected from pollution, but that the surroundings are filthy.	Do. do.	Do.
	Kulitalai	Is obtained from the Cauvery and its channels, wells, tanks and drains. Generally good and sufficient. Tanks and wells are set apart for drinking but not watched except in the hot season. One tank is strictly conserved. Only Local Fund wells have parapets, platforms and drains.	Natural	Nine villages were conserved, and some improvement is reported in house conservancy. In other respects much the same as detailed in last year's report.
Tanjam.	Visagapatam ...	Wells and tanks are the chief sources. Rivers, streams and springs are also used. With a few exception the quality of the water is good. Tanks and wells are set apart for drinking and guarded. Same as last reported in other respects.	Same as last reported. The sewage discharges into nullahs and low grounds outside the village.	Same as last reported. An itinerating conservancy establishment has been entertained since September. In the two conserved villages the sweepings are burnt outside the village.
Vizagapatam	Vizianagram ...	From wells, tanks, rivers, streams, channels and springs. Quality varies in different parts. Some of the sources within union limits are conserved. Wells have parapet walls, platforms and drains. Tanks are subject to every imaginable pollution.	Natural. Side channels exist in unions and discharge into paddy fields or irrigation tanks.	No system. Conservancy establishments were employed in four unions, and the sweepings, &c., removed outside the towns and sold or otherwise disposed under special regulations. In the villages the sweepings were used as manure. Domestic cleansing was attended to by house-owners. No latrines. House-drainage natural and artificial.
	Narsapatnam ...	From rivers, tanks and wells. Same as last reported ...	No change since last report	No system in the taluk generally. Conservancy establishments were maintained in three unions, and the sweepings collected and carted to the fields. An itinerating conservancy establishment is also employed. No public latrines.
	Parvatipur ...	Sources same as Narsapatnam. In other respects same as last reported.	Natural. Side channels exist in some places.	Same as last reported. An itinerating conservancy establishment which was entertained had to be abolished as the funds provided for it were required for other purposes.

SECTION X.

GENERAL REMARKS AND PERSONAL PROCEEDINGS.

70. During the year I visited the 24 Municipal towns noted in the margin, and the Deputy Sanitary Commissioner 19. In addition many small towns and villages were inspected.

Visited by Sanitary Commissioner.		*Visited by Deputy Sanitary Commissioner.*	
*Anantapur.	Ellore.	Cuddapah.	Kumbakónam.
Adóni.	Masulipatam.	Kurnool.	Tanjore.
Bellary.	Guntúr.	Dindigul.	Manargudi.
Berhampore.	Bezváda.	Madura.	Mayaveram.
Chicacole.	Cochin.	Pariyakulam.	Palamcottah.
Parlakimedi.	Palghat.	Pulni.	Tinnevelly.
Vizianagram.	Mangalore.	Cannanore.	Tuticorin.
Bimlipatam.	Nellore.	Calicut.	Trichinopoly.
Vizagapatam.	Ongole.	Tellicherry.	Srirangam.
Anakapalle.	Negapatam.	Salem.	
Cocanada.	Coonoor.		
Rajahmundry.	Ootacamund.		

In my inspection of Municipalities I was usually accompanied by some members of the Municipal Council, to whom I pointed out the chief sanitary defects I observed, and the way in which they could most easily be remedied. I dwelt on three subjects which are all capable of being easily worked and which required no special technical training or knowledge. These subjects are measures well within the means and unaided powers of execution of the several Municipal Committee, and are the following:—

(i) Public scavengering of towns on a systematic plan and under strict supervision.

(ii) Prosecution of the practice of vaccination as a protection against epidemics of small-pox, and

(iii) Attention on the part of the people generally to domestic and personal hygiene, especially in reference to the provision of suitable means for the proper ventilation of their dwellings and protection of their bodies against adverse influences of climate, &c.

71. In nearly all Municipal towns a supply of good water is much wanted, and there is also urgent need for comprehensive schemes of drainage. There is ample evidence, however, that the sanitary improvements of our municipalities are engaging the attention of the Municipal Councils, and that they are alive to the necessity of carrying out sanitary measures on a more systematic plan than has hitherto been the rule. For the prosecution of sanitary measures in many municipalities a difficulty has been experienced in preparing designs, &c., as no competent agency could be obtained for the work. In Tanjore, Negapatam, Madura, Dindigul, Salem, Cuddapah, Conjeeveram, Trichinopoly and Tinnevelly schemes for obtaining a supply of good and sufficient water are under consideration, and for Kumbakónam and Negapatam drainage schemes have been prepared.

72. A chief cause of sickness and death in towns is the insanitary condition of the private houses and backyards. The houses are badly ventilated, the backyards very often dirty and drainage of them most defective and the latrine arrangements unsatisfactory. It is, therefore, no wonder that the death-rate of towns is higher, as a rule, than that of the small towns and villages, where the people at any rate have comparatively purer air to breathe.

73. From the various inspection reports there is also evidence that an advance in the path of rural sanitary reform has been made in some districts. The Kurnool District Board have, at present, a scheme under consideration for the improvement of conservancy in villages with over 2,000 inhabitants and for smaller villages situated on important trade routes. This District Board, some time ago, decided that at first a beginning be made with a single town where the benefits derived from efficient sanitation could be practically shown to the people. The town of Nandyál was fixed upon, and a part of the drainage scheme has been carried out. With reference to this the District Medical and Sanitary Officer reports that already "good has been effected not only to the inhabitants, but has caused a general "appreciation of sanitary work by villagers coming from distant parts of the district. "Through the generosity of a private individual, all the work of drainage in one

"of the streets of Nandyál was carried to its logical conclusion, namely, the per-"fection of house-connection, and the correct preparation of receiving surfaces "both for household water and for drainage from stables, cow-stalls, &c. Correct "pavements for courtyards and cattle sheds were also laid down by private funds." In Bestawarpett, an important village in the Cumbum taluk, the inhabitants have volunteered to pay for the same character of drains.

74. In my letter, No. 170, dated 28th February 1887, to Government, I recommended that all the rubbish and filth of backyards and compounds of houses in towns and villages should be removed and stored in depôts situated outside the towns and villages, and that the manure thus collected should, under the superintendence of the Revenue authorities, be distributed to the contributors as manure for their fields during the cultivating season. From a report received, it would appear that there are 54 villages in the Kurnool District where sites for this purpose have been selected and maintained by the District Board for the storage of manure heaps belonging to private owners.

75. In accordance with Government Order, No. 966L., dated 30th May 1887, Local and Municipal, several Municipalities and District Boards forwarded plans of sanitary works for approval.

76. In Tinnevelly District the Chairman of the Melavivaragavapooram Union wrote a pamphlet called "Hints on Sanitation," which was printed and circulated to all Taluk Boards in the district.

77. The uncontrolled manner in which wet cultivation is carried on in this Presidency and the injurious effects it must have on the health of the people was brought to the notice of Government during the year, but Government were not prepared to take any action in a matter so deeply affecting the customs and incomes of the ryots. Section 228, Madras Act IV of 1884, gives Municipal Councils power to prevent wet cultivation within Municipal limits where they think it necessary.

78. The following statement gives the number of places visited by District Medical and Sanitary Officers during the year 1888. In all districts, inspection work was done. In 1887 there were 127 places visited by, and reports received from, District Medical and Sanitary Officers:—

Districts.	Number of villages visited and reports received.	Number of villages visited, but no reports received.	Total number of villages visited.	—
Anantapur	3	25	28	8 places were twice visited.
Bellary	...	29	29	18 do. do.
Chingleput	...	22	22	10 do. do.
Coimbatore	27	3	30	10 do. do.
Cuddapah	13	...	13	
Ganjam	12	...	12	1 place was twice visited.
Godávari	9	6	15	2 places were twice visited.
Kistna	...	12	12	1 place was visited 6 times.
Kurnool	...	29	29	3 places were twice visited.
Madura	17	19	36	25 do. do.
Malabar	7	...	7	2 do. do.
Nellore	24	3	27	4 do. do.
Nilgiris	1	...	1	
North Arcot	1	13	14	1 place was visited 5 times and 4 twice.
Salem	25	...	25	
South Arcot	2	11	13	3 places were twice visited.
South Canara	4	27	31	1 place was twice visited.
Tanjore	8	19	27	27 places were twice visited.
Tinnevelly	20	...	20	10 do. do.
Trichinopoly	10	...	10	9 do. do.
Vizagapatam	...	11	11	4 do. do.

79. The service registers have been maintained and brought up to date.

J. A. LAING, Surgeon-Major,
Sanitary Commissioner for Madras.

May 1889.

APPENDIX.

VITAL STATISTICS OF THE GENERAL POPULATION.

I.—*Births registered in the districts of the Madras Presidency during the year* 1888.

1	2			3	4			5			6			7	8	9
Number.	Population (exclusive of Europeans and Eurasians) according to Census of 1881.			Districts.	Population (exclusive of Europeans and Eurasians) for which Returns were received.			Number of births registered (exclusive of Europeans and Eurasians and still births.)			Ratio of births per 1,000 of population.			Number of males born to every 100 females born.	Excess of births over deaths per 1,000 of population.	Excess of deaths over births per 1,000 of population.
	Males.	Females.	Total.		Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.			
1	678,904	657,113	1,336,017	Anantapur ...	678,904	657,113	1,336,017	10,769	10,356	21,125	20·5	19·5	40·0	104·0	13·4	...
2				Bellary ...				16,609	15,792	32,401				105·2		
3	491,085	487,439	978,524	Chingleput ...	491,085	487,439	978,524	19,583	18,771	38,354	20·0	19·2	39·2	104·3	12·7	...
4	806,530	850,614	1,657,144	Coimbatore ...	806,530	850,614	1,657,144	26,486	24,752	51,238	16·0	14·9	30·9	107·0	14·1	...
5	569,792	550,922	1,120,714	Cuddapah ...	569,792	550,922	1,120,714	15,805	15,249	31,054	14·1	13·6	27·7	103·6	3·8	...
6	869,257	879,996	* 1,749,253	Ganjam ...	480,067	492,135	973,102	10,803	9,678	20,341	11·0	9·9	20·9	110·2	3·0	...
7	888,567	902,283	* 1,790,850	Godâvari ...	888,567	902,283	1,790,850	19,494	18,027	37,521	10·9	10·1	21·0	108·1	5·8	...
8	780,510	767,845	1,548,355	Kistna ...	780,510	767,845	1,548,355	28,144	26,776	54,920	18·2	17·3	35·3	105·1	16·0	...
9	359,299	349,919	709,218	Kurnool ...	343,816	334,648	678,464	12,802	12,599	25,401	18·8	18·5	37·4	101·6	6·3	...
10	192,066	197,918	389,984	Madras ...	192,066	197,918	389,984	8,030	7,431	15,461	20·6	19·0	39·6	108·1	1·8	...
11	1,032,353	1,135,774	2,168,127	Madura ...	625,845	667,984	1,293,829	20,936	20,239	41,175	16·2	15·6	31·8	103·4	12·6	...
12	1,172,047	1,189,906	2,361,953	Malabar ...	1,166,917	1,184,235	2,351,152	30,242	28,691	58,933	12·8	12·2	25·0	105·4	5·3	...
13	615,154	604,729	1,219,883	Nellore ...	601,181	583,584	1,184,765	15,708	14,918	30,716	13·3	12·6	25·9	105·9	9·1	...
14	49,322	39,002	88,324	Nilgiris ...	49,322	39,002	88,324	893	793	1,686	10·1	8·9	19·1	126·6	2·8	...
15	907,059	910,194	1,817,253	North Arcot ...	909,650	912,662	† 1,822,312	28,226	27,193	55,419	15·5	14·9	30·4	103·8	9·2	...
16	778,145	820,825	1,598,970	Salem ...	774,723	817,551	‡ 1,592,274	32,647	31,556	64,203	20·5	19·8	40·3	103·4	8·7	...
17	905,516	908,763	1,814,279	South Arcot ...	906,347	909,569	† 1,815,916	28,097	27,173	55,270	15·5	15·0	30·5	103·4	8·7	...
18	472,088	487,179	959,267	South Canara.	470,383	485,212	955,595	15,869	14,949	30,818	16·6	15·6	32·2	106·2	6·9	...
19	1,026,070	1,103,468	2,129,538	Tanjore ...	1,026,070	1,103,468	2,129,538	30,083	28,435	58,518	14·1	13·4	27·5	105·6	1·7	...
20	825,508	873,548	1,699,056	Tinnevelly ...	825,508	873,548	1,699,056	23,812	22,611	46,423	14·0	13·3	27·3	105·3	4·1	...
21	586,127	628,358	1,214,485	Trichinopoly ...	586,127	628,358	1,214,485	18,290	17,565	35,855	15·1	14·4	29·5	104·1	4·7	...
22	1,254,536	1,230,041	* 2,484,577	Vizagapatam ...	617,106	614,968	1,232,074	13,471	13,042	26,513	10·9	10·6	21·5	103·3	9·0	...
	15,259,935	15,575,836	30,835,771	Total, Madras Presidency ...	13,791,416	14,061,058	27,852,474	426,749	406,596	833,345	15·3	14·6	29·9	104·9	8·5	...

* Including the Hill Tracts.
† These figures include 5,059 and 1,637, the population of the 75 and 23 villages transferred from Salem to North and South Arcot districts respectively.
‡ Excludes 6,696, the population of 98 villages transferred to the North and South Arcot districts.

II.—*Deaths registered in the districts of the Madras Presidency during the year* 1888.

1	2	3	4	5			6	7			8		
Number.	Districts.	Area in square miles.	Average population per square mile.	Number of deaths registered (exclusive of Europeans and Eurasians and born dead).			Number of males died to every 100 deaths of females.	Ratio of deaths per 1,000 of population.			Mean ratio of deaths per 1,000 during previous 5 years.		
				Males.	Females.	Total.		Males.	Females.	Total.	Males.	Females.	Total.
1	Anantapur ...	11,007	121·4	7,281	7,247	14,528	100·5	26·4	26·7	26·6	21·0	21·3	21·1
2	Bellary ...			10,647	10,310	20,957	103·2						
3	Chingleput ...	2,842	345·3	13,183	12,748	25,931	103·4	26·8	26·2	26·5	25·3	25·2	25·2
4	Coimbatore ...	7,842	211·3	14,470	13,516	27,986	107·0	17·9	15·8	16·8	18·6	16·7	17·7
5	Cuddapah ...	8,745	128·1	13,789	12,969	26,758	106·0	24·2	23·6	23·9	19·2	19·3	19·3
6	Ganjam ...	8,311	210·5	9,338	8,052	17,390	116·0	19·4	16·3	17·9	18·3	16·0	17·1
7	Godâvari ...	7,345	243·9	14,681	12,589	27,270	116·6	16·5	13·9	15·2	23·3	20·9	22·1
8	Kistna ...	8,471	182·7	16,002	14,224	30,226	112·5	20·5	18·5	19·5	23·4	22·0	22·7
9	Kurnool ...	7,788	91·0	11,027	10,084	21,111	109·3	32·0	30·1	31·1	23·8	23·1	23·4
10	Madras ...	27	15,031·4	7,308	7,447	14,755	98·1	38·0	37·6	37·8	40·5	39·5	40·0
11	Madura ...	8,401	253·1	12,578	12,273	24,851	102·5	20·1	18·3	19·2	21·8	19·3	20·5
12	Malabar ...	5,765	410·2	24,458	21,854	46,312	112·0	20·9	18·4	19·7	21·7	18·5	20·1
13	Nellore ...	8,739	139·6	10,394	9,508	90,902	109·3	17·3	16·3	16·8	15·9	15·1	15·5
14	Nilgiris ...	957	95·1	751	679	1,430	110·6	15·2	17·4	16·3	15·7	17·0	16·4
15	North Arcot ...	7,256	250·5	19,734	18,951	38,685	104·1	21·7	20·7	21·2	19·9	19·3	19·6
16	Salem ...	7,653	209·0	18,047	17,094	35,141	105·5	23·2	20·9	22·1	20·1	18·6	19·7
17	South Arcot ...	4,873	372·4	20,578	19,082	39,660	107·8	22·7	20·9	21·8	22·1	20·0	21·0
18	South Canara ...	3,902	245·9	12,712	11,472	24,184	110·8	27·0	23·6	25·3	24·3	22·0	23·1
19	Tanjore ...	3,654	583·0	27,385	27,518	54,903	99·5	26·7	24·9	25·8	26·0	23·9	24·9
20	Tinnevelly ...	5,381	315·8	20,444	19,007	39,451	107·6	24·7	21·8	23·2	24·9	22·5	23·7
21	Trichinopoly ...	3,561	341·2	15,278	14,910	30,188	102·4	25·9	23·7	24·8	23·6	21·7	22·6
22	Vizagapatam ...	17,380	142·9	8,231	7,165	15,396	114·9	13·3	11·7	12·5	17·0	15·8	16·4
	Total, Madras Presidency ...	139,900	220·6	308,296	288,719	597,015	106·7	22·3	20·5	21·4	21·8	20·2	21·0

III.—*Deaths registered in the districts of the Madras Presidency during each month of the year* 1888.

1	2	3												4
Number.	Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total deaths registered during the year.
1	Anantapur ...	1,189	1,002	1,151	1,184	1,254	1,273	1,337	1,499	1,176	1,130	1,158	1,175	14,528
2	Bellary ...	1,366	1,514	1,786	1,588	1,520	2,107	2,126	1,810	1,613	1,973	1,668	1,886	20,957
3	Chingleput ...	3,086	2,155	1,846	1,867	1,861	1,900	2,023	2,111	2,039	2,028	2,252	2,763	25,931
4	Coimbatore ...	3,553	2,538	2,186	2,055	1,867	1,946	2,083	1,977	2,018	2,328	2,607	2,828	27,986
5	Cuddapah ...	3,342	2,471	2,353	2,106	2,016	1,730	1,880	2,035	2,271	2,078	1,980	2,496	26,758
6	Ganjam ...	1,404	1,044	1,380	1,269	1,246	1,543	1,613	1,572	1,725	1,251	1,549	1,794	17,390
7	Godâvari ...	2,372	1,866	1,859	1,639	1,841	2,430	3,482	2,510	2,310	2,164	2,472	2,325	27,270
8	Kistna ...	2,478	3,469	2,807	1,851	2,000	2,436	2,720	2,955	2,762	2,206	2,295	2,357	30,226
9	Kurnool ...	2,098	1,844	1,865	1,727	1,812	1,799	1,834	1,765	1,535	1,402	1,582	1,848	21,111
10	Madras ...	1,544	1,256	1,238	1,228	1,195	1,042	956	1,295	1,098	1,175	1,166	1,562	14,755
11	Madura ...	2,549	2,148	2,004	1,926	1,932	1,756	1,822	1,724	1,707	1,879	2,260	3,144	24,851
12	Malabar ...	4,105	4,350	4,007	3,574	3,839	4,271	5,740	4,831	3,331	2,740	2,609	2,915	46,312
13	Nellore ...	2,412	1,706	2,115	1,636	1,491	1,058	1,423	1,331	1,763	1,646	1,321	1,400	19,902
14	Nilgiris ...	91	66	105	157	185	192	146	110	115	89	82	92	1,430
15	North Arcot ...	5,614	3,230	2,755	2,516	2,680	2,642	2,483	2,984	2,925	2,835	3,127	4,894	38,685
16	Salem ...	4,181	3,098	2,615	2,510	2,615	2,694	2,754	2,502	2,472	2,523	2,998	4,179	35,141
17	South Arcot ...	3,786	3,478	3,317	2,713	2,810	2,716	3,015	3,042	2,882	3,310	3,733	4,858	39,660
18	South Canara ...	2,144	2,083	1,792	1,487	1,525	2,025	2,264	2,101	2,012	2,140	1,958	2,653	24,184
19	Tanjore ...	10,639	5,623	3,869	3,401	3,097	3,521	4,143	3,857	3,546	3,867	4,020	5,320	54,903
20	Tinnevelly ...	8,367	4,181	2,956	2,012	2,195	2,226	2,213	2,061	2,030	2,418	2,784	6,008	39,451
21	Trichinopoly ...	5,227	2,318	2,095	2,166	2,421	2,299	2,526	2,154	1,924	1,986	2,158	2,914	30,188
22	Vizagapatam ...	1,543	977	1,176	1,238	1,040	1,380	1,016	1,127	1,589	1,252	1,368	1,690	15,396
	Total, Madras Presidency ...	73,090	52,417	47,077	41,850	42,442	45,586	49,599	47,353	44,843	44,510	47,147	61,101	597,015
	Ratio of deaths per 1,000 in each month ...	2·6	1·8	1·7	1·5	1·5	1·6	1·7	1·7	1·6	1·6	1·7	2·2	21·4

IV.—*Deaths * registered according to age in the districts of the Madras Presidency during the year* 1888.

1	2	3		4		5		6		7		8		9		10		11		12	
Number.	Districts.	Under 1 year.		1 year and under 5.		5 years and under 10.		10 years and under 15.		15 years and under 20.		20 years and under 30.		30 years and under 40.		40 years and under 50.		50 years and under 60.		60 years and upwards.	
		Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
1	Anantapur ...	1,674	1,543	941	942	391	322	240	246	290	501	644	1,030	781	714	781	559	688	507	851	883
2	Bellary ...	2,663	2,304	2,225	2,306	800	631	554	280	339	544	847	1,200	970	895	898	647	732	604	819	899
3	Chingleput ...	4,316	3,739	1,760	1,776	691	581	378	397	392	590	890	1,268	963	914	1,008	776	960	857	1,825	1,850
4	Coimbatore ...	4,005	3,482	1,873	1,862	666	553	529	415	517	551	1,199	1,385	1,375	1,266	1,272	973	1,244	1,136	1,790	1,860
5	Cuddapah ...	2,623	2,248	1,374	1,352	700	638	443	423	630	919	1,463	1,876	1,813	1,487	1,803	1,164	1,449	1,298	1,471	1,634
6	Ganjam ...	1,655	1,288	1,332	1,103	789	688	661	488	610	554	832	731	818	658	830	531	677	582	1,134	1,414
7	Godâvari ...	2,130	1,673	1,523	1,292	828	698	603	455	732	812	1,571	1,483	1,671	1,152	1,399	1,011	1,471	1,200	2,753	2,813
8	Kistna ...	4,057	3,109	1,920	1,781	786	698	536	505	614	940	1,356	1,446	1,350	1,127	1,196	769	1,213	914	2,974	2,935
9	Kurnool ...	2,385	2,106	1,760	1,796	622	526	309	288	425	570	1,036	1,171	1,335	947	1,181	750	996	872	978	1,058
10	Madras ...	2,686	2,382	814	884	210	254	150	176	189	411	601	735	534	511	508	399	650	511	966	1,184
11	Madura ...	3,302	2,974	2,039	2,111	697	606	437	487	491	490	1,000	1,163	1,165	1,131	1,215	911	1,091	995	1,141	1,455
12	Malabar ...	3,001	2,594	3,418	3,053	1,503	1,294	1,001	890	1,074	1,367	3,144	3,317	3,331	2,706	2,645	1,667	2,105	1,406	3,236	3,560
13	Nellore ...	2,005	1,749	1,171	1,067	725	661	634	590	646	551	687	696	756	656	847	626	1,048	988	1,875	1,954
14	Nilgiris ...	154	131	126	124	42	31	33	19	38	39	54	80	75	62	61	34	45	31	123	128
15	North Arcot ...	4,596	4,045	2,706	2,726	1,070	973	696	637	815	1,235	1,728	2,365	1,875	1,648	2,011	1,324	1,770	1,459	2,467	2,539
16	Salem ...	5,766	4,966	2,662	2,633	877	791	530	450	632	765	1,346	1,747	1,695	1,470	1,641	1,213	1,358	1,173	1,540	1,886
17	South Arcot ...	5,831	5,036	3,468	3,340	982	881	572	486	570	786	1,272	1,718	1,589	1,452	1,731	1,191	1,797	1,484	2,766	2,708
18	South Canara ...	2,856	2,448	1,439	1,482	537	549	350	301	430	533	1,349	1,445	1,537	1,154	1,412	882	1,171	905	1,631	1,773
19	Tanjore ...	5,211	5,264	3,058	2,774	2,294	2,024	2,266	1,728	2,245	2,105	2,503	2,959	2,547	3,055	2,324	2,791	2,064	2,467	2,878	4,361
20	Tinnevelly ...	3,958	3,528	3,260	3,129	1,268	1,105	839	678	801	872	1,683	1,879	1,895	1,647	1,942	1,386	1,868	1,478	2,930	3,305
21	Trichinopoly ...	3,454	3,188	2,368	2,173	794	779	559	457	577	696	1,168	1,403	1,373	1,312	1,408	1,120	1,332	1,227	2,245	2,555
22	Vizagapatam ...	1,121	1,023	1,074	887	666	545	460	445	489	501	762	765	883	667	854	656	858	754	1,064	922
	Total, Madras Presidency ...	69,449	58,820	42,309	40,658	17,938	15,828	12,580	10,771	13,546	16,332	27,135	31,865	30,331	26,581	28,967	21,380	26,587	22,808	39,454	43,676
	Ratio per mille of population † ...	156·3	129·1	30·3	27·3	8·8	7·7	6·4	6·2	10·4	13·5	11·1	11·4	13·8	12·4	20·0	14·8	30·7	24·1	54·5	48·6

* Exclusive of Europeans and Eurasians, and born dead.
† Worked on the total population as per census of 1881, including Europeans and Eurasians.

V.—*Deaths registered according to classes in the districts of the Madras Presidency during the year* 1888.

1	2	3					4					5				
Number.	Districts.	Population for which returns were received.					Number of deaths registered.					Ratio of deaths per 1,000 of population.				
		Native Christians	Muhammadans.	Hindus.	Other classes.	Total.	Native Christians.	Muhammadans.	Hindus.	Other classes.	Total.	Native Christians.	Muhammadans.	Hindus	Other classes.	Total.
1	Anantapur	4,318	110,006	1,220,657	1,036	1,336,017	18	693	13,817	...	14,528	21·1	26·6	26·6	3·8	26·6
2	Bellary						73	2,233	18,647	4	20,957					
3	Chingleput	13,917	25,034	939,314	259	978,524	211	521	25,199	...	25,931	15·2	20·8	26·8	...	26·5
4	Coimbatore	12,780	37,855	1,806,343	166	1,857,144	123	540	27,322	1	27,986	9·6	14·3	17·0	6·0	16·8
5	Cuddapah	5,743	97,749	1,017,211	11	1,120,714	68	1,910	24,780	...	26,758	11·8	19·7	24·3	...	23·9
6	Ganjam	877	4,916	966,813	496	973,102	26	85	17,275	4	17,390	29·6	17·3	17·8	8·1	17·9
7	Godávari	3,231	38,798	1,748,734	87	1,790,850	42	482	26,746	...	27,270	13·0	12·4	15·3	...	15·2
8	Kistna	36,069	87,161	1,425,013	112	1,548,355	344	1,219	28,663	...	30,226	9·5	16·2	20·1	...	19·5
9	Kurnool	11,368	75,875	591,199	22	678,464	150	2,218	18,743	...	21,111	13·2	29·2	31·7	...	31·1
10	Madras	23,767	50,298	315,527	392	389,984	742	2,145	11,867	1	14,755	31·2	42·6	37·6	2·5	37·8
11	Madura	34,174	62,328	1,197,323	4	1,293,829	463	1,165	23,223	...	24,851	13·5	18·9	19·4	...	19·2
12	Malabar	40,114	641,399	1,669,269	370	2,351,152	1,082	15,616	29,603	11	46,312	26·9	24·3	17·7	29·7	19·7
13	Nellore	19,587	57,382	1,107,260	56	1,184,765	174	1,177	18,551	...	19,902	8·9	20·5	16·8	...	16·8
14	Nilgiris	5,778	3,531	78,970	45	88,324	125	56	1,249	...	1,430	21·6	15·8	15·8	...	16·2
15	North Arcot	9,458	82,440	1,722,642	7,763	1,822,312	85	1,588	36,997	15	38,685	9·0	19·2	21·4	1·9	21·2
16	Salem	15,941	51,081	1,225,171	81	1,592,274	194	1,058	33,888	1	35,141	12·1	20·7	22·2	12·3	22·1
17	South Arcot	39,112	48,289	1,723,251	5,264	1,815,916	419	751	38,460	30	39,660	10·7	15·5	22·3	5·7	21·8
18	South Canara	57,968	89,983	797,427	10,217	955,595	1,287	2,496	20,068	333	24,184	22·2	20·7	25·2	32·6	25·3
19	Tanjore	77,413	112,058	1,939,421	646	2,129,538	1,366	2,923	50,015	...	54,903	17·6	26·1	26·1	...	25·8
20	Tinnevelly	140,255	89,767	1,468,977	57	1,699,056	2,591	2,378	34,482	...	39,451	18·5	26·5	23·5	...	23·2
21	Trichinopoly	60,892	34,104	1,119,434	55	1,214,485	1,038	602	28,548	...	30,188	17·5	17·7	25·8	...	24·8
22	Vizagapatam	2,590	15,248	1,213,467	769	1,232,074	39	162	15,188	11	15,396	13·5	10·6	12·5	14·3	12·5
	Total, Madras Presidency.	615,352	1,816,791	25,393,423	27,908	27,852,474	10,655	42,018	543,931	411	597,015	17·3	23·1	21·4	14·7	21·4

VI.—*Deaths* registered from different causes in the districts and towns of the Madras Presidency during the year* 1888.

1	2	3	4	5	6	7	8					9	10	11							
							Injuries.							Ratio of deaths per 1,000 of population.							
							Suicides.													From all causes.	
Number.	Districts and Towns.	Population for which returns were received.†	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Males.	Females.	Wounds and accidents.	Snake-bite and killed by wild beasts.	Total.	All other causes.	Total deaths from all causes.	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	All other causes.	For the year.	Mean of previous 5 years.
	A.—Districts.‡																				
1	Anantapur	1,245,669	760	380	2,201	354	10	46	145	47	248	10,445	14,388	1·6	1·2	5·4	0·9	0·4	16·2	25·8	29·9
2	Bellary		1,274	1,167	4,594	794	19	34	136	39	228	9,721	17,778								
3	Chingleput	918,803	2,137	246	5,080	3,918	39	39	371	118	567	12,158	24,106	2·3	0·3	5·5	4·3	0·6	13·2	26·2	26·1
4	Coimbatore	1,599,654	1,491	735	10,732	976	61	71	357	114	603	11,833	26,370	0·9	0·4	6·7	0·6	0·4	7·4	16·5	17·3
5	Cuddapah	1,102,056	2,120	1,000	18,098	718	56	106	379	122	663	3,557	26,156	1·9	0·9	16·4	0·6	0·6	3·2	23·7	19·1
6	Ganjam	916,187	602	2,034	10,636	245	22	19	103	33	177	1,856	15,600	0·6	2·2	11·7	0·3	0·2	2·0	17·0	16·5
7	Godávari	1,388,553	2,771	29	11,894	445	56	92	230	125	503	9,859	25,301	1·6	0·02	6·9	0·3	0·3	5·8	14·9	13·3
8	Kistna	1,474,370	3,286	62	11,091	367	82	97	337	125	641	13,292	28,730	2·2	0·04	7·5	0·2	0·4	9·0	19·5	19·9
9	Kurnool	658,222	384	1,480	14,684	304	26	67	191	93	377	3,113	20,342	0·5	2·2	22·3	0·4	0·5	4·7	30·6	32·1
10	Madras	405,848	521	35	3,306	2,524	1	...	113	2	116	8,253	14,755	1·3	0·09	8·1	6·2	0·3	20·3	36·3	38·6
11	Madura	1,173,592	728	1,698	6,437	377	46	86	258	128	518	11,690	21,448	0·6	1·4	5·5	0·3	0·4	9·9	18·2	18·3
12	Malabar	2,181,724	4,059	1,706	17,972	4,243	72	31	445	140	688	11,540	40,206	1·8	0·8	8·2	1·9	0·3	5·3	18·4	19·5
13	Nellore	1,148,413	1,228	430	8,516	661	185	190	405	61	841	7,382	19,038	1·0	0·4	7·4	0·6	0·7	6·4	16·6	15·5
14	Nilgiris	73,921	...	45	923	52	...	...	5	1	6	50	1,076	...	0·6	12·5	0·7	0·08	0·6	14·5	14·0
15	North Arcot	1,720,498	4,032	2,109	13,350	1,172	89	149	551	162	951	14,155	35,749	2·3	1·2	7·7	0·7	0·5	8·2	20·7	19·4
16	Salem	1,490,482	2,548	1,092	13,203	657	37	57	434	130	658	14,240	32,398	1·7	0·7	8·8	0·4	0·4	9·5	21·7	19·5
17	South Arcot	1,732,821	2,611	1,475	12,460	836	51	38	414	273	776	19,577	37,735	1·5	0·8	7·2	0·5	0·4	11·3	21·8	21·0
18	South Canara	928,743	1,357	1,123	6,551	2,032	45	41	301	70	457	11,358	22,878	1·5	1·2	7·1	2·2	0·5	12·3	24·8	25·0
19	Tanjore	1,929,311	7,895	1,091	2,335	662	47	37	294	192	570	36,280	48,833	4·1	0·5	1·2	0·3	0·3	18·8	25·3	24·0
20	Tinnevelly	1,525,520	6,477	445	4,557	932	41	95	341	78	555	22,398	35,364	4·2	0·3	3·0	0·6	0·4	14·7	23·2	23·1
21	Trichinopoly	1,110,811	3,922	675	5,631	468	49	39	194	155	437	15,959	27,110	3·5	0·6	5·0	0·4	0·4	14·4	24·4	23·5
22	Vizagapatam	1,131,041	255	435	11,302	162	10	11	166	56	243	839	13,236	0·2	0·4	9·9	0·1	0·2	0·7	11·7	11·0
	Total of districts ...	26,151,239	50,458	19,472	195,383	22,917	1044	1345	6,170	2,264	10,823	249,536	548,586	1·9	0·7	7·5	0·8	0·4	9·5	20·9	20·7

* Exclusive of Europeans and Eurasians, and born dead.
† Inclusive of Europeans and Eurasians, as the census of 1881 does not show these classes separately for towns under the column of Christians to be omitted.
‡ Exclusive of B—Towns.

VI.—*Deaths* registered from different causes in the districts and towns of the Madras Presidency during the year* 1888.—continued.

1	2	3	4	5	6	7	8					9	10	11							
							Injuries.							Ratio of deaths per 1,000 of population. †							
							Suicides.													From all causes.	
Number.	Districts and towns.	Population for which returns were received.	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Males.	Females.	Wounds and accidents.	Snake-bite and killed by wild beasts.	Total.	All other causes.	Total deaths from all causes.	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	All other causes	For the year.	Mean of previous 5 years.
	B—*Towns.*																				
1	Bellary. Anantapur ...	4,907	66	...	11	3	...	...	2	1	3	77	160	13·4	...	2·2	0·6	0·6	15·7	32·6	28·1
2	Bellary. Bellary ...	53,460	112	56	565	62	1	2	12	1	16	1,335	2,146	2·1	1·0	10·6	1·2	0·3	25·0	40·2	24·0
3	Bellary. Adoni ...	22,441	235	52	165	2	...	1	7	1	9	265	728	10·4	2·3	7·4	0·1	0·4	11·8	32·4	21·5
4	Bellary. Hospet ...	10,219	30	21	120	9	...	1	2	...	3	122	305	2·9	2·1	11·7	0·9	0·3	11·9	29·8	22·2
5	Chingleput. M. T. Conjeeveram.	37,275	322	21	241	161	...	2	5	1	8	606	1,359	8·6	0·5	6·4	4·3	0·2	16·2	36·4	32·8
6	Chingleput. T. St. Thomas' Mt.	15,013	54	8	31	...	...	1	...	...	1	86	160	3·2	0·5	2·1	...	0·06	5·7	10·6	12·2
7	Chingleput. T. Saidapet ...	10,290	68	9	41	14	...	...	2	...	2	172	306	6·6	0·8	3·9	1·3	0·1	16·7	29·7	24·6
8	Coimbatore. M. T. Coimbatore.	38,967	50	11	198	122	1	5	15	1	22	622	1,025	1·3	0·3	5·1	3·1	0·5	15·9	26·3	29·9
9	Coimbatore. M. T. Erode ...	9,804	62	4	39	32	...	...	5	...	5	176	318	6·3	0·4	3·9	3·2	0·5	17·8	32·2	21·3
10	Coimbatore. M. T. Karur ...	9,205	48	10	47	31	...	...	4	1	5	132	273	5·2	1·1	5·1	3·3	0·5	14·3	29·7	30·4
11	Cuddapah. M. T. Cuddapah ...	18,982	93	15	160	35	...	...	7	...	7	292	602	5·0	0·8	8·4	1·8	0·4	15·4	31·7	31·2
12	Ganjam. M. T. Berhampore.	23,599	54	62	398	163	...	...	3	...	3	358	1,038	2·2	2·6	16·8	6·8	0·1	15·1	43·6	37·1
13	Ganjam. M. T. Chicacole	18,302	31	4	149	82	...	1	...	2	3	218	432	1·7	0·2	8·1	1·7	0·1	11·6	23·6	22·2
14	Ganjam. M. T. Parlakimedi.	15,385	1	106	181	3	...	...	2	1	3	26	320	0·06	6·9	11·8	0·2	0·2	1·7	26·8	18·5
15	Godávari. M. T. Ellore ...	25,092	26	...	103	57	...	1	2	1	4	280	470	1·0	·4	4·1	2·2	0·1	11·1	18·7	29·3
16	Godávari. M. T. Rajahmundry	24,555	9	...	171	90	1	3	14	2	20	334	624	0·3	...	6·9	3·6	0·8	13·6	25·4	29·6
17	Godávari. M. T. Cocanada ...	30,441	3	9	53	100	2	...	6	...	8	416	591	0·09	0·3	1·8	3·2	0·2	13·6	19·4	24·8
18	Godávari. T. Peddapuram ...	11,278	...	4	57	2	...	...	3	1	4	142	209	...	0·3	5·0	0·2	0·3	12·6	18·5	24·3
19	Godávari. T. Pithapuram ...	11,598	...	...	65	1	1	...	1	...	2	7	75	...	...	5·6	0·08	0·1	0·6	6·4	12·0
20	Kistna. Masulipatam. M. T. Masulipatam.	35,056	63	1	57	5	...	1	6	...	7	187	370	2·5	...	6·1	0·3	0·3	9·5	18·8	21·4
21	Kistna. Guntur ...	19,646	50	...	119	7	...	1	6	...	7	477	603	1·7	0·03	1·6	0·1	...	13·6	17·2	15·1
22	Kistna. M. T. Bezvada ...	9,358	23	...	41	49	...	1	9	2	12	179	304	2·5	...	4·4	5·2	1·3	19·2	32·6	...
23	Kistna. T. Jaggayapet ...	10,072	...	...	2	4	3	3	4	...	...	192	210	...	...	0·2	0·4	1·2	19·0	20·8	24·5
24	Kurnool. M. T. Kurnool ...	20,329	27	129	324	27	1	1	7	1	10	252	769	1·3	6·3	16·0	1·3	0·5	12·4	37·8	30·4
25	Malabar. Madura. M. T. Madura ...	76,847	83	101	457	399	...	3	36	2	41	1,187	2,268	1·1	1·3	5·9	5·2	0·5	15·4	29·5	30·3
26	Malabar. Madura. M. T. Dindigul ...	14,182	41	68	42	28	...	...	13	1	14	256	449	2·9	4·8	2·9	2·0	1·0	18·0	31·6	24·1
27	Malabar. Madura. M. T. Periyakulam.	16,446	2	6	98	65	...	...	3	1	4	205	380	0·1	0·4	6·0	3·9	0·2	12·4	23·1	22·7
28	Malabar. Madura. M. T. Palni ...	13,315	5	7	49	15	...	...	7	...	7	223	306	0·4	0·5	3·7	1·1	0·5	16·7	23·0	22·9
29	Malabar. M. T. Tellicherry ...	24,581	299	66	81	29	1	...	7	2	10	323	808	12·1	2·6	3·3	1·2	0·4	13·1	32·8	29·5
30	Malabar. M. T. Calicut ...	57,085	966	114	163	309	4	2	14	2	22	963	2,537	16·9	2·0	2·8	5·4	0·4	16·9	44·4	30·0
31	Malabar. M. T. Palghat ...	36,339	37	9	238	64	...	2	10	6	18	566	932	1·0	0·2	6·5	1·7	0·5	15·6	25·6	30·7
32	Malabar. M. T. Cochin ...	15,098	42	...	60	54	...	...	4	...	4	314	474	2·6	...	3·8	3·4	0·2	20·0	30·2	28·3
33	Malabar. M. T. Cannanore ...	26,386	484	46	51	11	...	...	4	...	4	305	901	18·3	1·7	1·9	0·4	0·1	11·5	34·1	26·5
34	Malabar. T. Ponani ...	12,421	256	64	52	39	...	...	...	...	...	41	452	20·6	5·1	4·2	3·1	...	3·3	36·4	15·4
35	Nellore. M. T. Nellore ...	27,505	120	14	146	10	1	1	12	1	15	368	672	4·3	0·5	5·3	0·3	0·5	13·3	24·4	22·7
36	Nellore. M. T. Ongole ...	9,200	15	...	46	23	...	...	2	...	2	105	191	1·6	...	5	2·5	0·2	11·4	20·7	27·7
37	Nilgiris. M. T. Ootacamund.	12,335	...	1	83	32	...	2	1	1	4	110	230	...	0·08	6·7	2·6	0·4	8·9	18·6	26·6
38	Nilgiris. M. T. Coonoor ...	4,778	...	2	44	23	...	...	4	...	4	51	124	...	0·4	9·2	4·8	0·8	10·6	25·9	17·3
39	North Arcot. M. T. Vellore ...	40,958	171	67	271	97	...	1	8	...	9	524	1,139	4·2	1·6	6·6	2·4	0·2	12·8	27·8	21·1
40	North Arcot. M. T. Walajapet ...	10,387	28	3	56	5	...	...	2	...	2	242	336	2·7	0·2	5·4	0·4	0·1	23·5	32·4	26·6
41	North Arcot. M. T. Gudiyatam ...	16,690	507	25	76	16	...	1	1	1	2	217	843	30·3	1·5	4·5	0·9	0·1	13·0	50·5	29·8
42	North Arcot. M. T. Tirupati ...	13,232	73	...	79	15	1	3	1	...	5	58	228	5·5	...	5·9	1·1	0·4	4·2	17·2	22·3
43	North Arcot. T. Arcot ...	10,718	67	...	12	13	...	...	1	...	1	184	278	6·2	0·1	1·1	1·2	0·1	17·1	25·9	28·1
44	North Arcot. T. Ambur ...	20,390	92	...	15	...	1	...	1	...	2	3	112	8·8	...	1·4	...	0·2	0·3	10·3	17·6
45	Salem. M. T. Salem ...	59,631	488	310	348	118	2	1	10	2	15	659	1,938	8·2	5·2	5·8	1·9	0·3	11·1	32·5	19·8
46	Salem. M. T. Vaniambadi.	15,933	23	2	131	11	1	...	3	...	4	114	285	1·4	0·1	8·2	0·7	0·2	7·1	17·9	8·0
47	Salem. M. T. Tirupatur ...	14,273	10	1	117	74	1	...	6	...	7	146	355	0·7	0·07	8·2	5·2	0·5	10·2	24·8	17·7
48	Salem. T. Shendamangalam.	12,575	48	28	11	...	...	...	4	2	6	72	165	3·8	2·2	0·9	...	0·5	5·7	13·1	9·7
49	South Arcot. M. T. Cuddalore ...	43,545	156	43	132	141	...	1	7	5	13	371	856	3·6	1·0	3·0	3·2	0·3	8·5	19·6	16·1
50	South Arcot. M. T. Chidambaram.	19,837	131	...	139	60	...	...	3	2	5	234	569	6·6	...	7·0	3·0	0·3	11·8	28·7	22·8
51	South Arcot. T. Panruti ...	20,172	59	12	66	4	1	...	1	1	3	356	500	2·9	0·6	3·3	0·2	0·1	17·6	24·8	27·5
52	South Canara. M. T. Mangalore ...	32,099	70	306	129	170	1	2	16	...	19	612	1,306	2·1	9·5	4·0	5·3	0·6	19·1	40·7	25·2
53	Tanjore. M. T. Tanjore ...	54,745	364	65	202	298	...	...	8	3	11	562	1,502	6·6	1·2	3·6	5·4	0·2	10·3	27·4	24·7
54	Tanjore. M. T. Kumbakonam.	50,098	348	14	276	185	...	1	8	1	10	933	1,764	6·9	0·3	5·5	3·7	0·2	18·4	35·2	31·2
55	Tanjore. M. T. Negapatam.	53,776	312	72	219	306	...	...	6	...	6	627	1,542	5·8	1·3	4·1	5·7	0·1	11·7	28·6	27·7
56	Tanjore. M. T. Mayavaram.	23,044	121	26	120	83	...	...	5	2	7	458	815	5·2	1·1	5·2	3·6	0·3	19·9	35·3	30·3
57	Tanjore. M. T. Mannargudi.	19,409	82	10	44	100	...	...	12	3	15	196	447	4·2	0·5	2·3	5·1	0·8	10·1	23·0	26·8
58	Tanjore. M. T. Tinnevelly ...	23,231	231	8	35	148	...	...	3	...	3	256	681	9·9	0·3	1·5	6·4	0·1	11·0	29·3	29·4
59	Tanjore. M. T. Palamcottah.	17,964	179	1	23	52	1	2	6	...	9	336	600	10·0	0·06	1·3	2·9	0·5	18·7	33·4	27·5
60	Tanjore. M. T. Tuticorin ...	16,281	11	4	135	153	...	...	1	...	1	212	516	0·7	0·2	8·3	9·4	0·06	13·0	31·7	36·0
61	Tanjore. T. Kayalpatnam ...	11,806	...	...	1	...	...	...	...	...	...	98	94	...	...	...	0·09	...	...	7·9	8·0
62	Tanjore. T. Kulasekarapatnam.	14,972	46	...	42	16	2	...	1	...	3	189	296	3·1	...	2·8	1·1	0·2	12·6	19·8	25·6
63	Tinnevelly. T. Rajahpoliem ...	12,021	2	...	18	...	...	2	5	...	7	137	164	0·2	...	1·5	...	0·6	11·4	13·6	26·2
64	Tinnevelly. T. Nachiarcoil ...	18,256	...	1	3	...	1	1	6	...	8	145	167	...	0·05	0·2	...	0·4	7·9	8·6	29·2
65	Tinnevelly. T. Sivagiri ...	13,652	...	1	...	...	1	...	6	3	10	247	268	...	0·07	...	...	0·7	18·1	18·9	33·6
66	Tinnevelly. T. Viravanallur ...	12,818	118	...	3	...	...	1	3	1	5	161	287	9·6	...	...	0·2	...	0·4	13·1	23·3	25·6
67	Tinnevelly. T. Kallidakurchi ...	10,936	78	...	30	1	1	...	1	1	3	193	305	7·1	...	...	2·7	0·1	0·3	17·6	27·8	27·9
68	Tinnevelly. T. Sivakasi ...	10,833	10	1	29	...	1	1	10	1	13	233	286	0·9	0·1	2·7	...	1·2	21·5	26·4	19·4
69	Tinnevelly. T. Tenkasi ...	11,987	129	...	58	10	2	...	4	...	6	242	443	10·8	...	4·7	0·8	0·5	20·2	37·0	37·9
70	Trichinopoly. M. T. Trichinopoly.	84,449	431	262	428	311	1	2	20	...	23	872	2,327	5·1	3·1	5·1	3·6	0·2	10·3	27·4	25·6
71	Trichinopoly. M. T. Srirangam ...	19,773	77	96	73	59	1	3	2	1	7	449	751	3·9	4·3	3·6	2·9	0·3	22·7	37·9	33·7
72	Vizagapatam. M. T. Vizagapatam.	30,291	...	7	234	97	2	1	2	1	6	348	692	...	0·2	7·7	3·2	0·2	11·5	22·8	29·0
73	Vizagapatam. M. T. Vizianagram.	22,577	2	6	221	94	...	...	3	1	4	315	642	0·09	0·3	9·8	4·1	0·2	13·9	28·4	26·9
74	Vizagapatam. M. T. Bimlipatam.	8,582	...	...	40	43	1	...	1	1	3	122	207	...	...	4·6	5·0	0·2	14·2	24·1	25·4
75	Vizagapatam. M. T. Anakapalle.	13,341	...	...	104	11	1	...	2	2	5	180	300	...	...	7·8	0·3	0·4	13·5	22·5	24·2
76	Vizagapatam. T. Bobbili ...	14,943	...	...	212	...	...	...	3	...	3	1	216	...	...	14·2	...	0·2	0·06	14·4	15·6
77	Vizagapatam. T. Salur ...	11,856	...	4	98	1	...	...	...	...	...	105	105	...	0·3	8·3	0·09	...	...	8·7	14·7
	Total, Towns...	1,733,961	8,219	2,386	9,178	4,804	39	55	617	67	578	23,262	46,427	4·7	1·4	5·3	2·8	0·3	13·4	27·9	25·5
	Total, Madras Presidency ...	27,885,200	58,677	21,858	204,561	27,721	1083	1,400	6,787	2,331	11,401	272,797	597,015	2·1	0·8	7·3	1·0	0·4	9·8	21·4	21·0

* Exclusive of Europeans and Eurasians, and born dead.
† Worked on the population including Europeans and Eurasians.

VII.—*Deaths registered from Cholera in the districts of the Madras Presidency during each month of the year* 1888.

1	2	3		4		5												6			7			8
Number.	Districts.	Circles of registration.		Villages.*														Total.			Ratio of deaths per 1,000 of population.			Mean ratio per 1,000 for previous 5 years.
		Number in each district.	Number from which deaths from cholera were reported.	Number in each district.	Number from which deaths from cholera were reported.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Males.	Females.	Total.	Males.	Females.	Total.	
1	Anantapur ...	8	7	906	78	...	9	4	...	...	28	161	268	73	102	116	65	452	374	826	2·0	1·7	1·8	0·7
2	Bellary ...	11	11	1,597	161	18	10	85	65	43	391	151	76	50	304	150	308	924	727	1,651	2·6	2·6	2·6	0·7
3	Chingleput ...	7	7	2,000	360	554	241	46	210	226	150	3	1	248	202	120	174	1,295	1,266	2,561	1·0	1·0	1·0	1·5
4	Coimbatore ...	13	12	1,452	292	964	294	175	204	6	1	133	257		304		3	857	794	1,651	2·0	1·9	2·0	0·7
5	Cuddapah ...	12	12	1,238	199	741	459	60	...	...	10	72	206	332	113	34	96	1,165	1,048	2,213	2·0	1·9	2·0	0·7
6	Ganjam ...	8	7	7,174	100	...	71	72	...	...	...	2	219	117	34	134	84	354	334	688	0·7	0·7	0·7	0·8
7	Godâvari ...	14	12	2,202	198	33	199	261	94	193	491	1,300	219	19	113	134	...	1,472	1,337	2,809	1·6	1·5	1·6	1·9
8	Kistna ...	15	15	1,837	396	252	1,635	1,032	268	26	33	85	85	8	...	...	15	1,884	1,538	3,422	2·4	2·0	2·2	1·5
9	Kurnool ...	9	8	758	67	...	62	90	...	4	52	96	50	27	30	11	55	220	191	411	0·6	0·5	0·6	0·1
10	Madras ...	1	1	1	1	72	38	44	110	40	9	2	118	30	...	...	20	250	270	521	0·7	0·6	0·6	1·7
11	Madura ...	12	11	1,063	107	163	164	72	104	80	52	28	50	14	30	57	123	452	407	859	1·3	1·3	1·3	1·0
12	Malabar ...	17	17	431	219	521	630	599	355	519	721	1,525	891	225	4	2	66	2,844	3,299	6,143	2·4	2·8	2·6	0·3
13	Nellore ...	12	12	1,874	134	278	653	250	138	3	...	...	...	36	...	...	3	764	599	1,363	1·2	1·2	1·2	0·6
14	Nilgiris ...	5	...	48	...	...	1	12	15	10	4	1	2	3	139	30	...	18	30	48	2	0·3	0·7	0·5	0·6
15	North Arcot ...	14	14	3,638	436	2,290	510	98	124	138	66	16	399	270	97	57	905	2,657	2,313	4,970	2·9	2·5	2·7	0·9
16	Salem ...	12	12	4,479	276	1,096	640	258	213	72	32	42	83	44	56	56	577	1,088	1,429	3,117	2·1	1·7	1·9	1·1
17	South Arcot ...	10	10	3,146	469	436	586	258	54	25	62	20	149	84	4	298	843	1,569	1,388	2,957	1·7	1·5	1·6	2·2
18	South Canara.	6	6	1,276	190	11	4	...	...	...	6	2	4	138	142	304	532	684	733	1,427	1·4	1·5	1·5	0·02
19	Tanjore ...	14	14	3,545	172	5,287	1,555	367	63	26	183	370	162	21	314	116	656	4,563	4,557	9,120	4·4	4·1	4·3	3·6
20	Tinnevelly ...	12	12	1,616	511	3,596	1,131	409	84	106	79	77	10	76	11	24	1,765	3,808	3,473	7,281	4·6	4·0	4·3	3·2
21	Trichinopoly.	8	8	1,495	558	2,455	488	172	120	134	180	504	248	...	11	13	29	2,334	2,096	4,430	3·9	3·3	3·6	2·9
22	Vizagapatam.	18	9	2,667	34	20	20	69	45	53	19	...	11	19	...	...	1	151	106	257	0·2	0·1	0·2	0·4
	Total, Madras Presidency...	238	217	44,443	4,958	18,787	9,399	4,421	2,251	1,694	2,565	4,587	3,551	1,805	1,813	1,494	6,310	30,397	28,280	58,677	2·2	2·0	2·1	1·5

* As per returns furnished by Collectors.

IX.—*Deaths registered from fevers in the districts of the Madras Presidency during each month of the year* 1888.

1	2	3		4		5												6			7			8
Number.	Districts.	Circles of registration.		Villages.*														Total.			Ratio of deaths per 1,000 of population.			Mean ratio per 1,000 for previous 5 years.
		Number in each district.	Number from which deaths from fevers were reported.	Number in each district.	Number from which deaths from fevers were reported.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Males.	Females.	Total.	Males.	Females.	Total.	
1	Anantapur ...	8	8	906	420	198	169	208	238	238	216	190	186	142	138	122	167	1,113	1,099	2,212	5·7	5·7	5·7	4·9
2	Bellary ...	11	11	1,597	738	451	491	557	456	459	408	450	449	421	476	415	410	2,761	2,683	5,444				
3	Chingleput ...	7	7	2,000	1,183	579	447	431	434	378	397	409	413	423	433	496	553	2,701	2,692	5,393	5·5	5·5	5·5	6·2
4	Coimbatore ...	13	13	1,452	986	1,053	949	876	793	781	868	882	850	876	919	1,055	1,114	5,776	5,240	11,016	7·1	6·1	6·6	7·3
5	Cuddapah ...	12	12	1,238	1,161	2,045	1,581	1,771	1,603	1,527	1,286	1,296	1,281	1,374	1,432	1,400	1,662	9,389	8,869	18,258	16·5	16·0	16·2	12·9
6	Ganjam ...	8	8	7,174	2,145	1,008	662	942	955	923	992	1,062	949	1,090	841	935	1,055	6,165	5,249	11,414	12·8	10·7	11·7	11·9
7	Godâvari ...	14	14	2,202	629	1,400	894	731	767	740	887	984	1,041	1,102	1,072	1,371	1,156	6,571	5,574	12,145	7·5	6·2	6·8	9·4
8	Kistna ...	15	15	1,837	1,329	1,093	771	606	658	758	995	1,105	1,240	1,183	961	926	1,014	5,873	5,437	11,310	7·5	7·1	7·3	8·9
9	Kurnool ...	9	9	758	741	1,687	1,388	1,340	1,304	1,349	1,200	1,211	1,192	1,102	999	1,038	1,198	7,843	7,165	15,008	22·8	21·4	22·1	17·1
10	Madras ...	1	1	1	1	326	316	298	265	278	234	219	262	238	233	253	324	1,579	1,727	3,306	8·2	8·7	8·5	9·4
11	Madura ...	12	12	1,063	844	722	618	602	501	562	500	522	471	467	486	682	950	3,580	3,503	7,083	5·7	5·2	5·5	7·1
12	Malabar ...	17	17	431	429	1,753	1,680	1,571	1,440	1,519	1,706	1,935	1,781	1,431	1,208	1,207	1,366	10,317	8,300	18,617	8·8	7·0	7·9	9·5
13	Nellore ...	12	12	1,874	1,339	1,016	467	841	757	677	664	706	670	681	711	726	792	4,603	4,105	8,708	7·6	7·0	7·3	7·4
14	Nilgiris ...	5	5	48	48	71	47	74	111	146	150	100	78	83	64	66	60	552	498	1,050	11·2	12·7	11·9	11·2
15	North Arcot ...	14	14	3,638	3,329	1,309	1,126	1,096	995	1,128	1,092	967	997	1,103	1,103	1,250	1,673	7,018	6,821	13,839	7·7	7·5	7·6	7·7
16	Salem ...	12	12	4,479	1,534	1,320	1,037	1,041	1,041	1,121	1,170	1,230	1,048	1,011	1,047	1,213	1,531	6,986	6,824	13,810	9·0	8·3	8·6	8·0
17	South Arcot ...	10	10	3,146	1,808	1,198	945	1,077	902	1,013	954	1,067	966	1,005	1,046	1,176	1,446	6,607	6,190	12,797	7·3	6·8	7·0	6·2
18	South Canara.	6	6	1,276	943	590	524	458	402	462	678	778	668	575	490	471	584	3,574	3,106	6,680	7·6	6·4	7·0	8·6
19	Tanjore ...	14	14	3,545	129	337	248	254	217	212	212	270	232	265	242	271	386	1,573	1,623	3,196	1·5	1·5	1·5	1·7
20	Tinnevelly ...	12	12	1,616	793	671	502	455	355	364	377	348	317	274	325	315	629	2,624	2,308	4,932	3·2	2·6	2·9	3·3
21	Trichinopoly.	8	8	1,495	971	686	472	442	458	566	520	467	463	419	444	491	704	3,085	3,047	6,132	5·3	4·8	5·0	4·9
22	Vizagapatam.	18	18	2,667	945	1,228	703	843	828	731	1,186	826	929	1,208	1,032	1,147	1,460	6,512	5,699	12,211	10·5	9·2	9·9	13·2
	Total, Madras Presidency.	238	238	44,443	22,445	20,741	16,037	16,514	15,480	15,932	16,693	17,044	16,533	16,563	15,762	17,028	20,234	106,802	97,759	204,561	7·7	6·9	7·3	7·8

* As per returns furnished by Collectors.

VIII.—*Deaths registered from Small-pox in the districts of the Madras Presidency during each month of the year* 1888.

1	2	3		4		5													6			7		8	9
Number.	Districts.	Circles of registration.		Villages. *															Total.			Number of deaths among children.		Ratio of deaths per 1,000 of population.			Mean ratio per 1,000 for previous 5 years.
		Number in each district.	Number from which deaths from small-pox were reported.	Number in each district.	Number, from which deaths from small-pox were reported.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Males.	Females.	Total.	Under 1 year.	Under 12 years.	Males.	Females.	Total.	
1	Anantapur ...	8	7	906	107	39	49	52	32	40	17	16	13	23	11	26	42	176	184	360	99	154	1·2	1·2	1·2	1·0
2	Bellary ...	11	11	1,597	214	26	85	121	115	106	178	194	87	75	48	23	149	680	616	1,296	420	856				
3	Chingleput ...	7	7	2,000	97	25	20	33	24	13	25	29	33	25	13	21	21	148	136	284	90	135	0·3	0·3	0·3	1·0
4	Coimbatore ...	13	13	1,452	245	49	126	85	90	61	65	70	66	32	38	19	59	391	369	760	232	346	0·5	0·4	0·4	0·5
5	Cuddapah ...	12	12	1,238	254	70	53	113	96	100	73	82	63	73	71	89	132	505	510	1,015	254	447	0·9	0·9	0·9	0·8
6	Ganjam ...	8	8	7,174	443	164	108	175	189	124	274	218	164	161	85	...	348	1,158	1,048	2,206	263	686	2·4	2·1	2·2	0·6
7	Godâvari ...	14	11	2,202	17	5	2	5	5	4	6	4	3	4	5	2	...	18	24	42	8	15	0·02	0·02	0·02	2·5
8	Kistna ...	15	13	1,837	34	2	5	2	3	22	2	10	2	8	157	...	...	30	33	63	1	3	0·04	0·04	0·04	2·2
9	Kurnool ...	9	9	758	216	51	110	130	110	188	194	163	142	83	101	2	180	831	778	1,609	343	649	2·4	2·3	2·4	1·2
10	Madras ...	1	1	1	1	5	3	5	2	1	3	5	2	1	...	106	6	13	22	35	12	16	0·07	0·1	0·09	2·8
11	Madura ...	12	11	1,063	426	186	197	232	215	150	97	148	135	127	152	46	136	890	990	1,880	462	827	1·4	1·5	1·5	0·9
12	Malabar ...	17	14	431	245	194	500	461	313	127	88	76	53	47	15	8	66	1,077	928	2,005	18	117	0·9	0·8	0·8	2·2
13	Nellore ...	12	11	1,874	160	74	49	41	50	53	53	27	28	34	...	...	12	219	225	444	73	66	0·3	0·4	0·4	1·0
14	Nilgiris ...	5	5	48	19	...	1	12	15	10	4	1	2	3	139	133	161	18	30	48	2	7	0·3	0·7	0·5	0·6
15	North Arcot ...	14	13	3,638	863	228	229	256	218	190	174	139	177	161	151	112	122	1,098	1,107	2,205	683	1,271	1·2	1·2	1·2	1·4
16	Salem ...	12	12	4,479	131	66	86	96	104	109	151	170	150	116	153	131	197	703	730	1,433	349	521	0·9	0·9	0·9	0·8
17	South Arcot ...	10	9	3,146	242	115	102	153	115	65	73	118	116	132	53	5	15	793	737	1,530	452	785	0·8	0·8	0·8	1·4
18	South Canara.	6	6	1,276	298	176	316	316	230	126	63	51	43	55	123	117	772	657	1,429	102	233	1·6	1·3	1·5	0·6
19	Tanjore ...	14	14	3,545	56	63	72	78	117	98	73	144	160	132	101	44	304	645	633	1,278	281	577	0·6	0·6	0·6	0·7
20	Tinnevelly ...	12	12	1,616	128	83	60	46	56	44	33	18	26	12	15	24	656	216	245	461	56	144	0·3	0·3	0·3	0·6
21	Trichinopoly.	8	8	1,495	199	57	47	85	88	99	95	56	77	115	114	94	96	517	506	1,023	237	506	0·8	0·8	0·8	0·3
22	Vizagapatam.	18	12	2,667	135	98	80	64	91	...	22	32	...	76	9	2	29	219	233	452	76	127	0·3	0·4	0·4	0·8
	Total, Madras Presidency...	238	219	44,443	4,510	1,776	2,300	2,561	2,248	1,730	1,763	1,771	1,543	1,463	1,293	1,510	1,910	11,117	10,741	21,858	4,513	8,487	0·8	0·7	0·8	1·2

* As per returns furnished by Collectors.

X.—*Deaths registered from bowel-complaints in the districts of the Madras Presidency during each month of the year* 1888.

1	2	3		4		5												6			7			8
Number.	Districts.	Circles of registration.		Villages.*														Total.			Ratio of deaths per 1,000 of population.			Mean ratio per 1,000 for previous 5 years.
		Number in each district.	Number from which bowel-complaints were reported.	Number in each district.	Number from which deaths from bowel-complaints were reported.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Males.	Females.	Total.	Males.	Females.	Total.	
1	Anantapur ...	8	8	906	150	29	17	12	15	36	28	30	42	34	37	44	33	183	174	357	0·9	0·8	0·9	0·7
2	Bellary ...	11	11	1,597	275	59	46	59	48	44	82	104	98	79	92	90	66	467	400	867				
3	Chingleput ...	7	7	2,000	1,073	491	333	261	241	270	278	350	356	339	331	371	472	2,144	1,949	4,093	4·3	4·0	4·2	3·5
4	Coimbatore ...	13	13	1,452	358	145	69	90	72	57	76	86	95	96	123	129	123	579	582	1,161	0·7	0·7	0·7	0·8
5	Cuddapah ...	12	12	1,238	308	68	54	41	56	49	44	64	56	77	66	64	114	403	350	753	0·7	0·6	0·7	0·4
6	Ganjam ...	8	8	7,174	151	37	43	19	28	31	37	38	39	63	40	32	36	271	172	443	0·5	0·3	0·4	0·4
7	Godâvari ...	14	14	2,202	54	56	51	57	48	59	46	67	90	54	60	54	53	379	316	695	0·4	0·3	0·4	0·5
8	Kistna ...	15	15	1,837	175	26	58	35	31	34	25	52	34	41	35	31	30	235	197	432	0·3	0·2	0·3	0·3
9	Kurnool ...	9	9	758	141	33	20	13	15	32	25	47	39	19	20	30	38	201	130	331	0·6	0·4	0·5	0·4
10	Madras ...	1	1	1	1	282	216	204	197	174	169	153	272	191	192	199	275	1,194	1,130	2,324	6·2	6·7	6·5	6·5
11	Madura ...	12	11	1,063	137	91	73	58	62	84	69	76	67	49	51	92	112	449	435	884	0·7	0·6	0·7	0·6
12	Malabar ...	17	17	431	354	416	367	291	367	430	441	587	566	325	339	313	307	2,493	2,256	4,749	2·1	1·9	2·0	2·0
13	Nellore ...	12	12	1,874	276	68	32	59	38	57	78	54	45	103	97	32	33	375	319	694	0·6	0·5	0·6	0·3
14	Nilgiris ...	5	5	48	22	9	6	8	16	15	15	12	11	7	2	5	1	58	49	107	1·2	1·2	1·2	1·1
15	North Arcot ...	14	14	3,638	692	145	104	76	69	66	84	95	132	104	100	149	194	748	570	1,318	0·8	0·6	0·7	0·6
16	Salem ...	12	12	4,479	281	84	48	52	49	47	74	78	51	73	78	83	143	453	407	860	0·6	0·5	0·5	0·4
17	South Arcot ...	10	10	3,146	339	100	67	72	52	64	45	86	109	79	116	114	137	603	438	1,041	0·7	0·5	0·6	0·4
18	South Canara.	6	6	1,276	608	220	195	141	100	118	202	213	212	192	161	176	272	1,239	963	2,202	2·6	2·0	2·3	2·3
19	Tanjore ...	14	14	3,545	41	340	148	86	88	88	110	147	132	90	102	113	190	831	803	1,634	0·7	0·7	0·7	0·7
20	Tinnevelly ...	12	12	1,616	282	274	136	91	59	62	84	67	73	49	76	109	232	706	606	1,312	0·8	0·7	0·8	1·1
21	Trichinopoly.	8	8	1,495	215	152	53	69	94	85	84	66	36	36	49	50	111	447	409	856	0·8	0·6	0·7	0·5
22	Vizagapatam.	18	18	2,667	85	40	26	29	43	38	40	28	32	44	27	42	19	229	179	408	0·3	0·3	0·3	0·3
	Total, Madras Presidency.	238	237	44,443	6,018	3,165	2,162	1,814	1,788	1,920	2,136	2,500	2,585	2,144	2,194	2,322	2,991	14,687	13,034	27,721	1·1	0·9	1·0	0·9

* As per returns furnished by Collectors.

XI.—*Births registered according to Months and Classes in the districts of the Madras Presidency during the year* 1888.

1	2	3												4	5					6				
															Births registered according to classes.					Ratio of births per 1,000 of population.				
Number.	Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total Births.	Native Christians.	Muhammadans.	Hindus.	Other classes.	Total.	Native Christians.	Muhammadans.	Hindus.	Other classes.	Total.
1	Anantapur	1,697	1,520	1,785	1,758	1,937	1,880	1,821	1,772	1,765	1,868	1,787	1,535	21,125	18	1,272	19,834	1	21,125	} 12·9	38·0	40·4	4·8	40·0
2	Bellary	2,025	2,422	2,831	2,779	2,972	3,064	3,252	2,646	2,572	2,882	2,653	2,303	32,401	38	2,912	29,447	4	32,401					
3	Chingleput	2,827	2,277	2,444	2,518	2,828	3,296	3,992	3,945	3,673	3,599	3,528	3,427	38,354	297	505	37,552	...	38,354	21·3	20·2	40·0	...	39·2
4	Coimbatore	3,275	3,934	4,300	4,051	4,406	4,271	4,880	4,204	4,256	4,857	4,666	4,136	51,238	254	1,030	49,954	...	51,238	19·8	27·2	31·1	...	30·9
5	Cuddapah	2,221	2,204	2,709	2,495	2,694	2,446	2,582	2,627	2,604	2,889	2,900	2,683	31,054	74	2,757	28,223	...	31,054	12·9	28·2	27·7	...	27·7
6	Ganjam	1,231	846	1,031	1,411	1,468	1,919	2,220	2,017	2,322	1,862	2,071	1,943	20,341	32	69	20,232	8	20,341	36·5	14·0	20·9	16·2	20·9
7	Godávari	2,861	1,894	2,171	2,374	2,739	2,952	3,772	3,967	3,563	3,490	3,995	3,743	37,521	62	542	36,917	...	37,521	19·2	14·0	21·1	...	21·0
8	Kistna	3,631	2,936	3,260	3,634	4,169	5,069	5,479	5,663	5,421	5,730	5,139	4,769	54,920	917	2,915	51,087	1	54,920	25·4	33·4	35·8	8·9	35·3
9	Kurnool	1,777	1,862	2,184	2,214	2,505	2,258	2,062	2,073	2,047	2,218	2,173	2,030	25,401	215	2,728	22,458	...	25,401	12·9	36·0	38·0	...	37·4
10	Madras	1,283	1,123	1,337	1,214	1,300	1,180	1,310	1,364	1,301	1,332	1,378	1,339	15,461	783	2,031	12,647	...	15,461	32·9	40·4	40·1	...	39·6
11	Madura	2,776	2,634	3,334	3,275	3,799	3,664	3,978	3,395	3,575	3,575	3,549	3,621	41,175	964	1,788	38,423	...	41,175	28·2	28·9	32·1	...	31·8
12	Malabar	4,910	5,015	5,482	5,469	5,530	5,286	5,513	4,821	4,562	4,392	3,956	3,997	58,933	1,135	18,252	39,544	2	58,933	28·3	28·4	28·7	8·4	28·0
13	Nellore	2,396	1,467	2,360	2,242	2,155	2,677	2,987	2,751	3,353	3,037	2,886	2,385	30,716	224	1,488	29,004	...	30,716	11·4	25·7	26·2	...	25·9
14	Nilgiris	104	136	161	138	151	150	145	145	154	153	132	117	1,686	193	49	1,444	...	1,686	33·4	13·8	18·3	...	19·1
15	North Arcot	3,568	3,205	3,902	3,373	4,102	4,825	5,411	5,688	5,824	5,331	5,329	4,861	55,419	105	1,659	53,642	15	55,419	10·9	20·1	31·1	1·9	30·4
16	Salem	4,451	4,254	5,052	4,959	5,665	5,527	6,018	5,605	5,586	6,016	5,647	5,423	64,203	282	1,554	62,367	...	64,203	17·7	30·4	40·9	...	40·3
17	South Arcot	3,363	3,230	3,861	3,708	4,390	4,584	6,321	5,681	5,492	5,408	4,837	4,406	55,270	813	1,077	53,341	39	55,270	20·8	22·3	30·9	7·4	30·5
18	South Canara	2,842	2,679	2,792	2,768	2,638	2,966	2,996	2,424	2,110	1,946	2,160	2,497	30,818	2,053	3,117	25,350	298	30,818	35·4	34·6	31·8	29·1	32·2
19	Tanjore	4,384	4,241	4,809	4,894	4,589	4,627	5,575	5,835	5,185	5,061	4,730	4,598	58,518	1,325	2,199	54,994	...	58,518	17·1	19·6	28·3	...	27·5
20	Tinnevelly	3,326	3,035	3,632	3,291	4,025	3,987	3,941	4,068	3,987	4,517	4,304	4,320	46,423	2,796	2,270	41,357	...	46,423	19·1	25·3	28·1	...	27·3
21	Trichinopoly	2,394	2,180	2,812	2,778	3,350	3,219	3,632	3,096	2,839	3,364	3,033	3,158	35,855	1,278	543	34,034	...	35,855	21·0	15·9	30·4	...	29·5
22	Vizagapatam	1,709	1,241	1,578	1,600	1,639	2,453	2,614	2,642	3,131	2,772	2,753	2,381	26,513	33	146	26,327	7	26,513	12·7	9·6	21·7	9·1	21·5
	Total, Madras Presidency	59,051	54,355	63,827	62,943	69,041	72,320	80,501	76,419	75,322	78,289	73,606	69,671	833,345	13,889	50,903	768,178	375	833,345	22·6	28·0	30·2	13·4	29·9
	Ratio per mille of population	2·1	1·9	2·3	2·2	2·5	2·6	2·9	2·7	2·7	2·7	2·6	2·5	29·9										

XII.—Deaths and Births registered among Europeans and Eurasians from different causes in each district of the Madras Presidency and the number born dead among all classes during the year 1888.

Columns 1–8 (Population; Deaths from Cholera, Small-pox, Fevers, Bowel-complaints, Injuries)

1	2		3			4			5			6			7			8											
			Population for which returns were received.			Cholera.			Small-pox.			Fevers.			Bowel-complaints.			Injuries. Suicides.			Wounds or accidents.			Snake-bite.			Killed by wild beasts.		
Number.	Districts.		Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.
1	Anantapur and	Europeans.	417	135	552	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	Bellary	Eurasians.	79	48	127	2	...	2	...	...	...	4	5	9	...	...	...	...	...	...	1	...	1	1	...	1	...	...	...
3	Chingleput	Europeans.	1,061	622	1,683	1	...	1	...	...	...	1	...	1	...	...	...	...	...	...	2	...	2	...	...	...	...	...	...
		Eurasians.	480	694	1,174	...	...	...	...	...	...	1	1	2	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...
4	Coimbatore	Europeans.	184	90	274	...	...	...	...	...	...	1	...	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	146	127	272	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...
5	Cuddapah	Europeans.	22	20	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	156	126	282	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	Ganjam	Europeans.	116	13	129	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	92	130	222	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	Godávari	Europeans.	194	56	250	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	208	204	412	...	...	...	...	...	...	4	...	4	...	1	1	...	...	...	1	...	1	...	...	...	...	...	...
8	Kistna	Europeans.	35	17	52	...	1	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	43	30	73	...	...	...	...	...	...	...	2	2	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
9	Kurnool	Europeans.	33	19	52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	22	13	35	...	...	...	...	...	...	1	...	1	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...
10	Madras	Europeans.	2,004	1,201	3,205	4	1	5	...	...	...	4	6	10	4	2	6	...	...	...	3	...	3	...	...	...	...	...	...
		Eurasians.	6,100	6,559	12,669	10	7	17	1	...	1	23	33	56	20	18	38	...	...	...	2	2	4	...	...	...	...	...	...
11	Madura	Europeans.	101	75	176	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	253	124	377	...	...	...	...	...	...	3	...	3	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...
12	Malabar	Europeans.	1,283	275	1,558	...	...	...	...	...	...	6	...	6	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	944	580	1,524	5	5	10	...	...	...	5	2	7	2	1	3	...	...	...	...	...	...	...	...	...	...	...	...
13	Nellore	Europeans.	23	10	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	155	165	320	...	2	2	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	Nilgiris	Europeans.	1,127	571	1,698	...	...	...	...	...	...	1	1	2	4	...	4	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	527	485	1,012	...	...	...	...	...	...	4	2	6	2	1	3	...	...	...	...	...	...	...	...	...	...	...	...
15	North Arcot	Europeans.	72	43	115	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	223	223	446	1	1	2	...	...	...	...	1	1	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...
16	Salem	Europeans.	102	78	180	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	236	209	445	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	South Arcot	Europeans.	69	15	84	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	186	189	375	...	1	1	...	...	...	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18	South Canara	Europeans.	79	41	120	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	69	58	127	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19	Tanjore	Europeans.	110	58	168	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	348	329	677	3	1	4	...	...	...	2	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20	Tinnevelly	Europeans.	71	54	125	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	308	258	566	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
21	Trichinopoly	Europeans.	110	67	177	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	197	174	371	5	...	5	...	...	...	...	1	1	1	2	3	...	...	...	...	...	...	...	...	...	...	...	...
22	Vizagapatam	Europeans.	112	51	163	...	...	...	...	...	...	2	2	4	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
		Eurasians.	197	197	394	1	...	1	...	...	...	1	1	2	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...
	Total	Europeans.	7,325	3,511	10,836	7	2	9	...	...	...	15	12	27	10	5	15	...	...	...	5	...	5	...	...	...	...	...	...
		Eurasians.	10,968	10,922	21,890	28	18	46	1	...	1	50	51	101	30	28	58	1	...	1	4	2	6	1	...	1	...	...	...

Columns 9–14 (All other causes; Total Deaths; Total Births; Ratio per 1,000 of population; Born dead)

1	2		9			10			11			12											13			14		
			All other causes.			Total Deaths from all causes.			Total Births.			Ratio per 1,000 of population.					Total Deaths.			Total Births.			Born dead among Europeans and Eurasians.			Born dead among all other classes.		
Number.	Districts.		Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.
1	Anantapur and	Europeans.	...	1	1	...	1	1	3	...	3	...	...	...	...	...	...	7·4	1·8	5·4	...	5·4	...	...	...	242	204	446
2	Bellary	Eurasians.	6	3	9	14	8	22	8	8	16	15·7	...	70·9	...	15·7	17·7	166·6	173·2	63·0	63·0	126·0	...	...	...	136	111	247
3	Chingleput	Europeans.	20	4	24	24	4	28	9	9	18	0·6	...	0·6	...	1·2	22·6	6·4	16·6	5·3	5·3	10·7	...	1	1	} 709	616	1,325
		Eurasians.	2	5	7	3	7	10	4	3	7	...	...	1·7	0·8	...	6·2	10·0	8·5	3·4	2·5	5·9	1	...	1			
4	Coimbatore	Europeans.	...	...	...	1	1	2	1	2	3	...	...	3·6	3·6	...	5·4	11·1	7·3	3·6	7·3	10·9	1	...	1	} 268	273	541
		Eurasians.	...	...	...	1	...	1	5	5	10	...	...	...	...	3·6	6·9	...	3·6	18·3	18·3	36·7	...	...	...			
5	Cuddapah	Europeans.	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	23·8	...	23·8	...	...	...	} 277	238	515
		Eurasians.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1			
6	Ganjam	Europeans.	...	...	...	...	1	1	1	...	1	...	...	7·7	...	...	...	76·9	7·7	7·7	...	7·7	1	...	1	} 98	88	186
		Eurasians.	1	...	1	2	1	3	1	3	4	9·0	...	...	...	...	21·6	7·7	13·5	4·5	13·5	18·0	...	...	...			
7	Godávari	Europeans.	1	1	2	1	2	3	3	3	6	...	...	4	...	...	5·1	35·7	12	12	12	24	...	...	...	} 220	222	442
		Eurasians.	3	6	9	8	7	15	6	5	11	...	...	9·7	2·4	2·4	38·4	34·3	36·4	14·5	12·1	26·7	...	...	...			
8	Kistna	Europeans.	1	1	2	1	3	4	1	4	5	19·2	...	19·2	...	...	28·5	176·4	76·9	19·2	76·9	96·1	...	...	...	} 346	353	699
		Eurasians.	1	1	2	2	3	5	4	5	9	...	...	27·4	13·6	...	46·5	100	68·5	54·8	68·5	123·3	...	...	...			
9	Kurnool	Europeans.	...	...	...	...	...	...	2	1	3	...	...	...	...	...	...	...	...	38·4	19·2	57·6	...	...	...	} 274	235	509
		Eurasians.	...	...	...	2	1	3	1	2	3	...	...	28·6	57·1	...	90·9	76·9	85·7	28·6	57·1	85·7	...	...	...			
10	Madras	Europeans.	45	20	65	60	29	89	44	61	105	1·5	...	3·1	1·8	0·9	29·9	24·1	27·7	13·7	19·0	32·7	2	2	4	} 268	204	472
		Eurasians.	111	92	203	167	152	319	206	208	414	1·3	0·02	4·4	3·0	0·3	27·3	23·2	25·2	16·2	16·4	32·6	8	4	12			
11	Madura	Europeans.	...	...	...	...	...	...	1	3	4	...	...	...	...	...	...	...	...	5·7	17·0	22·7	1	...	1	} 500	439	939
		Eurasians.	1	3	4	5	4	9	10	4	14	...	...	7·9	5·3	...	19·7	32·2	23·8	26·5	10·6	37·1	...	...	...			
12	Malabar	Europeans.	1	1	2	8	1	9	8	6	14	...	...	3·8	0·6	...	6·2	3·6	5·7	5·1	3·8	8·9	...	...	...	} 783	696	1,479
		Eurasians.	23	24	47	35	32	67	59	53	112	6·5	...	4·6	1·9	...	37·1	55·1	43·9	38·7	34·7	73·4	2	2	4			
13	Nellore	Europeans.	...	1	1	...	1	1	...	2	2	...	...	...	...	...	...	100	30·3	...	60·6	60·6	...	...	...	} 136	148	284
		Eurasians.	...	1	1	...	4	4	5	1	6	6·2	...	3·1	...	...	...	24·2	12·5	15·6	3·1	18·7	...	...	...			
14	Nilgiris	Europeans.	7	4	11	12	5	17	31	20	51	...	...	1·1	2·3	...	10·6	8·7	10·0	18·2	11·8	30·0	...	...	...	} 20	16	36
		Eurasians.	4	1	5	10	4	14	8	15	23	...	...	59·2	29·6	...	18·9	8·2	13·8	7·9	14·8	22·7	2	...	2			
15	North Arcot	Europeans.	...	...	...	1	...	1	...	5	5	8·7	...	...	...	...	13·9	...	8·7	...	43·5	43·5	...	...	...	} 583	483	1,066
		Eurasians.	2	2	4	3	5	8	3	1	4	4·4	...	2·2	2·2	...	13·5	22·4	17·9	6·7	2·2	8·9	...	1	1			
16	Salem	Europeans.	2	...	2	2	...	2	2	3	5	...	...	...	...	...	19·6	...	11·1	11·1	16·6	27·7	...	...	...	} 547	469	1,016
		Eurasians.	2	2	4	3	2	5	4	4	8	...	...	2·2	...	...	12·7	9·5	11·2	8·9	8·9	17·9	...	...	...			
17	South Arcot	Europeans.	2	...	2	2	1	3	1	...	1	...	...	...	11·9	...	28·9	66·6	35·7	11·9	...	11·9	...	...	...	} 557	473	1,080
		Eurasians.	1	1	2	2	3	5	4	10	14	2·6	...	5·3	...	...	10·7	15·8	13·3	10·6	26·6	37·3	...	...	...			
18	South Canara	Europeans.	4	...	4	4	...	4	6	3	9	...	...	...	...	...	50·6	...	33·3	50	25	75	...	...	...	} 648	546	1,194
		Eurasians.	1	...	1	1	...	1	3	1	4	...	...	...	...	...	14·5	...	7·9	23·6	7·9	31·5	...	...	...			
19	Tanjore	Europeans.	2	...	2	2	...	2	5	2	7	...	...	...	...	...	18·1	...	11·9	29·7	11·9	41·6	...	2	2	} 893	781	1,674
		Eurasians.	10	2	12	15	4	19	7	3	10	5·9	...	4·4	...	...	43·1	12·1	28·1	10·3	4·4	14·7	3	1	4			
20	Tinnevelly	Europeans.	2	1	3	2	2	4	2	1	3	...	...	...	8	...	28·1	37·0	32	16	8	24	...	...	...	} 517	472	989
		Eurasians.	1	3	4	2	3	5	4	9	13	...	...	...	1·7	...	6·5	11·6	8·8	7·1	15·9	23·0	...	...	...			
21	Trichinopoly	Europeans.	3	...	3	4	...	4	3	2	5	5·6	...	...	...	...	36·3	...	22·6	17·0	11·3	28·3	...	...	...	} 383	354	737
		Eurasians.	10	4	14	16	7	23	12	9	21	13·4	...	2·7	8·1	...	81·2	40·2	62·0	32·3	24·2	56·6	...	...	...			
22	Vizagapatam	Europeans.	3	2	5	6	4	10	5	4	9	...	...	24·5	6·1	...	53·5	78·4	61·3	20·6	24·5	55·2	...	...	...	} 132	98	230
		Eurasians.	7	6	13	10	8	18	8	8	16	2·5	...	5·0	5·0	...	50·7	40·6	45·6	20·3	20·3	40·6	...	1	1			
	Total	Europeans.	93	36	129	130	55	185	129	131	260	0·8	...	2·5	1·3	0·4	17·7	15·6	17·0	11·9	12·0	23·9	5	5	10	} 8,537	7,519	16,056
		Eurasians.	186	156	342	301	255	556	362	357	719	2·1	0·04	4·6	2·6	0·3	27·4	23·3	25·4	16·5	16·3	32·8	16	10	26			

NOTE.—Still-birth is excluded both under birth and death.

Return showing the Births and Deaths registered in the Municipalities of the Madras Presidency during the year 1888.

Districts.	Municipal towns.	Population, Census of 1881.	Births.							Deaths.											
			Class.				Total Births.			Class.				Total Deaths.			Causes of death.					
			Christians.	Hindus.	Muhammadans.	Other Classes.	M.	F.	Total.	Christians.	Hindus.	Muhammadans.	Other Classes.	M.	F.	Total.	Cholera.		Small-pox.		Fevers.	
																	M.	F.	M.	F.	M.	F.
Ganjam	Chicacole	18,302	1	427	11	...	232	207	439	1	406	26	...	238	195	433	16	15	...	4	81	68
	Berhampore	23,599	23	534	40	...	317	280	597	13	989	39	...	551	490	1,041	33	23	35	27	196	201
	Parlakimedi	15,365	...	272	3	...	159	116	275	...	318	2	...	186	134	320	1	...	57	49	107	74
Vizagapatam.	Vizagapatam	30,291	25	853	49	...	496	431	927	31	697	42	...	350	360	710	...	...	...	...	18	23
	Bimlipatam	8,582	10	271	5	...	140	146	286	6	105	11	...	114	98	212	...	...	...	...	18	23
	Vizianagrum	22,577	1	766	27	...	422	372	794	4	612	29	...	377	268	645	2	1	3	3	137	84
	Anakapalle	13,341	1	542	1	...	288	256	544	...	304	2	...	152	154	306	...	...	...	...	61	43
Godávari	Cocanada	30,441	18	866	34	...	480	438	918	21	557	31	...	332	277	609	2	1	5	4	36	24
	Rajahmundry	24,555	9	599	35	...	360	283	643	3	558	63	...	365	260	625	8	1	...	...	94	77
	Ellore	25,092	9	531	130	...	346	324	670	9	374	87	...	261	209	470	13	13	...	...	51	53
Kistna	Masulipatam	35,056	10	868	133	...	556	455	1,011	9	516	80	...	348	257	605	30	33	1	...	33	24
	Guntur	19,646	7	302	143	...	241	211	452	9	246	117	...	208	164	372	28	23	...	...	66	54
	Bezvada	9,336	4	252	53	...	161	148	309	9	240	50	...	171	137	308	11	12	...	...	19	24
Nellore	Nellore	27,505	24	596	136	...	420	336	756	19	545	113	...	341	336	677	66	55	7	7	79	66
	Ongole	9,200	31	293	32	...	185	171	356	15	157	20	...	107	85	192	11	5	...	...	18	28
Madras	Madras	405,848	1,318	12,631	2,031	...	8,280	7,700	15,980	1,166	11,852	2,145	...	7,535	7,628	15,163	264	279	14	22	1,606	1,766
Chingleput	Conjeeveram	37,275	...	1,208	29	...	658	579	1,237	...	1,314	45	...	654	705	1,359	148	174	14	7	133	108
South Arcot.	Cuddalore	43,545	17	798	19	...	421	413	834	13	818	33	...	453	411	864	80	78	26	17	64	70
	Chidambaram	19,837	8	448	25	...	238	238	476	...	542	27	...	287	282	569	65	66	...	...	67	72
Trichinopoly.	Trichinopoly	84,449	165	1,033	86	...	686	598	1,284	237	1,880	237	...	1,210	1,144	2,354	229	208	135	127	225	204
	Srirangam	19,773	3	616	3	...	321	301	622	5	749	3	...	386	365	751	45	32	42	44	40	33
Tanjore	Tanjore	54,745	85	1,087	63	...	661	574	1,235	82	1,318	103	...	777	726	1,503	175	189	35	30	108	94
	Kumbakonam	50,098	20	1,261	27	...	619	689	1,308	40	1,667	57	...	895	869	1,764	176	170	8	6	134	142
	Mayavaram	23,044	9	690	17	...	386	330	716	28	743	44	...	424	391	815	56	65	15	11	45	75
	Negapatam	53,776	141	648	244	...	533	500	1,033	186	978	397	...	736	825	1,561	155	161	35	37	100	123
	Mannargudi	19,409	5	400	6	...	275	226	501	5	423	19	...	200	247	447	36	46	8	2	22	28
Madura	Madura	76,847	99	2,505	232	...	1,418	1,418	2,836	64	1,979	228	...	1,074	1,197	2,271	55	28	34	67	226	238
	Periyakulam	16,446	46	514	69	...	302	257	629	20	327	33	...	185	195	380	1	1	1	5	53	45
	Dindigul	14,182	130	467	74	...	332	339	671	91	323	41	...	220	235	455	24	17	31	37	18	25
	Palni	13,315	15	330	24	...	176	193	369	2	285	19	...	103	143	306	5	...	5	2	28	21
Tinnevelly	Tinnevelly	23,221	4	462	22	...	242	246	488	2	637	42	...	328	353	681	121	110	4	4	17	16
	Palamcottah	17,964	60	460	20	...	288	252	540	73	504	27	...	334	270	604	96	83	...	1	17	6
	Tuticorin	16,281	235	324	37	...	275	321	596	158	342	21	...	286	235	521	7	4	...	4	77	58
Kurnool	Kurnool	20,329	9	357	310	...	324	352	676	6	362	404	...	396	376	772	15	12	69	60	177	148
Cuddapah	Cuddapah	18,982	2	179	192	...	207	166	373	8	345	249	...	336	266	602	55	38	7	8	81	79
Bellary	Bellary	53,460	31	1,000	444	...	753	722	1,475	82	1,317	766	...	1,053	1,112	2,165	67	46	28	28	274	300
	Adoni	22,441	2	439	235	...	352	344	676	1	443	284	...	349	379	728	114	121	26	26	83	82
Anantapur	Anantapur	4,907	...	130	56	...	96	90	186	1	125	34	...	76	84	160	31	35	...	...	6	5
North Arcot.	Vellore	40,958	41	1,126	278	...	738	707	1,445	46	842	258	...	584	562	1,146	85	87	35	32	131	141
	Gudiyatam	16,690	2	434	74	...	268	242	510	1	625	217	...	395	448	843	240	267	16	9	32	44
	Walajapet	10,387	2	347	34	...	201	182	383	...	289	46	...	189	147	336	20	8	1	2	34	22
	Tirupati	13,232	4	115	8	...	75	52	127	3	221	5	...	133	96	229	47	27	...	...	52	27
Salem	Salem	59,631	41	1,740	138	...	1,033	895	1,928	21	1,706	211	...	1,016	922	1,938	273	215	137	173	169	179
	Vaniyambadi	15,933	...	217	353	...	297	273	570	...	116	169	...	166	119	285	11	12	1	1	69	62
	Tirupatur	14,278	6	311	164	...	255	222	480	4	212	139	...	170	185	355	6	4	...	1	56	61
Coimbatore.	Coimbatore	38,967	60	1,415	70	...	789	756	1,545	38	940	41	...	860	468	1,028	27	23	9	2	117	81
	Erode	9,864	31	401	65	...	245	252	497	11	266	41	...	151	167	318	30	32	1	3	17	22
	Karur	9,205	8	354	28	...	209	181	390	1	244	28	...	145	128	273	23	25	4	6	82	25
Nilgiris	Ootacamund	12,335	107	175	19	...	211	180	391	94	121	27	...	142	106	248	...	...	...	1	52	37
	Coonoor	4,778	28	67	15	...	62	48	110	40	83	13	...	69	67	136	...	...	1	1	26	21
South Canara.	Mangalore	32,099	316	682	197	...	619	576	1,195	268	789	244	...	664	647	1,311	35	35	145	161	58	71
Malabar	Tellicherry	24,581	59	346	325	...	359	371	730	122	313	382	...	378	439	817	126	177	24	43	42	46
	Calicut	57,085	149	1,065	993	...	1,133	1,074	2,207	139	993	1,521	...	1,229	1,334	2,563	388	530	66	48	91	77
	Palghat	36,339	27	986	189	...	606	596	1,202	16	763	163	...	448	485	933	26	11	4	5	128	110
	Cochin	15,698	371	145	104	...	326	284	610	276	121	109	...	262	244	506	21	24	...	...	34	29
	Cannanore	26,386	101	220	234	...	291	273	564	90	249	505	...	433	471	904	193	201	22	24	32	30
	Total	1,861,508	4,014	46,213	8,385	...	30,336	28,276	58,612 (a)	3,589	44,743	10,150	...	29,582	28,900	58,482 (b)	3,792	3,963	1115	1153	5,867	5,772
		...	32·7	31·3	32·1	...	...	...	31·5	29·3	30·2	38·9	...	...	...	31·4	...	...	...	...	...	...

(a) Inclusive of 217 Europeans and 702 Eurasians but exclusive of 2,175 still-births.
(b) Do. 152 do. 553 do. do. of 2,175 born dead.

Return showing the Births and Deaths registered in the Municipalities of the Madras Presidency during the year 1888—continued.

Districts.	Municipal towns.	Population, Census of 1881.	Deaths—*continued.*												Still-birth or born dead.		Ratio per 1,000 of population.					Ratio per mille per annum.		Average ratio of previous five years ending 1887.	
			Causes of death—*continued.*																						
			Bowel-complaints.		Injuries.								All other causes.												
					Suicides		Wounds or accidents.		Snake-bite.		Killed by wild beasts.						Cholera.	Small-pox.	Fevers.	Bowel-complaints.	Injuries.	Total Births.	Total Deaths.	Births.	Deaths.
			M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.									
Ganjam	Chicacole	18,302	24	8	...	1	...	1	...	1	...	...	117	97	8	5	1·6	0·2	8·1	1·7	0·1	23·9	23·6	25·7	22·5
	Berhampore	23,599	83	80	...	...	1	2	...	...	...	...	201	157	5	1	2·3	2·6	16·9	6·9	0·1	25·2	44·1	36·6	38·0
	Parlakimedi	15,365	1	2	...	...	2	...	1	...	...	...	17	9	6	2	0·06	6·9	11·8	0·2	0·2	17·8	20·8	...	...
Vizagapatam.	Vizagapatam	30,291	53	46	2	1	1	1	1	...	...	...	183	178	1	1	...	0·2	7·8	3·2	0·2	30·6	23·4	30·5	29·7
	Bimlipatam	8,582	20	25	1	...	1	...	...	...	...	...	74	51	12	8	...	...	4·6	5·2	0·2	33·3	24·7	32·1	27·6
	Vizianagrum	22,577	61	33	...	...	2	1	1	...	...	...	171	146	...	...	0·1	0·3	9·3	4·1	0·2	35·1	28·5	32·1	27·0
	Anakapalle	13,341	2	9	1	...	1	1	2	...	...	...	85	101	...	...	...	...	7·7	0·8	0·3	40·7	22·9	33·6	24·3
Godávari	Cocanada	30,441	59	42	2	...	5	2	...	...	...	...	223	204	7	7	0·09	0·3	1·9	3·3	0·2	30·1	20·0	30·1	25·7
	Rajahmundry	24,555	47	43	1	3	8	6	...	1	1	...	196	138	10	11	0·3	...	6·9	3·6	0·8	26·1	25·4	28·4	30·9
	Ellore	25,092	36	21	...	1	2	...	...	1	...	...	168	122	4	3	1·0	...	4·1	2·2	0·1	28·7	18·7	27·0	30·1
Kistna	Masulipatam	35,056	4	1	...	...	...	...	...	...	...	...	280	199	...	...	1·7	0·03	1·6	0·1	...	28·8	17·2	24·5	15·1
	Guntur	19,646	...	7	...	1	4	3	...	...	...	...	110	77	32	28	2·5	...	6·1	0·3	0·3	23·0	18·9	25·4	23·6
	Bezvada	9,336	27	23	...	1	7	2	1	1	...	...	106	74	...	...	2·5	...	4·4	5·3	1·3	33·0	32·9	...	...
Nellore	Nellore	27,505	6	4	1	1	7	5	1	...	...	...	174	196	...	...	4·3	0·5	5·3	0·3	0·5	27·4	24·6	25·3	23·0
	Ongole	9,200	17	6	...	...	...	2	...	...	...	...	61	44	9	5	1·7	...	5·0	2·5	0·2	38·6	20·8	41·9	30·0
Madras	Madras	405,848	1,218	1,350	1	...	73	47	2	...	...	...	4,357	4,164	278	210	1·3	0·08	8·3	6·3	0·3	39·4	37·4	40·0	40·3
Chingleput	Conjeeveram	37,275	84	77	...	2	3	2	1	...	...	...	271	335	59	48	8·6	0·5	6·4	4·3	0·2	33·1	36·4	40·2	34·9
South Arcot.	Cuddalore	43,545	80	62	...	1	5	2	3	2	...	...	195	179	4	1	3·6	1·0	3·0	3·2	0·3	19·1	19·8	28·2	16·8
	Chidambaram	19,837	31	29	...	...	2	1	1	1	...	...	121	113	10	11	6·6	...	7·0	3·0	0·3	23·9	28·7	20·4	22·9
Trichinopoly	Trichinopoly	84,449	163	151	1	2	11	9	...	...	...	...	446	443	26	21	5·1	3·1	5·1	3·7	0·2	15·2	27·8	20·7	26·1
	Srirangam	19,773	31	28	1	3	1	1	1	...	...	...	225	224	26	15	3·9	4·3	3·6	2·0	0·3	31·4	37·9	32·6	35·0
Tanjore	Tanjore	54,745	161	137	...	...	2	6	1	1	1	...	294	269	18	10	6·6	1·2	3·6	5·4	0·2	22·5	27·4	25·0	25·5
	Kumbakonam	50,098	105	80	...	1	4	4	...	...	...	...	468	465	56	44	6·9	0·2	5·5	3·6	0·1	26·1	35·2	28·4	33·8
	Mayavaram	23,044	45	38	...	...	3	2	1	1	...	...	259	199	14	19	5·2	1·1	5·2	3·6	0·3	31·0	35·3	28·5	31·6
	Negapatam	53,776	141	165	...	...	2	4	...	...	...	...	303	335	29	44	5·8	1·3	4·1	5·6	0·1	19·2	20·0	20·2	29·0
	Mannargudi	19,409	34	66	...	...	7	6	2	1	...	...	91	104	15	15	4·2	0·5	2·2	5·1	0·8	25·8	23·0	31·1	28·2
Madura	Madura	76,847	194	206	...	3	19	17	...	2	...	...	546	641	131	118	1·1	1·3	5·0	5·2	0·5	36·9	29·6	35·0	33·0
	Periyakulam	16,446	33	32	...	...	2	1	...	1	...	...	95	110	14	11	0·1	0·4	6·0	3·9	0·2	38·2	23·1	...	...
	Dindigul	14,182	17	12	...	...	4	9	1	...	...	...	125	135	11	16	2·9	4·8	3·0	2·0	1·0	47·3	32·0	42·7	25·0
	Palni	13,315	10	5	...	...	3	4	...	...	...	...	112	111	4	1	0·4	0·5	3·7	1·1	0·5	27·7	23·0	...	...
Tinnevelly	Tinnevelly	23,221	68	80	...	...	2	1	...	...	...	...	116	140	6	5	9·9	0·3	1·5	6·4	0·1	21·0	29·3	29·1	29·9
	Palamcottah	17,964	37	16	1	2	3	3	...	...	...	...	180	159	5	9	10·0	0·06	1·3	2·9	0·5	30·0	33·6	30·5	28·3
	Tuticorin	16,281	78	76	...	...	1	...	...	...	...	...	123	93	1	2	0·7	0·2	5·3	9·4	0·06	36·6	32·0	35·0	36·2
Kurnool	Kurnool	20,329	15	14	1	1	3	4	...	1	...	...	116	136	10	9	1·3	6·3	16·0	1·4	0·5	33·2	37·9	35·7	31·0
Cuddapah	Cuddapah	18,982	23	12	...	...	5	2	...	...	...	...	165	127	6	7	5·0	0·8	8·4	1·8	0·4	19·6	31·7	24·0	32·6
Bellary	Bellary	53,460	30	32	1	2	9	4	1	...	...	...	643	700	3	4	2·1	1·0	10·7	1·2	0·3	27·5	40·4	25·8	24·6
	Adoni	22,441	1	1	...	1	3	4	1	...	...	...	121	144	6	6	10·4	2·3	7·4	0·1	0·4	30·1	32·4	37·5	22·1
Anantapur	Anantapur	4,907	3	...	...	...	2	...	1	...	...	...	34	43	....	2	13·4	...	2·2	0·6	0·6	37·9	32·6	28·9	30·0
North Arcot.	Vellore	40,958	51	47	...	1	5	3	...	...	...	...	277	251	31	28	4·21	1·6	6·6	2·4	0·2	35·2	27·9	32·0	22·7
	Gudiyatam	16,690	7	9	...	...	1	...	1	...	...	...	98	119	12	2	30·3	1·5	4·5	0·9	0·1	30·5	50·5	...	...
	Walajapet	10,387	2	3	...	...	1	1	...	...	...	...	131	111	10	10	2·7	0·2	5·4	0·4	0·1	36·8	32·4	37·9	28·4
	Tirupati	13,232	12	3	1	3	1	...	...	...	...	...	20	36	2	...	5·5	...	5·9	1·1	0·4	9·3	17·3	...	...
Salem	Salem	59,631	59	59	2	1	6	4	...	2	...	...	370	289	18	20	8·2	5·2	5·8	1·9	0·3	32·2	32·5	28·8	20·3
	Vaniyambadi	15,933	8	3	1	...	2	1	...	...	...	...	74	40	6	2	1·4	0·1	8·2	0·7	0·2	35·7	17·9	...	...
	Tirupatur	14,278	30	44	1	...	3	3	...	...	...	...	74	72	1	1	0·7	0·07	8·2	5·2	0·5	33·6	24·8	...	...
Coimbatore	Coimbatore	38,967	62	61	2	5	7	8	1	...	...	...	335	288	14	9	1·3	0·3	5·1	3·1	0·5	39·6	28·3	40·1	30·3
	Erode	9,864	10	22	...	...	3	2	...	...	...	...	90	56	...	...	6·3	0·4	3·9	3·2	0·5	50·3	32·2	32·5	21·3
	Karur	9,205	18	15	...	...	4	...	1	...	...	...	74	58	14	15	5·2	1·1	5·1	3·3	0·5	42·3	29·7	46·5	35·3
Nilgiris	Ootacamund	12,335	25	9	...	2	...	1	1	...	...	...	64	50	8	1	...	0·08	7·2	2·7	0·4	31·6	19·6	30·0	27·3
	Coonoor	4,778	11	13	...	...	1	3	...	...	...	...	30	29	2	2	...	0·4	9·8	5·0	0·8	23·0	28·4	14·7	19·7
South Canara	Mangalore	32,099	88	82	1	2	6	10	...	...	...	...	331	286	34	28	2·1	9·5	4·0	5·3	0·6	37·1	40·8	33·3	26·8
Malabar	Tellicherry	24,581	19	10	1	...	6	2	...	1	...	...	159	168	26	34	12·3	2·6	3·3	1·2	0·4	29·7	33·2	31·2	22·9
	Calicut	57,085	161	150	4	2	10	4	1	1	...	...	508	472	88	85	16·9	2·0	2·9	5·4	0·4	38·6	44·8	38·2	32·9
	Palghat	36,339	35	30	...	2	5	5	3	2	1	...	246	320	42	45	1·0	0·2	6·5	1·7	0·5	33·0	25·6	36·9	33·0
	Cochin	15,698	29	28	...	...	4	...	...	...	...	...	174	165	17	14	2·8	...	4·0	3·5	0·2	39·4	32·2	40·7	42·6
	Cannanore	26,386	9	2	...	...	3	1	...	...	...	...	174	133	18	11	1·8	1·7	1·9	0·4	0·1	21·3	34·2	41·2	27·8
	Total	1,861,508	3,678	3,605	27	45	278	206	29	21	5	...	14,791	14,135	1,169	1,006	4·1	1·2	6·3	3·9	0·3	31·5	31·4	32·5	30·5

GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following papers :—

From SURGEON-MAJOR J. A. LAING, Sanitary Commissioner, Madras, to the Chief Secretary to Government, Public Department, dated Ootacamund, 21st June 1889, No. O-15.

I have the honour to forward for submission to Government two stitched copies of the Sanitary Report for 1888.

2. The table of contents, cholera map and the usual diagrams will be inserted in the bound copies.

3. Two copies have been forwarded direct to the Government of India and two to the Sanitary Commissioner with that Government.

4. I regret I was unable to comply with the Orders of the Government of India in submitting the report on 1st June although every effort on my part was made to do so, but I had to wait for materials from out-stations and some of the returns and reports did not reach my office till May. I append a list of those that were received after 15th March 1889.

List of returns and reports for 1888 received in the Sanitary Commissioner's Office after 15th March 1889.

District.	Local Fund Sanitary Reports. Date of Receipt.	Sanitary Estimate of Villages. Date of Receipt.	Statement showing the No. of Villages in which deaths from Cholera, &c., occurred. Date of Receipt.	Municipalities.	Municipal Sanitary Reports. Date of Receipt.
Anantapur ...	18 5 89	...	10 5 89	Cocanada ...	18 4 89
Cuddapah ...	17 5 89	...	4 5 89	Kurnool ...	29 4 89
Kurnool ...	18 4 89	...	6 5 89	Dindigul ...	10 5 89
Nellore ...	6 6 89	8 5 89	19 5 89	Calicut ...	20 3 89
Nilgiris ...	17 5 89	15 5 89	6 3 89	Ongole ...	3 5 89
South Arcot ...	...	13 5 89	8 5 89	Gudiyatam ...	2 4 89
Vizagapatam ...	4 4 89	11 4 89	...	Kumbakonum ...	17 5 89
Tanjore ...	3 4 89	...	...	Mayaveram ...	6 4 89
Madura ...	...	...	8 5 89	Tanjore ...	28 3 89
Bellary ...	...	...	4 5 89	Srirangam ...	8 4 89
North Arcot ...	...	...	8 5 89	Anakapalle ...	1 4 89
Coimbatore ...	...	...	4 5 89	Vizagapatam ...	9 4 89
South Canara ...	...	...	7 5 89		
Tinnevelly ...	...	...	6 5 89		

ORDER.—9th August 1889, No. 670, Public.

With the letter read above the Sanitary Commissioner submits his report for 1888, which the Government now proceeds to review. The report would have

been before Government at an earlier date had it not been for delay on the part of some Presidents of Local Boards and Chairmen of Municipalities. The Sanitary Report of the Nellore Local Board was not received until the 6th June. There is no valid reason why Sanitary reports should not be sent in to the Commissioner by the due date; the Officers concerned must distinctly understand that Government insists upon this being done and will next year duly notice the conduct of those who neglect warning now given.

2. *Rainfall and prices of food grains.*—In the year under report the mean quantity of rain registered was 43·92 inches which is less than that of any year since *1882. The decrease, which occurred in every District except Malabar and Tinnevelly, was specially marked in the northern portion of the Presidency, and was most conspicuous in Ganjam, where the rainfall was only 27·09 inches, against 46·56 inches in 1887, 65·51 in 1886 and 45·31 the average of the 10 years previous.

*1887	51·04
1886	47·70
1885	45·08
1884	47·08
1883	47·42

The table below shows that, taking the Presidency as a whole, the prices of food grains remained nearly the same as in the preceding year.

	No. of seers sold for a rupee.	
	1888.	1887.
Rice	15·3	15·5
Ragi	29·4	29·9
Cholum	27·5	28·0

In Ganjam, however, in consequence of a bad season, prices particularly of rice and ragi rose considerably.

	Ganjam. No. of seers sold for a rupee.		
	1888.	1887.	Average of 10 years previous to 1886.
Rice ...	16·4	18·5	18·3
Ragi	26·3	32·1	27·9
Cholum	26·6	27·9	26·8

3. *Vital statistics.*—The Government regrets to notice that the total population for which returns of births and deaths was received again shows a decrease as compared with the previous year. The retrogression occurs in Vizagapatam where the population for which statistics are furnished has gone down from 1,424,400 to 1,232,074, thus neutralising increases in Ganjam and Nellore. The Collector will report what action he has taken in pursuance of G. O. 4th March 1889, No. 215.

4. *Births.*—The mean birth-rate of the year is reported to have been 29·9 per mille of the population against 30·4 per mille in 1887 and 25·5 per mille the average for the 10 years previous. It is observed, however, that in the report for 1887 the birth-rate for that year is given as 31·0 per mille, and that the figures of the preceding years differ from those given in para. 8 of the present report. The district birth rates for 1887 given in para. 6 of the report for that year also differ from those given in para. 6 of the present report. These discrepancies should be explained.

As the normal birth-rate of the Presidency may be assumed to be at least 40 per mille, the Government cannot look on the registration work of the year, showing as it does a decline instead of an advance, as at all satisfactory. There can be but little doubt that the manifestly incorrect figures which appear in several districts are the result of want of interest in, and lack of attention to, the subject of vital statistics on the part of Collectors and their subordinates. These officers are reminded that it forms a portion of their duties to exercise, as regards this work, that constant supervision without which it is hopeless to look for anything like accurate results, and that the Government expects them to do this. Taking each district as a whole, those shewing the highest registered birth-rate were Salem, (40·3 per mille), Anantapur and Bellary (40·0), Madras (39·6), and Chingleput (39·2) while in the Nilgiris the rate was as low as 19·1 per mille, and in Ganjam (20·9) Godavari (21·0) and Vizagapatam (21·5) it was very little better. With the exception of Ganjam, however, all the last mentioned districts show some little improvement as compared with 1887. The steady deterioration of registration in Ganjam noticed in para. 7 of the report requires explanation from the Collector.

	Registered birth-rate in 1887, as given in the present report.
Nilgiris	18·3
Ganjam	21·2
Godavari	20·2
Vizagapatam.	20·5

Although registration is compulsory under Madras Act IV of 1884, the average registered birth-rate for the 55 district Municipalities was only 30·1 per mille. In many towns the provisions of the Act were obviously allowed to remain a dead letter, the worst instances being Tirupati, where only 9·6 births per 1000 were registered, Trichinopoly (14·9), Parlakimedi (17·9), and Cuddalore (18·9). The neglect of registration in these and other towns will be duly noticed in reviewing their administration reports for the year 1888-89. Birth registration was most complete in the towns of Erode, Dindigul, Karur, and Anakapalle, where the number registered ranged from 50·2 to 40·3 per 1,000, showing that registration was in these Municipalities a reality and not a farce.

5. *Deaths.*—The following statement shows the total number of deaths per mille under the principal diseases, as compared with the three preceding years:—

	1885.	1886.	1887.	1888.
Cholera	2·0	·4	1·0	2·1
Small-pox	1·2	·6	·7	·8
Fever	7·7	·9	8·6	7·3
Bowel-complaint	1·1	7·9	·9	1·0
Injuries...	·4	·4	·6	·4
Other causes	9·4	9·5	9·8	9·8
	21·8	19·7	21·6	21·4

The main features of 1888 were a large increase of deaths from cholera and a decrease under fever. As in the previous year the mortality in Madras Town* was far larger than in any other district of the Presidency. In reviewing the administration report of the Municipality for 1887-88 the serious attention of the Municipal Commission has been called to this subject and a special enquiry by the Sanitary Commissioner into the conditions of the divisions where the mortality is highest, has been ordered.

*1887	39·4 per 1000
1888	37·8 per 1000

Among the mofussil districts the mortality ranged from 31·1 per mille in Kurnool to 12·5 per mille in Vizagapatam. Registration in this latter District is evidently greatly neglected and the Collector will give his serious attention to the

matter. Registration in Godavari (15·2 per 1000), Nilgiris (16·3), Nellore (16·8), Ganjam (17·9), is also susceptible of much improvement.

In the mofussil Municipalities the registration of deaths was on the whole much more complete than that of births. The highest death-rate registered (50·5 per 1,000) was in Gudiyatam where cholera carried off no less than 30·3 per 1,000 of the population. Calicut which shows the next highest death-rate also suffered severely from this disease. The mortality in Berhampore, (43·6 per 1,000) is still very high, and is still largely due to fever. The special report on this town called for from the Collector in G. O., 7th January 1889, No. 9 has been received and is under consideration in the Local and Municipal Department. As remarked by the Commissioner the low death-rates recorded in Vaniyambadi, Masulipatam, and Tirupati are certainly due to defective registration. The last mentioned town holds the same position in regard to the registration of deaths as it does in regard to that of births.

6. *Principal Diseases.—Cholera.*—This disease appears unhappily to have again entered on a cycle of increasing intensity, the number of deaths in 1888 having been 58,677, against 28,359 in 1887 and 12,417 in 1886. The mortality was highest in January and February, and the next largest number of deaths was recorded in December. The districts which suffered most in proportion to population were Tanjore (9,120 deaths), Tinnevelly (7,281), Trichinopoly (4,430), North Arcot (4,970), Malabar (6,143), and Chingleput (2,561); those least affected were Vizagapatam, Madura, and Kurnool. The only district in which there were no deaths from cholera was Nilgiris.

Among Municipalities the town most severely visited was Gudiyatam where, as has been above remarked, no less than 30·3 per mille of the population fell victims to the disease. Other towns in which the cholera mortality exceeded 10 per mille of the population were Anantapur, Adoni, Tellicherry, Calicut, Cannanore, and Palamcotta.

The Government is glad to note that the measures resorted to by the local authorities to prevent the spread of this disease are considered by the Sanitary Commissioner to have been generally satisfactory.

7. *Small-pox.*—The deaths from this cause show an increase as compared with 1886 and 1887, but were considerably below the average of the 5 years preceding. The districts most affected were Kurnool (death-rate 2·4 per 1000) and Ganjam (2·2); the lowest death-rate recorded (0·02 per 1000) was in Godavari. It is curious to note that the three district Municipalities which suffered most from this disease (Mangalore, Parlakimedi, and Kurnool) were towns in which the number of vaccine operations was very large, but the reason for this probably is that vaccination was not largely carried on until small-pox had broken out and carried off many persons. The beneficial effects resulting from vaccination are clearly demonstrated by the table in para. 39 of the report showing the small-pox mortality in the Town of Madras for a series of years (*a*) prior and (*b*) subsequent to the institution of compulsory vaccination in the Municipality. The figures there given afford the strongest of arguments in favour of local bodies making strenuous and sustained efforts for the spread, and efficient performance, of vaccination.

	Death-rate per mille from Small-pox.
In 1888	0·8
„ 1887	0·7
„ 1886	0·6
Average for the 5 years ending with 1885	1·1

8. *Fevers.*—It is satisfactory to note that the mortality from this cause was less than in any year since 1883. Kurnool, Cuddapah, Nilgiris, Ganjam and Vizagapatam were the districts most affected in proportion to population, while

Tinnevelly and Tanjore suffered least. Among Municipalities the highest mortality occurred as in 1887 in Berhampore, but whereas in that year the deaths from this cause amounted to 43·2 per mille, in 1888 they were only 16·8 per mille. Next to Berhampore in the order of mortality come Kurnool, Parlakimedi, and Bellary, while the towns least affected were Palamcottah, Tinnevelly, Masulipatam and Cocanada.

9. *Bowel-complaints.*—The mortality from bowel-complaints (1·0 per 1000) was slightly in excess of the average for the 5 years previous (0·9 per 1000). It is remarkable how much higher the alleged death-rate from this cause is in Municipalities than elsewhere. Thus while the average death-rate under this head for the 21 Local Fund Circles and the Madras Town taken together was 0·8 per 1,000, in the 55 district Municipalities it was 3·2 per 1000, and in Madras Town alone 6·5 per 1,000. It is probable that this arises from the more exact medical knowledge available in the Municipal towns, and that in rural tracts many deaths really due to this cause are entered under the head of "other causes." The towns which showed the highest mortality were Tuticorin (9·4 per 1,000), Berhampore (6·8), Madras (6·5) and Tinnevelly (6·4)

10. *Injuries.*—The deaths from injuries were almost the same in number as in the previous year.* Suicides increased from 1,784 to 2,483, while deaths from wounds and accidents fell from 7,369 to 6,587. The number of deaths from snakes and wild beasts has been remarkably constant during the last 10 years, as will be seen from the figures given below :—

* 1887 11,328
1888 11,401

Year.	No. of deaths.	Year.	No. of deaths.
1879	2,369	1884	2,290
1880	2,373	1885	2,370
1881	2,392	1886	2,418
1882	2,302	1887	2,205
1883	2,318	1888	2,331

11. *"Other causes,"* not specified, continue to account for over two-fifths of the total number of deaths registered. The mortality under this head was 9·8 per mille as in the previous year.

12. *Sanitation in Municipalities and Local Fund Circles.*—The matters touched on by the Sanitary Commissioner under these heads will be fully dealt with in the general Municipal and Local Fund reviews for 1888-89, as well as in reviewing the individual administration reports of the Municipalities and Local Boards, where the figures for the whole official year will be available. For the present it will be sufficient to record the following remarks :—

(1) The inadequate expenditure in proportion to allotments by the Cuddapah and Vellore Municipalities referred to by the Commissioner in para. 61 of his report is due to the fact that large provision was made for special water-supply and drainage schemes in these towns, and that the carrying out of the water-supply scheme in Cuddapah was delayed by alterations in the plan and that of the drainage project in Vellore by the circumstance that an expert had to be obtained from Calcutta to draw up a scheme, the services of a Public Works officer not being available.

(2) The fact that the carrying out of special works has often to be delayed either through alterations in the original scheme or for want of a competent officer to prepare a plan, accounts for a great deal of the apparent failure of Municipalities to utilize allotments under "improvement of water-supply," "construction and repair of markets and slaughter-houses," and "other sanitary objects." Taking those heads of expenditure given in para. 64 of the report for which

special plans and estimates are as a rule not required, it will be found that the proportion of outlay to allotments by Municipalities during the first nine months of 1888-89 has been very creditable. The whole year's allotment for the improvement for town sites was more than spent during this period; the entire allotment for sanitary arrangements at fairs and festivals was all but worked up to; and the expenditure on conservancy in these nine months amounted to 73·6 per cent. of the year's allotments.

(3) The expenditure of allotments by Local Boards was by no means so satisfactory. The total outlay on sanitation during the first nine months of 1888-89 was only 53·9 per cent. of the year's allotments, against 56·1 per cent. in the corresponding period of 1887-88, Of the amount available for expenditure on conservancy only two-thirds was utilised during these months, and of the allotments for improvement of village sites little more than one-third, figures which forebode large lapses at the close of the year.

(4) The disgraceful sanitary condition of Tirupati has recently attracted the special notice of Government (G. O. 22nd May 1889, No. 644 M) and the Council have been warned that if they fail to erect public latrines without delay, the Divisional Officer will take action under Section 36 of the District Municipalities Act. The sanitation of Coonoor is, it is believed, being considerably improved under the present Chairman.

(5) In regard to the remarks of the Sanitary Commissioner on the marked apathy and indifference to sanitation exhibited by the Local Boards of Nellore, it is observed that in para. 13 of G. O. 16th January 1889, No. 91 L, the District and Taluk Board Presidents were warned that if the sanitary allotments for the current year should prove to have been left unutilised as they were in 1887-88, they would be held personally responsible. The Government will therefore defer orders until the figures for the whole year are available.

(6) The private scavenging system cannot be said to have made much progress in Municipalities during 1888, since the number of private dwellings so served, was only 16,071 against 15,668 in 1887, and it is observed with regret that in 10 Municipalities the number of private privies under Municipal management showed a decrease. The advance made in this direction in Calicut and Conjeeveram is noted with satisfaction.

13. *General remarks.*—The Sanitary Commissioner and his Deputy visited 43 Mofussil Municipalities against 40 in 1887. In future every Municipal town should be visited by one or other of these officers during each calendar year. Information should also be given in future reports as to the length of time spent in travelling by the Commissioner and Deputy Commissioner respectively. The appointment of a special Sanitary Engineer for the Presidency which has been proposed by this Government and approved by the Government of India, will, if sanctioned by the Secretary of State, remove the difficulty in procuring competent agency for designing Sanitary Works referred to in para. 71 of the report. The Government is glad to notice that the Sanitary inspection work of District Medical Officers shows considerable amendment as compared with 1887.* There is however still much room for improvement, more especially in Nilgiris, Malabar, Trichinopoly, Vizagapatam and Ganjam where the number of villages visited was altogether inadequate. It is

	No. of villages visited by Medical Officers.
*In 1886	... 357
1887	... 127
1888	... 412

presumed that the entry over column 3 of the statement attatched to para. 78 of the report refers to nonreceipt of inspection reports by the Sanitary Commissioner. District Medical Officers should invariably furnish the President of the District Board (or the Collector in the case of Municipalities) with their remarks on all towns and villages visited by them.

14. The receipt of the cholera map and other information referred to in para. 2 of the Commissioner's covering letter is awaited.

(True Extract.)

J. F. PRICE,
Chief Secretary.

To

The Sanitary Commissioner, Madras.
" Surgeon-General with the Government of Madras.
" Local and Municipal Department.
" Military Department.
" Revenue Department.
" Board of Revenue.
" Inspector-General of Police.
" Inspector-General of Jails.
All Collectors.
The Accountant-General.

Endorsement, dated 9th August 1889, No. 671, Public.

Copy to the Government of India, Home Department.

J. F. PRICE,
Chief Secretary.