Vol. XV January—March. 1940 No. 1

The Journal of The Madras Geographical Association

PUBLISHED QUARTERLY.

EDITOR

N. Subrahmanyam. M.A., L.T., F.R.G.S.

THE MADRAS GEOGRAPHICAL ASSOCIATION,

Gopalapuram, Cathedral P.O., Madras.

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THE JOURNAL OF THE MADRAS GEOGRAPHICAL ASSOCIATION

VOL÷XV NO÷1

JAN. MARCH÷1940

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The Place of Geography in National Planning*

BY

Shibaprasad Chatterjee, M.Sc., T.D., Ph.D., D.Litt., F.G.S.

At the outset I must say how happy I am to preside over the Geography section of the Indian Science Congress, which is holding its twenty-seventh session at Madras, the city which can well claim to be the cradle of the still young school of geography in India. Considering the fact that the aid of geography is often sought in other lands in planning any scheme that affects the whole nation, I decided to address you to-day on 'the place of geography in national planning,' taking my examples from India, and more particularly from Bengal, my home province.

In times like this, when the political map of Europe is again being re-drawn, the importance of the study of geography needs no emphasis. We have got to know the geography of distant lands. It was not until the last world war broke out that the importance of geography could be seen clearly abroad. In the post-war period the science of geography developed considerably, most of the Universities of Europe and America providing facilities for the study of the subject. Let us hope that this time our educational authorities will not fail to give proper attention to the subject, which is long overdue.

* Summary of the Presidential Address of the Geography and Geodesy Section of the 27th Session of the Indian Science Congress, Madras—January, 1940.

It is true that geography takes aid of other branches of knowledge, like geology, meteorology and economics with a view to explaining the causes of certain geographical phenomena, e.g., types of topography or climate or economic activities, but the effects of these on man are never lost sight of. Therein lies its claim to be regarded as indispensable in any scheme of national planning. Prof. Patrick Abercrombie rightly observed that 'geography gives the planner aids in three different directions: Natural conditions, Historical growth, Survey of existing state.'.

In any scheme of planning, the physiography of the country is to be known first, then its soil conditions and vegetation coverings. The geographer is competent to furnish ready information on these points. Then, the planner, if he is to plan for building new cities or for developing industry, must take into account the different stages in the historic growth of existing cities or industries. Geography would also help him in this respect. And finally, if all the information regarding the existing conditions be not readily available, a geographical survey of these needs be conducted.

No country in the world needs this kind of survey more than India. Take, for instance, Bengal, where lands are deteriorating, soils fast losing their powers of productivity, rivers failing to fulfil their task of land-building, marshes and lakes increasing in area at the cost of good arable lands, and a large number of population subsisting on a semi-starved diet in a pitiable environment. Other provinces are no better, though their problems may be slightly different. For a proper solution of these I maintain that a stock-taking on a provincial basis is needed in the first instance, that is to say, a geographical survey is to be conducted with a view to studying the economical and agricultural possibilities of the provinces, and furnishing materials on which an edifice of future prosperous India could be built up .

Such a survey, if conducted in India, will have to take into account the major problems affecting one-fifth of the population of the world. A study of the *Oikoumenes* of the world will tell us that out of 209 crores of human beings (1935) more than one-half live in Asia. Of these, India has a population of 37 crores, and China, 45 crores. Africa is about seven times as large as India, but does not have more than two-fifths of the population of India. The New World has about the same size as Asia, but the population is less than that of India. Australasia is twice as large as India but its population amounts to one crore only.

India does not possess any colony, and hence the vast population has to depend entirely on the resources of the country. Unfortunately, the factory industry has not yet been fully developed with the result that the burden of feeding the millions has fallen on the land. The area of British India is about one and a half times greater than that of Indian India. The net area sown in proportion to the total area is far greater in Indian India than in British India, and consequently the area of culturable waste is less in the former than that in the latter. This is all the more striking as we know that the natural conditions, such as, rainfall, temperature, soil, relief—are definitely unfavourable from agricultural point of view in most of the States. None of the important Indian States excepting Travancore receives annual rainfall over 50 inches, and several States, between 20 and 30 inches, leaving aside the question of the Rajputana and Punjab States to the west of the Aravallis where the landscape is dominated by the great Indian desert, the Thar. Most of the important States have a continental type of climate with extremes of temperature, and some have no pronounced winter season. Our information on soil conditions is meagre, but from what we know about the geology of India we find that the residual type of soil predominates in most of the Indian States, which cannot be as fertile as alluvial soil predominating in British India. With regard to relief, practically the whole of the plains watered by the rivers belonging to the Gangetic and Indus systems are situated within British India. The unfavourable climatic, physiographical and pedological conditions are also reflected in the nature of principal crops sown. The principal single crop in British India is rice, whereas in Indian India millets predominate, which are eaten by the poorer people who cannot afford to have more expensive food-grains such as rice or wheat.

This is a point that needs careful investigation, if we are to plan a scheme in the national interest. A geographical survey of the area covered by surface water, buildings, roads and mantles of really unfertile soil is needed before we can say whether the land is better utilized in Indian India than in British India.

Let us now compare the figures based on provincial statistics for the year 1935-36. First as to the area actually sown. In Northern India the proportion of cultivated area to the total is about the same in the Gangetic valley (Bengal, Bihar and U.P.) and in the upper Indus valley (the Punjab) and definitely low in the two Frontier Provinces, Assam in the east and N.W. Frontier Province in the west. Sind, which receives less than 10 inches of annual

rainfall has the minimum area under the plough. In the Deccan, Bombay and the two adjoining States, Hyderabad in the east and Baroda in the north, have the maximum area under the plough in the whole of India. This zone of maximum cultivation is surrounded by another zone, where not more than three-eighths of the total area are being actually cultivated. Mysore, Madras, the Central Provinces, Gwalior and the Rajputana States belong to this zone. Travancore and Orissa lie outside this zone, the former having slightly greater and the latter, slightly less percentage of the cultivated area.

As we proceed from Assam to the Punjab through Bengal, Bihar and the United Provinces, we find that the proportion of irrigated area to the total sown area increases steadily following the decrease of rainfall, being maximum in Sind, where artificial irrigation is practised very extensively. This tells us something more, since irrigation means man's effort to get more than what the land readily produces. There is no doubt that the people of the lower Gangetic valley and Brahmaputra valley are not making as much effort in this direction as the people of the Indus valley. It may be argued that irrigation is not the problem with which the agricultural population of the former natural region is faced to-day. But what about solving the drainage problem in Bengal or the problem of bringing more lands under the plough in Assam, which means spending of human energy and getting greater yields from the land?

The proportion of irrigated land also increases as we proceed from Assam to Travancore through Bengal, Orissa and Madras. Travancore is one of the rainiest areas of India, and still the area of irrigated land is about one-half of the total area under the plough. This makes us think whether irrigation can be dispensed with in Bengal. The remaining of the British Indian provinces (Bombay and the Central Provinces) and the Indian States (Hyderabad, Gwalior and Baroda) have low proportions of irrigated land. The proportion of irrigated land in Rajputana though higher than that of its immediate western neighbour, Gwalior, falls far short of the figure that is expected in an arid country like Rajputana.

The area of land kept fallow is definitely higher in the lower Gangetic valley (Bengal) than in the upper Gangetic (U.P.) and upper Indus (Punjab) valleys. In the lower Indus valley (Sind) the proportion of fallow land to the total sown area is about the same as in the lower Gangetic valley (Bengal). I am not sure

whether it is necessary to leave more land fallow in the lower course than in the upper course of a river, but this point needs investigation, as a large area remains abandoned, at least for sometime. In the northern mountainous region the proportion of fallow land is also low (Kashmir and N.W. Frontier Province).

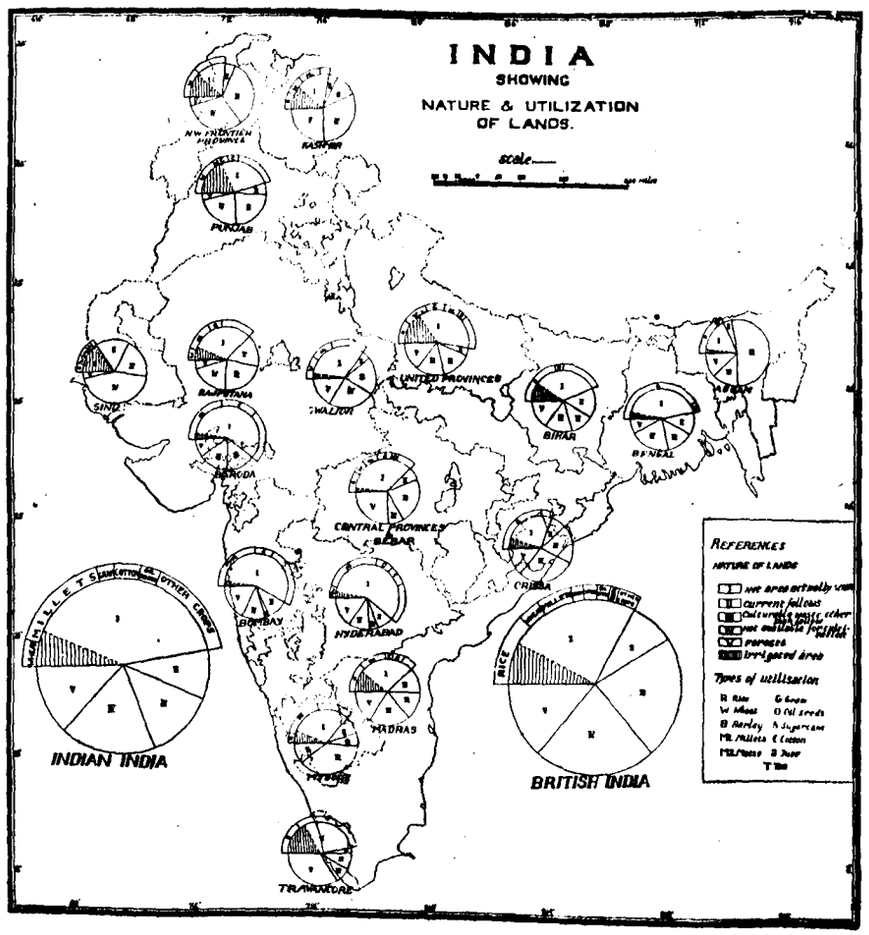
The upper Brahmaputra valley and the mountainous region of Assam have also a very low proportion of land kept fallow. In the zone of maximum cultivation, Bombay and Hyderabad have fairly large fallow lands, but Baroda has none. The arid lands of India (Sind and Rajputana) have a large proportion of fallow lands. A detailed survey of lands kept fallow in different parts of India and their mapping are necessary before we can say something for or against the practice of keeping a large proportion of valuable agricultural lands fallow.

As to the distribution of lands classified under culturable waste, we find that the proportion of this type of land to the total area, is maximum in Assam, and minimum in Bombay. In the Gangetic valley the proportion is about the same, that is to say, about one-eighth of the total area, in the three provinces, Bengal, Bihar and the United Provinces. In the zone of maximum cultivation, Bombay, as already mentioned, and Hyderabad have very low percentage of culturable waste. There is yet a possibility of bringing under the plough about one-quarter of the total area in the Punjab and little less than a quarter in Sind by developing irrigational schemes.

After successfully tackling the problem of culturable waste land, we should find out the nature of land which is considered as worthless to-day from agricultural point of view. In this connection I would like to refer to what has been achieved by the present Russian Government in the Karakum and Kizilkum deserts of Russian Turkestan. For centuries nothing could be grown in these deserts, but to-day thousands of acres of land are being cultivated with the help of artificial irrigation by hundreds of nomad families who have just been settled on the land. As to the distribution of such type of land, it is natural that we should find the maximum proportion in the region of very scanty rainfall (Sind), and in the mountainous district (Kashmir and N.W. Frontier Province). In Southern India, Mysore has a large percentage of area not available for cultivation.

Forests still occupy a considerable area, though deforestation started from the time the Aryans entered India. The dense forests

PLATE I



of the Gangetic valley had to be cleared off to give place to the plants favoured by man—wheat, rice, barley, all members of the grass-family. Forests also indirectly help agriculture by checking the run-off on the surface and thus preventing erosion of the valuable mantle of soil. This is all the more important in hilly countries where there is a danger of the surface soil being washed away.

With regard to the distribution of forests in India, we find that the Kashmir valley and the adjoining mountain slopes in the north, and the Vindhya and Satpura ranges in Central India have yet large areas covered with forests. In the south, in Travancore, forests still occupy more than one-quarter of the total area. In the zone of maximum cultivation, the forests still occupy a large area, about one-eighth of the area in Bombay and Hyderabad. In the Gangetic valley, the true forests are found only in the Sundarban region of Bengal. The high proportions shown in Bihar and the United Provinces are really due to the forests growing in a different type of natural region, though included within the political boundaries of the two provinces.

The map also shows the predominating single crops in different provinces and States. As we proceed from Bengal to the Punjab, rice cultivation decreases with the corresponding increase in the cultivation of wheat, following the decrease of oceanic influence inland. In the region of maximum cultivation, millets take the principal place, the next important single crop being cotton. Jute is principally grown in Bengal, and tea in Assam. Thus each region has its favourite crop. Bengal and Bihar favour rice, the Punjab favours wheat, the United Provinces, as it shares the climate of the first two regions favours both rice and wheat, and the Deccan, millets. It is with these crops that the hungry millions are being fed daily. A survey of crops, and their distribution and accurate mapping on large scale map of India will enable us to see the picture of agricultural India in its true perspective.

Let us now have a look at the population map of the Gangetic plain, the most densely populated region of India. It is clear that the population increases considerably as we proceed towards the plain either from the northern mountainous region or from the southern plateau region. A part of the former region included within the boundary of the United Provinces in the west of Nepal (Almorah, Garhwal and Nainital districts) and a part of the latter region included within the Province of Bihar (Singhbhum, Ranchi, Palamau and Hazaribagh districts) in the north of the Eastern

States show a clear contrast with the other districts as regards population. Two other regions, one in the north of Rewa and Panna (Mirzapur, Banda, Hamirpur and Jalaun districts) and the other in the north of Rajputana and west of the Jumna are sparsely populated. All these regions do not form part of the Gangetic valley. Coming to the Gangetic valley proper, we also find the population is not evenly distributed. In the Doab of the Hoogly and the Ganges-Meghna, the central part is more sparsely populated than either the western or the eastern, the Sundarbans, and the dead and dying rivers being responsible for the sparse population. A little patch in the lower course of the Hoogly appears to be densely populated. This is the industrial district adjoining Calcutta. If we carefully examine the map, we find that there is some order in the variation of population in the Gangetic valley, that is to say, area of dense population alternates with area of relatively sparse population. This illustrates the theory of Vidal de la Balche that population does not spread out evenly like oil, but spreads out in swarms like bees.

A comparison of the population map with the maps showing the distribution of total earners and workers in trade and industry who do not have to depend on the land for their living, reveals that compared with population the Doab of Bengal has a much smaller number of earners than in the middle or upper Gangetic valley, that is to say in most of the districts of Bihar and the United Provinces, and that the proportion of earners is greater in the upper Gangetic valley (U.P.), than that of the middle Gangetic valley (Bihar). The area in the immediate west of the Jumna (Karnal, Rhotak and Gurgaon) has a smaller percentage of earners, and this probably accounts for the sparse population in the area. The industrial area like the Howrah district in the east or the Delhi province in the west has obviously very thick population.

Since organized industries do not play a large part in the life of the people of the Gangetic valley, and the vast majority have to depend on the land for their sustenance, it will be interesting to see how far the agricultural land is being utilized in this area. Generally speaking, the area of high density of population corresponds to the area where intensive cultivation is practised, e.g., the western part of the Doab of Bengal (Faridpur and Barisal districts) or the Doab of the Ganges and Jumna (Fatehpur, Cawnpore, Etawah and Agra districts). The area of low density of population such as the Khulna district of Bengal or the Santhal Pargana of Bihar or the Chotanagpur Plateau, has not yet utilized

the whole of agricultural land available for cultivation. The local causes, if any, of this wastage, are to be determined by the planner.

I shall now take up Bengal with a view to indicating what assistance the geographer can give in solving some of the problems with which we are faced to-day.

Bengal has a more or less triangular shape with its apex in the northern Himalayan mountain and its base washed by the waters of the Bay of Bengal. Three great rivers the Ganges, (also known as Padma) Brahmaputra and Meghna find their way to the Bay through Bengal, and it is common knowledge that the destiny of Bengal lies in the hands of her mighty rivers.

Bengal may be divided into the following regions:—

Uplands

1. Himalayan region .. Mountain
2. Chittagong Hill region .. Hill.
3. Rarh region .. Plateau.

Lowlands

4. Barendra region.
5. Brahmaputra-Meghna region.
6. Bagri region.
7. Hoogly region.
8. Lower Ganges region.
9. Lower Padma-Meghna region.
10. Sundarban region.

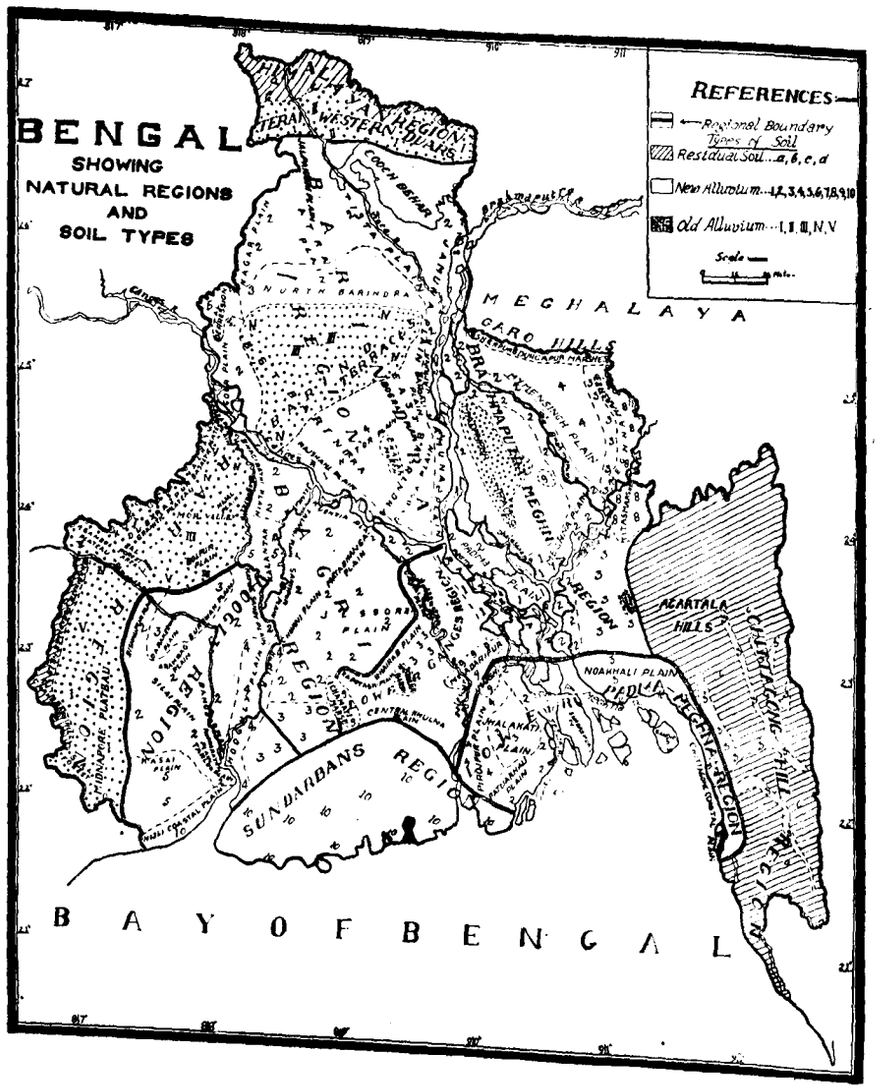
For the soil regions I propose the following classification:—

(Plate II)

Residual Soil

Gneissic soil .. (*a*)
Ferruginous clay .. (*b*)
Sandy loam .. (*c*)
Lateritic soil .. (*d*)

PLATE II



Residual Soil: Gneissic soil (*a*), Ferruginous clay (*b*), Sandy loam (*c*), Lateritic soil (*d*).

New Alluvium: Doash (loam) 1, Pali (sandy loam) 2, Matial (clayey loam) 3, Entel (hard clayey loam) 4, Khiyar (dark heavy clay) 5, Kalantar (stiff clay) 6, Balia (sandy) 7, Bhasa (soft clay-marshy) 8, Tobe (peaty) 9, Mahina (coastal soil impregnated with salt) 10.

Old Alluvium: Sandy loam I, Black clay II, Stiff clay III, Clayey loam IV, Lateritic clay V.

New Alluvium

Doash (loam)	.. 1
Pali (sandy loam)	.. 2
Matial (clayey loam)	.. 3
Entel (hard clayey loam)	.. 4
Khiyar (dark heavy clay)	.. 5
Kalantar (stiff clay)	.. 6
Balia (sandy)	.. 7
Bhasa (soft clay-marshy)	.. 8
Tobe (peaty)	.. 9
Mahina (coastal soil impregnated with salt)	.. 10

Old Alluvium

Sandy loam	
Black clay	.. II
Stiff clay	.. III
Clayey loam	.. IV
Lateritic clay	.. V

Bengal is essentially a land of plains. The upland region is confined in three distinct zones in Bengal—(1) in the extreme north (the Sikkim Himalaya), (2) in the south-east (the Chittagong Hill Tracts), and a narrow stretch of land running along western border from the south of the Ganges to very near the sea board.

The Himalayan region:—

The bracing climate of this region in summer has led to the growth of summer resorts in the mountains. The majestic peeks of the Himalaya rise above the dense forests of the Terai and Western Duars. Cultivation of any kind including tea stops at an altitude of 6,000 ft. above which dense forests clad the mountain slopes. Alpine vegetation is met with at much higher levels. The scarcity of level ground for cultivation is the main problem of the mountaineers. A belt of old alluvium runs along the foot of the Himalaya extending from the Western Duars to the Terai forests and receive a large amount of rainfall, the normal annual rainfall being maximum in Bengal. The soil is in most part sandy loam excepting a patch of black clay in the area between the Tista and Jaldhaka. The latter type of soil is extensively used for pottery. Immediately north of this soil lies a belt of ferruginous clay which is very suitable for tea plants. Further north gneissic soil is met with, which in composition ranges from white sand to red

clay. This region has an unlimited water-power resources, especially in the Tista river, which if properly harnessed will cheapen electricity and help in the industrialization of the country. At present, factory industry is confined to tea.

Chittagong Hill region:—

This region consists of long parallel ranges and valleys, the structure being of the Appalachian type. There are four important valleys, which have now been brought under the plough. Like the Himalayan region it is covered with dense jungle. It also receives copious rainfall, the normal annual rainfall being 100 inches. The region has also water-power resources, mainly the river Karnaphuli, which remain to be exploited. Unlike the Himalayan region it has a hot summer and mild winter. The soil is sandy loam in higher levels and clayey loam in the valley bottoms. The yield of sugarcane is definitely higher in this type of soil.

The Rarh region:—

It occupies most of the western districts of Bengal—part of Murshidabad, Bankura, practically the whole of Burdwan and the western half of Midnapore, and presents the appearance of an undulating plateau. It is mainly composed of old alluvium, the residual soil being found in the higher levels along the extreme western border. In the area between the Damodar and Bhagirathi stand several granitic and basaltic hills, with lateritic cappings. To the west of the Dubrajpur granitic hills are found two hot springs which, if properly advertised, may attract a large number of patients from other districts of Bengal, as it is believed that the waters of the springs are very efficacious for certain diseases. The country to the immediate north of the Damodar contains sal forests (shorea robusta). The most characteristic tree in the region being the palmyra palm (borassus flabeiformis), which supplies the villager with trunk and leaves for building his houses, and fruits, in time of famine. It is a region of minimum rainfall, and hence irrigation is the main problem. Since most of the rivers including the Damodar are subject to heavy floods during the rains, it will be necessary to store up the flood waters at certain favourable spots. For this, a geographical survey of the region is needed.

Low Lands

Low lands occupy the rest of Bengal, where the gradient is almost imperceptible.

Barendra region :—

It occupies the Doab of the Ganges and the Brahmaputra roughly corresponding to the Rajshahi division, and may be subdivided into East Barendra, North Barendra and West Barendra. A very extensive capping of old alluvium is met with in this region. This is locally known as 'Barind'. It covers an area of about 3,000 sq. miles, and certainly occupied a much larger space in the past. Fluvial erosion has now left a few low hills with intervening wide depressions. None of the hills rise above 100 ft., and their flat tops at different levels present a terrace-like appearance. The soil is stiff clay in the tops of hills, where nothing but grass and scrub jungle grow. In the depressions, the soil is clayey loam, which is good for winter rice. In the north-western part is found 'Pali' soil which changes to 'Matial' soil further south. The former soil is very fertile and produces two crops in the year (do fasli). The latter cannot retain moisture for long and considering the factor that rainfall is low this soil does not yield two crops. One of the problems of cultivators in the northern part of the West Barendra region is how to irrigate their lands in years of scanty rainfall. Not many tanks exist there, and since most of the streams flow through somewhat deeper valleys water could not be lifted by mud basket to the fields which lie at higher levels. In the central part, however, irrigation from tanks is practised.

In the north of the East Barendra (Rangpur) 'Pali' soil predominates in the north and in the east which receives fresh supply of silt every year, and is very fertile producing two crops. Dark heavy clayey soil predominates in the central and southern Rangpur where marshes and riverbeds once pervailed. Sandy soil prevails along the banks of the Jamuna and in the islands. Artificial irrigation for crops other than tobacco is not practised.

In the south-western half of West Barendra (Malda) 'Khiyar' (heavy clayey soil) predominates in the area between the Mahananda and Kalindi, known as the Tal depression. This area gets submerged as soon as the rains set in; and consequently only the crops that can be harvested before the rains are grown in this region. Further south the country presents a pleasing aspect, no longer marshy tracts covered by reed and tall grass, but open stretches of cultivated fields formed of fertile 'Doash' (loam), and a series of sandy islands in the beds of the Ganges. This is the most densely populated tract in the whole of the Barendra region. The fertile loam extends along the northern bank of the Ganges up to the Barind old alluvium (Rajshahi plain). In the Nator plain

the soil is 'Entel' (hard clayey loam). Further west 'Matial' (clayey loam) prevails which is fertile but the area being extremely unhealthy, very few people live there. In the East Barendra region a stretch of fertile sandy loam runs parallel to the Jamuna and form the Bangali and Jamuna plains. The soil in the Bogra plain is 'Entel', and is good only for the cultivation of paddy.

Brahmaputra-Meghna region :—

Three administrative districts—Mymensingh, Dacca and Tippera—are included in this area. A considerable area of the region from Dacca on the south to Jamalpur on the north, consists of alluvial terraces, known locally as the Madhupur. jungle and still awaits development. It has been dissected by a number of rivulets. The valleys and depressions have subsequently been filled up by recent alluvium—clayey loam—which yield excellent crops. The uplands have a hard red clay soil, and are taken as 'unculturable waste'. This tract needs a careful survey, and it is likely that with the help of suitable manures, it can be made to yield rich crops. Another small out-crop of old alluvium forms the Lalmai hills, a few miles west of Comilla town.

The area is well watered by the Jamuna, Padma, Meghna, and their many important distributaries like the old Brahmaputra and Dhaleswari. All the rivers carry a large volume of water, which may be utilized in developing the existing fisheries. The Garo hills in the immediate north of the area also provide ample opportunities for a successful hydro-electric scheme. Another problem that needs solution is to remove the surplus water which remains on the surface in several localities in the north mainly between the old Brahmaputra and the foot of the Garo hills and also along a narrow strip of land bordering the Meghna, where nothing but scrub jungle and tall grass can at present be grown. The southern plains, Padma and Meghna plains, are however well drained and every inch of the ground is productive due to the land-building activities of the great rivers. Any interference with the rivers with a view to preventing the flood waters to spread over the plains will cause disaster to one of the most densely populated areas of Bengal.

From agricultural point of view, this is the most important tract being an ideal home of jute and sugarcane. Here are found over two-fifths of the jute lands, and one-quarter of the sugarcane fields. The yield of sugarcane per acre is definitely higher than the average for the province. The yield of jute per acre is not quite satisfactory in the southern part of the region. It is true that the normal annual rainfall in the southern part is 15 inches less than

that in the northern area. But this deficiency of rainfall, if it is a cause of lower yield, can be made good either by storing up of flood waters during the rains, or by flushing from rivers.

Oilseeds and rice are also grown extensively. Of the oil-seeds about two-fifths of the til (sesamum) growing areas, and over one-third of the mustard lands occur in this region. Slightly over one-sixth of the paddy lands is also found, though the yield of winter rice is lower than the average yield for the province. The cause of this lower yield may be traced to the unfertile soil of the Madhupur terraces, which, when dry, is as hard as stone. The soil of the Meghna plain retains moisture to a remarkable degree, and is very fertile. The southern part of the Padma plain consists of 'Doash' (loamy soil) and is undoubtedly the most fertile tract in the whole of Bengal, but 'Pali' (sandy loam) prevails in the northern part which cannot retain moisture to the same extent as the former type. In the Mymensingh plain clayey 'Entel' soil (hard clayey loam) prevails, which in places is as hard as the soil of the Madhupur terraces.

The climate of the region is of maritime monsoonal type. The temperature in summer months is considerably lowered by moisture-bearing winds from the Bay of Bengal. The mean temperature in January ranges from 66°F. in the south to 65°F. in the north. The weather is very pleasant in the cold season, from November to February. The normal annual rainfall also increases from the south (74″) to the north (89″).

No organized industry worth the name exists in this region. It is true that the cost of transport of coal from the Raniganj coal fields is enormous, but the proximity of raw materials like jute, oilseeds, sugarcane would have led to development of factory industries, had the cost of electricity been moderate. The water-power resources of the Himalayan region if properly exploited would lead to the development of industries.

The Bagri region:—

This is one of the three famous historical divisions of Bengal, lying in the south of the Barendra tract and in the east of the Rarh area. The Bhagirathi which is known as the Hooghli below its confluence with the Jalangi forms its western boundary, the Ganges —its northern, the Sundarbans—its southern, and the Garai and Bhairab plains—its eastern boundary. The latter boundary was drawn based on the type of fluvial erosion. This flat alluvial plain is watered by a number of moribund sluggish rivers which need resuscitation very badly. Before the construction of the railways,

it is the rivers of this region, the Bhagirathi, Jalangi and Matabhanga that afforded the principal means of communication between the lower and upper Gangetic valley but the thalwegs of these rivers have been silted up to such an extent that navigation is not possible except in the rains. This district abounds with marshes because of its defective drainage, and comes in the grip of flood every year. The predominant type of soil is 'Pali' (sandy loam), which is fertile elsewhere. But in this tract the yield of rice and other crops is definitely lower. This shows that the soil is not the only factor that affects the productivity of the land. The normal annual rainfall is 55 inches, about the same as in the Rarh region. The mean temperature in January is 50°F. and in April it rises to 85°F. In the Kalantar tract between the Bhagirathi and Jalangi the soil is hard clay and extremely unfertile. This tract is known locally as the 'region of death,' and its people are the first to feel the pinch of famine when it comes.

The Hooghly region:—

This is the only region in the whole of Bengal that shows some industrial activities. Rainfall is slightly higher in the south of the region (61″) whereas in the northern portion the normal annual rainfall is 57″. Out of this only about 4 inches of rain fall from January to April. Hard clayey loam (Entel) predominates along the river banks, and sandy or clayey loam, away from the river. In the area between the Hooghly and Damodar the nature of soil was found to change very rapidly. It was surprising to find in a small village, Dafarpur in the Howrah district, a small patch of very fertile soil, which caused the valuation of lands to rise considerably higher than those of the surrounding villages. In the Hijli coastal plain, sand dunes advance inland and sometimes threaten the existence of small villages which are situated in the plain. Some dykes have been built to prevent saltwater destroying the cultivated fields. The yield of jute and rice per acre is higher than in the neighbouring regions. The agricultural population of this region also suffers to some extent due to defective drainage. The main problem is to remove the surplus water. It is true that a number of drainage channels have been built up, but in times of sudden heavy showers some delay in opening the sluices often causes complete destruction of crops.

The lower Ganges region:—

Parts of two administrative districts, Khulna and Faridpur, are included within this region. Unlike the rivers of the Bagri

region the rivers of this tract are still engaged in their land-building work. In the south-eastern part of the region the main problem is of drinking water, since most of the rivers are getting more and more saline as their connections with the Ganges are getting silted up. This region abounds with marshes, which are gradually being reclaimed for cultivation, but wherever man has shown undue haste in reclaiming land by preventing the river from completing its task, the reclaimed land started deteriorating very soon, and was once again converted into uncultivable marshy area. The normal annual rainfall (73″) is lower than that of the adjoining lower Padma-Meghna region. Although the banks of the Padma are formed of fertile loamy soil, elsewhere in the region the typical soil is clayey loam. 'Tobe' (peaty soil) is found in the marshes. Since the whole of the region is only slightly raised above the flood level the difficulty about finding a suitable site for building habitations is most acute. In several villages houses are built on artificially raised ground.

The lower Padma-Meghna region:—

This is the rainiest area of Bengal (normal annual rainfall 114″), next to the northern Himalayan region. Along the Chittagong coastal plain is found a heavy clay soil which is impregnated with salt, and is locally known as 'Mahina.' The soil becomes fertile sandy loam as we approach the hill region from the coast. One of the problems is to prevent saline sea water from damaging the crops. The number of dykes is not sufficient along the Chittagong coastal plain. Near the mouths of the Meghna are found several large islands which are still in the process of formation. The islands are being rapidly reclaimed and produce rice, and betel palm. The whole area is well drained and consequently does not have any large marshy tract.

The Sundarban region:—

The Sundarbans occupy a large tract mainly in the administrative district of the 24-Parganas and Khulna, and present the appearance of morasses and swampy islands separated by river estuaries and a network of tidal creeks. The people of this region suffer badly for want of fresh drinking water. 'At times the women folk carry their pitchers by relays to fetch water from a fresh-water tank which often is situated at a distance of 10 or 12 miles.'

The land in the Sundarban area is extremely fertile; and it may look strange to find that the people of this region want it otherwise. The reason given by Sir James Westland is the following:

'So great is the evil fertility of the soil, that reclaimed land neglected for a single year will present to the next year's cultivator a forest of reeds (nal). He may cut it and burn it down, but it will spring up again almost as thick as ever.'

To sum up, since national planning means a conscious effort of man to change his environment in the best national interest, it is rational to be equipped with a thorough and accurate knowledge of the type, historic growth, and present distribution of the various factors that go to form our cultural landscape, which is the subject-matter of geography. By synthesizing the findings of other branches of knowledge, geography presents a complete picture of the country, which may then pass on to the hands of the planner for retouching. The role of the economist in national planning is not underestimated, but what is claimed by geography is that the geographer can certainly help the economist to keep his feet on the earth. To materialize the scheme of national planning in India, which is the home of one-fifth of the population of the world and where cultivable land per head of population is less than that of other agricultural countries, the starting of an All-India Organization for conducting the Geographical Survey of the country, more or less, on the lines of the existing Geological Survey will be a distinct step forward.

Some Chief Problems of a Suburban Municipality Adjoining the Metropolis with Special Reference to Saidapet*

By

N. Subrahmanyam, M.A., L.T., F.R.G.S.,

The Thesis stated.—The Municipality of Saidapet is a suburb of Madras contiguous with it and is also the headquarters of Chingleput District which surrounds the Metropolis. This peculiar position of the Municipality being also an adjoining part of the capital, *i.e.*, of Greater Madras, has led to the growth of certain interesting and important problems which are examined in this paper and an attempt made to suggest some feasible solutions for them.

The Plan.—The paper is divided into three parts. Part I is descriptive: it gives an account of the main features of the locality. Part II examines the problems; and Part III suggests some solutions.

PART I

Descriptive: Main Features of the Locality

Historical Background.—The exact origin of Saidapet is not definitely known. Puliyur near Kodambakkam is the only part of the present Municipality that can lay any claim to antiquity, being mentioned as a *kottam* or local sub-division in Chola times. Little Mount on the right bank of the Adyar, reputably connected with the martyrdom of St. Thomas, was well-known in the 17th century as a shrine of the Portuguese Church. But Saidapet town itself—the rectangular portion to the north of the railway line—does not appear to be an old village. The place seems to have been called originally *Saidabad* from a certain Saiyad, a member of the Karnatic Nawab's family, and subsequently corrupted into Saida-

* A paper read before the Geography and Geodesy Section of the 27th Session of the Indian Science Congress, Madras—January, 1940.

pet. The main building in the Home's Garden, which formed originally part of the Nawab's property and in which the Collector's Office is now held, the Mosque in front of it and the site known as Saiyad Bagh—all indicate this Moslem connection of the parts along the Mount Road. The weaving industry of Thopet, to the west of the railway line, seems to have been of comparatively recent growth—the stuff made here, the lungis and the kailis, not being connected with the early East India Company days, but being due to the demand of the Indians settled in Burma and the Straits Settlements in the 19th century. The construction of the railway and its recent electrification, the growth of the bus service, the development of the Colleges, the activities of the Turf Club and the creation of the Municipality have all had their influences on the life of this important suburb of the city

Position, Extent and Divisions.—The Municipality of Saidapet forms roughly an arc round Madras on its south-western side and on the southern half of the western side. It is said to cover an area of 8 square miles, though no adequate survey of it has yet been made. It is thus a little more than a quarter of the City of Madras in area. But the residential parts are not contiguous with each other but fall into isolated units, separated by fields and open land, and extending from Little Mount and Guindy in the south on the right bank of the Adyar to Choolaimedu in the North on the right bank of the Cooum. Saidapet town proper falls roughly into three parts:—One part lies along the Mount Road up to the Adyar on the east and the south. It contains the Collector's Office, the Y. M. C. A. College of Physical Education, Fanepet, Todhunternagar, Farm Village, Teachers' College, Richards Park and Panagal Buildings; and it is the part that is best known and gives the best impression to a casual visitor. The other parts are Periapet, which lies between the Mount Road and the Railway-line, and the old town, rectangular in pattern to the west of the Railway-line up to the Perumal temple. The area known as Mettupalayam is contiguous to it in the north-west.

To the north of Saidapet Town lie two other isolated groups of residential areas:—(1) West Mambalam; and (2) Kodambakkam, Saligramam and Puliyur. Thus the Municipality is spread over a large area in distinct residential groups, separated by long stretches of fields and open land.

The population of Saidapet.—The total population of this congeries of residential areas comprising the Municipality of Saidapet is 33,037 according to the census of 1931, and may come to half

a lakh by the next census of 1941. The figures of growth since 1881 are given below:—

As per 1881 census, the population was				15,345.
,,	1891	,,	,,	,, 17,821.
,,	1901	,,	,,	,, 21,507.
,,	1911	,,	,,	,, 22,043.
,,	1921	,,	,,	,, 27,404.
,,	1931	,,	,,	,, 33,037.

The above figures show that the growth has been steady, though it cannot be said to be rapid; the population has doubled itself in 50 years. While the area of the Municipality is a little over a fourth of Madras, its population is only about a twentieth.

Physical Description.—The surface within the Municipality is fairly level; and most of it drains into the Adyar, which is not at all useful for irrigational purposes. The soil is sandy loam for the most part; but the poor rainfall (less than 40 inches) and absence of good irrigational facilities have prevented the development of agriculture or market gardening except in certain parts where it could be carried on by irrigation from wells.

Industries and Occupations.—Weaving and dyeing, brick and pot making, making and repairing of jutkas, and dhobying are some of the chief occupation of the local people; while several others are employed in the City, residing only in Saidapet area. But nearly all of these industries have of late years suffered decline in one way or other. The weaving and dyeing industry has gone down through competition from more flourishing centres like Chirala. Though the brick trade is itself in a very flourishing condition in general in the neighbourhood of Madras owing to the boom in the building industry, the burning of brick kilns within the Saidapet Municipal area is controlled as a dangerous and offensive trade, as it leaves pits which become after the rains sources of mosquito breeding. They are therefore not permitted near residential areas, but only some distance away from them. Hence, they are more largely to be found in Kodambakkam area. A good number of people depend on this industry for their livelihood. The common use of cheap enamel and aluminium wares has reduced the use of pottery, though the potter still continues to ply his ancient trade.

The bus and electric train have rendered the *jutka* or pony cart almost a superfluity; and hence there is little need for making or repairing of it nowadays. Dhobying for the City of Madras

however continues to flourish well, owing to the advantages of fresh water in the river above the tidal limit and easy transport from the City.

Communications and Transport.—The electric railway and the Mount Road are the two chief means of communication from Madras to Saidapet and beyond. Four stations on the railway line—Kodambakkam, Mambalam, Saidapet and Guindy—serve the municipal area of Saidapet; while local as well as through buses run in good numbers pretty frequently for going to and returning from the City. The Mount Road, being but the first part of the Great Southern Trunk Road near the City, is metalled and tarred well, being classed as a first class road, and crosses the river Adyar by the narrow Marmalong Bridge. The Bazaar Road, which takes off from the Mount Road near the Teachers' College, continues as the Alandur Road crossing the Adyar by a causeway. This affords an alternative route, especially for heavy carts on race days, when the Mount Road teems with cars and buses. The Arcot Road from Kodambakkam Railway Station westwards is another second class road like the Alandur Road. This road is linked with Saidapet by two connecting third class roads—one through Mambalam, and the other a little more westerly joining it near Saligramam. The last is most cut up by the heavy and frequent brick cart traffic.

The description so far given presents a general idea of Saidapet,—what a straggling place it is, with scattered residential areas. In the next part we shall learn about its insufficient water-supply, poor drainage, poor public health, decadent industries and bad roads, etc. In spite of its contiguity to the City, it has not been a popular part of Greater Madras. Let us examine the reasons therefor a little more closely.

PART II

Some Chief Problems of Saidapet Municipality

Public Health.—The first problem of Saidapet is that of Public Health. From its locational and transport advantages, Saidapet could easily have been a more popular part of Greater Madras but for its reputation for filariasis, brought on by the mosquito. Other common diseases like cholera, small-pox and enteric fever make their periodical visitations. The municipal authorities are alive to the danger, and are making a vigorous campaign against them every year; while the Saidapet Health Association has been doing excellent work by way of study, research and propaganda with the hope of realising its high ideal of making Saidapet "the cleanest, healthiest town in South India by 1950." This question of the public health of Saidapet is a matter of the utmost concern for the City of Madras. But in spite of the vigorous measures taken to fight against these prevalent diseases, no substantial progress seems to have been achieved as their main causes have not been wholly removed. The provision of an ample supply of safe water for its citizens and a good system of drainage have been the crying needs of the locality for a long time; and these have been the main causes of the state of public health in the town.

Water-supply.—The wells of Saidapet generally contain brackish water, unfit for drinking. A few, however, with somewhat drinkable water in half a dozen places have been meeting the needs of the people till recently. From the time that the Municipality was constituted in 1920, the question of supplying good water was recognised by the authorities; and a scheme was sanctioned and taken on hand as early as 1927 after 4 years of discussion with the Government, though actually the fruition of it took place after nearly 10 years, and good water was made available only in 1937. Street fountains have been set up in over 50 places; and 20 more fountains have been sanctioned. Thus safe water has been provided for from Guindy and Little Mount in the south to Mambalam in the north of the Municipality, though it has not been found possible to give house connections. The northern parts like Kodambakkam, Puliyur, Saligramam and Choolaimedu are too far off to benefit by the scheme and continue to use only the few good wells in their localities as in the past. Thus the problem of water-supply has after all been solved ony in a limited way, which has no doubt contributed to some extent in improving the public health of the town.

Drainage.—But immediately, however, it has only served to bring out more prominently the connected problem of *drainage*, for which no proper provision has so far been made. Though in the outlying parts there is some kind of natural drainage, Saidapet town which is the biggest residential area within the Municipality has no system of drainage, open or underground. The waste water from houses is either allowed to run into the gardens or collected in cess-pools of masonry work, from which they are baled out every morning into the municipal carts and taken out and let off at some distance from the habitations. As a matter of fact, these cess-pools are often seen to overflow into the streets; and waste

water let out into the gardens similarly form smaller cess-pools there. These afford fine breeding places for mosquitoes which infest the locality and not only disturb the sleep of its residents, but are also the fertile causes of filariasis and other diseases mentioned above.

It is said that the construction of the Marmalong Bridge (early in the 18th century?) by Peter Uscan, the Armenian merchant-prince resulted in bunding up the river bank and preventing the natural drainage of East Saidapet into the river and created part of the drainage problem. But howsoever caused, the urgent need for a drainage scheme has been generally recognised. In fact, when the water-supply question was first taken up, the necessity for taking up the drainage question at the same time was also urged; but on the score of cost, it was decided to take it after the first scheme was completed. Now that water-supply has come in some measure, the drainage question has become more urgent than ever. The drainage and sewage disposal of the town are anything but satisfactory, and have become a greater menace for public health than ever. It is understood that the Superintending Engineer, Public Health of Madras has arranged to take the levels of Saidapet preliminary to working out a drainage scheme. Till it is carried out the Public Health of Saidapet cannot materially improve. It must be stated in this connection that the Public Health of Madras City stands seriously imperilled by the unsatisfactory conditions in the adjoining area of Saidapet.

Roads.—Another problem which is peculiar to Saidapet is that of roads. Through the Municipality run nearly two miles of the Great Southern Trunk Road, which has very heavy bus, car and lorry traffic always, and much more so during the race season. The infant Municipality in its early enthusiasm involved itself in a heavy debt by incurring capital expenditure on tar macadamising the entire length of this road on its own account, which has resulted in its inability to find the money for other more urgent beneficent schemes.

Another road problem of Saidapet Municipality is the need for linking up its scattered units spread over a long distance by means of good roads. At present a third class road connects Saidapet with Kodambakkam and Saligramam on the Arcot Road, and another similar road runs northwards to Kodambakkam Railway Station through Mambalam. Choolaimedu, the northernmost unit is only accessible from Kodambakkam R. S. by a very poor road, and can be reached more easily from Nungambakkam within the

city than directly from Saidapet. Further, all these roads are badly cut up by the heavy traffic of fully laden brick carts going from the kilns to the City. Their maintenance in proper condition would entail a heavy drain on a poor Municipality, which has more urgent calls on its purse. There is also a great need for laying of fresh roads for developing some of the parts of what is really Greater Madras.

Other Amenities.—A park has been laid near the Marmalong Bridge and a radio set installed in it; and electric lighting has been introduced for Saidapet proper. But the residents look for provision of many more such amenities, and in the various parts of the municipal area. West Mambalam stands for example as a glaring contrast to what has been provided for in East Mambalam or Thyagarajanagar by way of amenities, just across the railway-line within the city limits, though even there the development is still incomplete.

Town-Planning Schemes.—While Saidapet is the Headquarters of the Chingleput District, it is at the same time a contiguous and important part of Greater Madras. Four stations of the S. I. R. Electric Railway are in the municipal area; and town-planning schemes well-thought-out and properly carried out will bring in a large residential population, and tend to increase directly and indirectly the income of the Municipality, besides relieving the congestion within the City. These schemes would, however, mean the provision of good water-supply, proper drainage, lighting and other amenities, besides lay-out of good roads linking them with the City. There is no reason, for example, why West Mambalam should not be developed in the same manner as the adjacent part of East Mambalam across the railway-line, though there is no clean slate here to write upon as in the latter case. The parts already built over cannot of course be touched; but farther west is a vast open area which can be indefinitely developed and linked, by means of good roads, with the City. Guindy again with its high ground and easy drainage facilities forms an ideal site for a town-planning scheme of a healthy locality, but water has to be brought to it. All this would involve initial expenditure, which the Municipality in its present encumbered position can ill afford.

Finance.—As a matter of fact all the problems discussed above hinge upon finance, which is the major or key problem of the whole series. Saidapet started as a Municipality with certain initial disadvantages, which had affected its finances adversely. The

Public Health of the locality was none too good; and its reputation for mosquitoes and filariasis had not made it popular as a residential area, in spite of its advantages of contiguity to the City and transport facilities in the shape of the electric railway and the regular bus service. The residents of the town have moreover been largely of the poorer sort, eking out a more or less precarious existence from industries which are on the decline as pointed out in an earlier section. Hence the revenue to the Municipality from a potentially richer and larger population has been denied to it.

In the infancy of the Municipality again certain necessary and unnecessary expenditure was incurred by loans from the Government, which have saddled it with a dead weight of a consolidated loan of over two lakhs of rupees, whereas the repaying capacity has been found to be under its present conditions only Rs. 10,000 per annum. A daily market built at a cost of nearly a lakh of rupees might well have been put off, and probably also a local habitation for the Municipality. Water-supply and drainage were prime necessities for the locality more urgently called for; and none can find fault with the expenditure incurred for water-supply, nor the one to be incurred for a drainage scheme. But a loan of over a lakh of rupees was the result of tar macadamising the whole length of the Mount Road. This is a matter of provincial importance the road being part of the Great Southern Trunk Road; and it is a matter of greater and more immediate concern to the Corporation of Madras, whose citizens use it very largely on race days. Naturally, the Race Club should also have been made to bear a good part of the cost of it. But nothing like that happened.

At the same time the Municipality was deprived of its income from tolls, while the bulk of the license fees of lorries and buses went into the coffers of the District Board of Chingleput and of the Corporation of Madras. It was always a standing complaint that its due share was not given to the Saidapet Municipality. Under the circumstances, Government should have written off the loan incurred for tar macadamising the road on the score that it was a matter of provincial importance, thereby relieving the Municipality and allowing it to carry out more pressing and legitimate needs of the locality; but in spite of repeated requests and representations Government has not seen its way to accede to it.

There is another road problem for Saidapet. The scattered parts of the Municipality require to be knit together by a system of good roads from north to south—from Choolaimedu, through

Puliyur, Kodambakkam, Saligramam and Mambalam to Saidapet —with cross roads linking to the City, if these areas are to develop rapidly as parts of Greater Madras. But bringing together far-flung places and keeping in good repair the connecting roads, which are subject to the continuous and rapid wear and tear of heavy brick carts mean money again, which is beyond the means of the Municipality whose finances are none too rosy.

Town-planning schemes if successful might ultimately bring in a steady revenue from the new settlements, while relieving at the same time the congestion of the City as stated already. But the launching of them requires money in the first instance.

Thus we see that the major problem of this Municipality, situated in the peculiar position of being suburban to the metropolis without adequate resources is *finance*; and upon it depend all the other problems discussed earlier. The satisfactory solving of all these problems is a matter of concern not only to the Municipality of Saidapet, but also to the Corporation of Madras and to the Provincial Government as well.

PART III

Some Suggested Solutions

The first solution that can be suggested for the relief of Saidapet Municipality is an obvious one for the Government to write off its loan at least in part and set it free, in view of its peculiar position as a suburb of the Metropolis with urgent needs to be met in the interests of the town as well as of the City. This the Municipality claims is a piece of justice, and has repeatedly asked for, as some part of it at least, namely, that incurred for tar macadamising the Mount Road was a matter of concern not for itself but for the Madras Corporation and the Provincial Government. If complied with, it will set the administration free to launch on necessary schemes for supplying the urgent needs and amenities of its citizens.

The second solution that may be offered is in connection with *the readjustment of the areas* comprising the Municipality, which has been asking to be relieved of the distant areas in the north such as Kodambakkam, Puliyur, Saligramam and Choolaimedu, all of which bring in little revenue, involve good expenditure and are too far away to receive adequate attention. But these are areas that require to be properly developed as parts of Greater Madras, and contiguous to it; and they cannot therefore be safely taken

out of the control of a single authority in the interests of the health of the City as well as for other obvious reasons.

But the other request and complaint of the Saidapet Municipality is just and reasonable and ought to find favour with the Government if no extraneous considerations are allowed to come in. This is the request to extend its limits in the south so as to include in it the Engineering College, the Government Park, the Race Course and Alandur, all of which may be expected to bring in the requisite revenue for discharging duties properly by its residents as the Headquarters of a District and as a suburb of the Metropolis. Government's unwillingness to include the first two places as leading to an increase of its own expenses is natural and can be understood. But there is no reason why the latter two areas should not be included. The turf club is making an enormous profit from the citizens of Madras, for whose benefit the Mount Road is kept in a fine condition, but there is no toll-gate income now. The bringing in of the Race Course within the municipal limits is a piece of justice.

Alandur again is a well-populated area with good trade, healthier than Saidapet, and may be expected to bring in a good revenue by way of property and other taxes. Its inclusion in Saidapet will contribute to augment the revenues of a Municipality which has been saddled with the responsibility for providing the needs of poorer areas lying apart in the north. Incidentally it will bring under the control of a larger central authority, another part of Greater Madras.

But the best solution that can be offered is for the Government to take a more comprehensive and long view of the whole matter and create a suburban ring of municipal areas, as in London, surrounding the City on the south, west and north, from Adyar through Saidapet and Sembium to Tiruvottiyur, dividing the whole area into 2, 3 or 4 administrations with a common advisory board with representatives from these administrations, the Madras Corporation and the Madras Government. Such an advisory body may be expected to take a more just and impartial view of the needs and activities of the several parts far above the narrow parochialism of each of them. If necessary, the limits of the District of Madras may be extended to include the areas of the proposed suburban municipal ring; and to that extent the limits of Chingleput District may be curtailed. But as this district is already recognised to be too big, it can easily admit of such a curtailment. The Headquarters of the District may in that case have to be shifted to Pallavaram,

Poonamalle or Sriperumbudur; but that is not an insuperable difficulty, and is a matter of detail which need not be gone into at present.

In conclusion, it may be pointed out that the suburban areas round the Metropolis can be properly developed, and its population can get proper service, only if a comprehensive policy is adopted like the one suggested above. Otherwise the conflicting interests of the Metropolis and the Suburban Areas will lead to insuperable difficulties and incalculable mischiefs, which may be found in the long run to be too costly and irreparable in some cases.

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Saidapet Health Project (issued by the Saidapet Health Association).

Some Aspects of the Economic Geography of Guntur*

BY

M. V. KRISHNAMURTHY, B.A., B.ED.,
Asst., Hindu College School, Guntur.

COLONISATION

Guntur is a flourishing town and a trading centre, 200 miles north of Madras and 20 miles south-west of the Anicut across the Kristna. Originally a small agricultural settlement, it has grown to its present size in the course of a few years and bids fair to become a City in the near future.

The soils map of Guntur (Figure No. 2) shows a central region of red soil stretching westwards and surrounded by one of rich black. A small patch of *Pati* soil lies near the tank in the eastern half of the town and nowhere else within the revenue village of Guntur. It is well known that this kind of soil can be found only in areas that have long been used as house sites. One has therefore to conclude that this justifies the present name of that part of the town, called Old Guntur (marked O in the sketch map).

Historical references tend to confirm this view. An inscription of 1158 A.D. in the Siva's temple of the place shows that it must have been in existence for over a 1000 years. Reference to the village in the preface to the Andhra Mahabharata by Tikkana (12th Century) establishes that the village must be at least more than 7 centuries old.

Why was this particular site chosen for the first settlement? Food and water supply determine the habitation of man. The rich black soil of the place could be utilised for growing crops. The water-table at moderate depth as can be noticed from the map, induced the people to settle down. Everywhere else in the vicinity, either the soil was poor or the water-table was very low. Naturally the site on which Old Guntur now stands was the only spot that could attract settlers.

*A paper read before the Geography and Geodesy Section of the 27th Session of the Indian Science Congress, Madras—January, 1940.

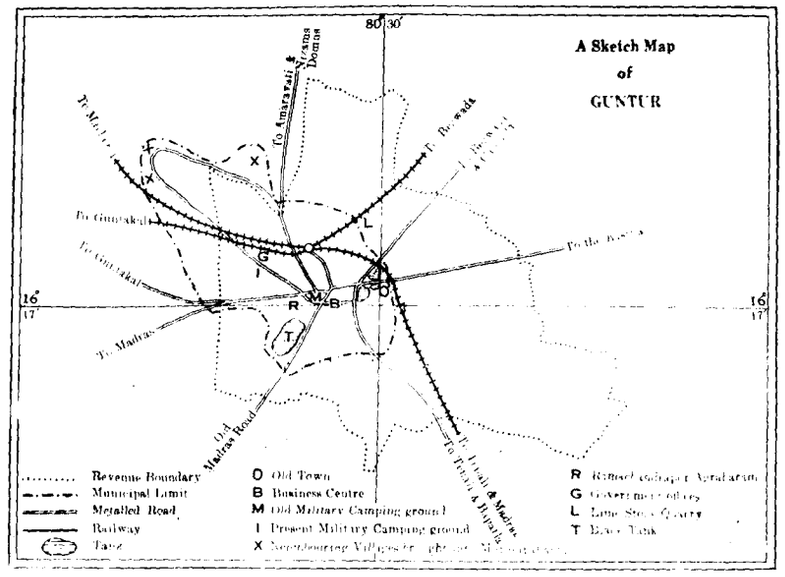

FIG. 1

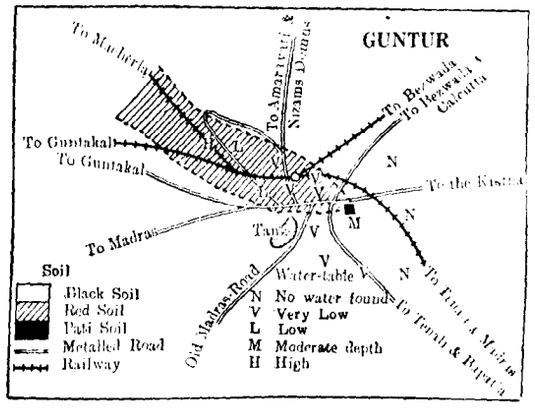

FIG. II

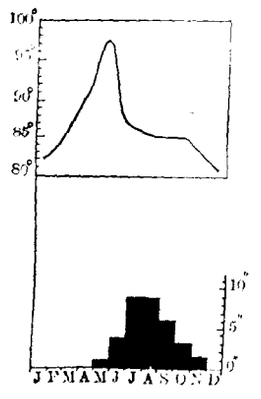

FIG. III

Guntur has been of military importance for several centuries. The celebrated poet of the Andhra Maha Bharata speaks of his father as the *Dandanadha* of Guntur. In 1753, the French established a military camp here in the site at present occupied by the Hindu College and High School Buildings, (M. in the sketch map). It was on account of its central and strategic position that Guntur was selected Head-quarters of the District when the English began direct administration of the region in 1846. Even now a military camping ground is set apart (I in the sketch map).

Therefore when metalled roads were constructed, naturally they passed through Guntur, and it became a focus of several routes. This helped to make the place a trading centre as well. The produce of the neighbouring parts was brought here for sale. Merchants were attracted to the place, opened business houses and gradually settled down. As a matter of course, the junction of the various routes meeting in the town helped to make it a business centre and it continues to be so even to this day.

These settlers had no need to care for the rich black soil like the agriculturists. Their only desire was to secure a cheap site not far away from their business quarters. Even the area of red soil, with its low water-table, was good enough for them.

Increasing business attracted labourers, who, however, did not at first entirely give up agriculture. They chose sites near enough both to the business centres and the fertile black soil, in spite of its low water-table. After the setting up of factories in recent times, these have turned full-time labourers, giving up agriculture unremunerative for people with small holdings.

Two centuries ago (1718), a gift of land, now known as Ramachendrapura Agraharam, (R in the sketch map) was made to some families who were obliged to settle down there, although the water-table was low. The black tank fed by the streams from the neighbouring hills was of some help to them.

In 1788, this region came into the hands of the British, who at first continued the prevailing Zamindary System. In 1846 this was given up and direct British Rule commenced. It is interesting to note that their offices, as well as the French Military Camp of 1753, were all in the red soil area close to the junction of the routes.

The construction of the railway line (1889) from Guntakal to Bezwada brought the town into greater prominence as a commercial centre. Foreign companies too opened business houses. Cotton, grown even in distant Palnad and other regions, was brought here for sale and export. But several of these business houses had to be closed down when cotton presses were set up in the cotton growing areas.

In 1904, Guntur was made the Head-quarters of the newly formed district. Civic amenities, like hospitals and educational institutions have also contributed to the growth of the town.

Since the construction of the railway line, the population of the town has rapidly increased year after year, till it reached the number 65,179 according to the census of 1931.

Census.	*Population.*	*Census.*	*Population.*
1871	18,033	1911	40,529
1881	19,646	1921	48,184
1891	23,359	1931	65,179
1901	30,833		

This rapid increase has been due to the exodus of the rural population into the urban area.

It should be noted that the new settlers were anything but agricultural. The only land available to them was the red soil area, which was not very productive and so could be had at a cheap rate. Even now further extensions of the town are towards the west, and north-west a region of poor red soil. The construction of most of the new government buildings (marked G in the sketch map), in that area has given a further impetus to its colonisation. These extensions have approached three small villages, (marked X in the sketch map, towards the west and northwest), which have therefore become part of the town.

Thus a small agricultural settlement became a focus of routes and developed into a commercial centre. The part played by the soils and water-table of the region in this evolution of the town should not be forgotten. The railway and the factories acted as great forces for the rapid growth of the town.

Climate

The Andhra Calendar is based on Chandramana (Lunar Movments). Still, by tradition the man in the street has got familiar with the weather conditions that may be expected with the Sun in the several constellations, from Ashvani to Revati.

Generally when the Telugu Year commences, the Sun has just crossed the equator in his northward journey. Summer may be said to have set in.

By the 10th of May the Sun, now in Krithika, comes overhead and remains on the horizon for a longer time. The days are unbearably hot and dusty. The maximum temperature in shade shoots up to about 120°F., while the minimum seldom goes below 80°F. Work out of doors after 10 A.M., is well-nigh impossible. The streets, otherwise crowded, present a deserted appearance. The sea breeze blows from about four in the evening and makes the conditions normal. Sometimes the hot west wind, continues far into the night, and the sea breeze is not felt.

On account of its low humidity, the high temperature of Guntur is without doubt more tolerable than the moist heat of the west coast.

But for the break of the monsoon early in June, the temperature should have risen higher still. The showers of rain help to render the weather conditions mild enough. There is a sudden fall in the temperature, although the Sun is not far away from the zenith. The minimum temperature is however almost steady.

The most rainy months are July to September (Fig. 3) and coincide with the Varasharuthuvu of the Hindu Calendar. When the rains are delayed, as may occasionally happen, epidemics break out, perhaps owing to the excessive heat, not so dry as before because of gentle showers.

In October when the general rains have ceased, the fall in temperature is steady. The west wind gives place to the cool north-easterly wind. Cyclones from the Bay sometimes cause destructive rains now. This is the time when the Sun will be in *Libra* (November) and the storms of the season have become proverbial. The Deepavali Day and Karthiga Purnama (Full Moon Day) are notorious for such stormy weather in this part of the country.

The days become shorter and the nights are longer in December, when the Sun is in the southern sky. Except for the cyclones, the accompanying season is generally dry and comparatively cool, favourable for human activities. From the commencement of the English new year, days become longer, and the heat begins to be felt from February. The succeeding months are once more hot and dry ; and with the scorching heat the monsoon is anxiously awaited.

The total rain for the year varies from 25 to 40 inches, resulting in a tropical grass-land vegetation in the region.

Climatic Control

The influence of the weather conditions on the lives of the people is very marked. The ryots depend entirely on rainfall for their crops.

In the dry months of April and May, the fields are manured and kept ready for the monsoon. With the early showers of rain about the 7th of June, when the Sun enters the ORION, is sown the first crop, which hitherto afforded fodder for the cattle, as the ryot found it exceedingly hard to feed them through the summer months when every blade of grass had been dried up in the scorching sun.

But nowadays, after the introduction of the ground-nut into this region about 20 years ago, this has been the commonest first crop. For ground-nut is harvested about the close of October and November, fetching the ryot some income when he is most in need of it. Fodder is grown as a second crop in the same field, after harvesting the ground-nuts.

The principal rainy season is July to September. The black soil when once saturated with water, can retain moisture enough to sustain the crops through the succeeding dry months. Chillies and tobacco need some rain only in the early stages of their growth. The former crop is planted at about the middle of September and the latter, a few weeks after that. Heavy rainfall is injurious, especially to the chillies in the period of growth. The plants are in full bloom in the cool dry months of November and December. They ripen with the increasing heat. Both the crops are harvested before the close of February.

Economic

The ryot may be said to be the very foundation of all society; and as such, the study of his economic condition demands our first attention.

Out of the total revenue area of 8,600 acres, the town site comprises of 1,700 acres. The 5,600 acres of cultivated land are distributed among nearly 1,000 ryots. Not more than a third of them have holdings of over 5 acres ; while the rest are owners of only 2 or 3 acres each. So they are obliged to look to other trades as supplementary sources for the maintenance of their families.

For several years, Guntur was noted for the production of tobacco and chillies. The comparative production of the various crops in 1937 (Fig. No. 4) discloses the fact that ground nut and tobacco form the principal crops at present. Chillies have been driven into the background.

FIG. 4. CROPS OF GUNTUR (REVENUE VILLAGE 1937).

Groundnuts.	Tobacco.	Fodder and Food Grains	Chillies.	Others.

The tempting price of Rs. 1-12-0 per maund, coupled with the good yield of 5 candies per acre, of ground-nut in the early years of its introduction, has been responsible for this change. But the land frequently used for groundnut and tobacco has been rendered unfit for chillies. The former exhausts the potash content and the latter the nitrates of the soil. The present continuous fall in the price (to As. 10 a maund), as well as the yield (1½ candies per acre) of groundnuts, is driving the ryots into a state of despair.

A species of tobacco, known as the country leaf, was being grown, and purchased by dealers from several parts of the country. This tobacco is cured by being dried in the sun, which costs the grower nothing.

But the advent of the Indian Leaf Tobacco Developing Company encouraged the production of the Virginia species. Guntur district is now considered the best region in India for this crop. The ryot is full of hope, but never sure of his income; for the price of tobacco, a commercial crop, is controlled by the fluctuations in the world market. Competition in this region is either lacking or too weak to last long. A few other companies also have recently opened their offices here, and the effect of this remains to be seen.

The costly process of curing demanded by the purchaser has been another handicap to the grower, without the necessary capital. The parasitic middle man has sprung up to take advantage of the situation.

In 1939 for example, the price of tobacco has gone down so low that the poor ryot has not been able to realise even the bare cost of production.

Thus these two commercial crops, which, the ignorant ryot believed, would improve his poverty-stricken condition, and might be adopted as his main-stay, have not fulfilled his hopes. He is bewildered. Perhaps, one may venture to say that they will prove harmful to him in the long run, if the same state of affairs is allowed to continue.

Food grains cannot be grown as a second crop; but as the only produce for the year, they do not fetch much income in dry areas. There is also a growing tendency on the part of the ryots to use rice instead of millets for their diet. So, ever since the groundnut displaced millets, the ryot is obliged to depend on others for his food stuffs too—a deplorable condition for an agricultural people. The large number of cattle and horses in the town may be considered to be the chief reason for the utilisation of 1,400 acres of land for growing fodder and food grains. The ryots that use all their land for commercial crops and have consequently neglected to grow fodder, find it necessary to make purchases of straw from the wet lands—miserable indeed.

The soils play an important part in the distribution of the crops. The red soil region can be used for oil-seeds and millets only; while any crop can be grown in the black soil. The statement given as annexure illustrates the annual income per acre of cultivated land for different crops.

In this estimate, it has been assumed that the ryot works in his own land. As already noticed, the ryots of this region have only small holdings. So several of them are obliged to toil hard in rented land. The additional burden of the rent payable to the owner is laid on them. The ryot has therefore almost nothing left to him for his hard labour. No wonder most of them would gladly seek other trades.

In arriving at the cost of production, the actual wages for the number of days the cattle have been employed in the field has been taken into account. As a matter of fact they have to be kept all the year round, which hits the ryot hard.

The cost of manure has also been overlooked, for it is expected that the manure is to be supplied by his cattle. But now-a-days as much of the land is being used for commercial crops, the ryot has not been able to maintain as many cattle as he used to. This has led to deterioration in the fertility of the soil and consequent decrease in the yield.

The agricultural labourer is no better than his master. The daily wages in kind or coin is As. 4 for a man and As. 2½ for a woman. For longer hours of work, as in harvesting, he receives a proportionate sum. He envies his brother, the unskilled labourer, earning a little more in the business centre.

Merely bewailing one's own sad plight can do no good. Self-awakening must be followed by self-improvement. The following

suggestions are made as remedial measures for the amelioration of the people depending on agriculture, particularly in the area of our study.

1. The ryot has to be educated about the variety of crops that can be grown in the locality, so that he may not be confined to a limited number in the rotation of the chief dry crops.

2. He needs instruction in the proper manuring of lands on a scientific basis so that the maximum yield may be obtained.

3. Co-operative production societies, with district or provincial head-quarters may be formed in every village, to prevent over production of any particular commodity with the consequent neglect of others.

4. Co-operative marketing societies under State guidance ought to afford relief to the pitiable ryot groaning under the burden of perennial debt. The Debt Relief Act can only save him from past liabilities, but can be no safe-guard against his running into future debts, which is almost certain so long as the present state of affairs continues.

Fruits like mangoes, oranges, and lemons can be grown in this region. Formerly there were some of these gardens, but when the plants gradually died out, they have not been replaced as it was not found to be a paying concern at the time.

A brief account of what has been done in Italy to encourage the fruit industry may not be out of place here. Fruit industry in Italy did not pay a few years back, until the Government came forward with their big schemes to give impetus to fruit industry —such as improving the varieties, raising the quality of fruits through proper standardisation or grading, efficient cold-storage, excellent transport facilities in the form of fast and cheap transportation and organisation of sale known as The Department of Collective Sales of the Products of Earth. The National Institute for Export created in 1925 at Rome has greatly contributed to keep up the price of Italian produce by

(a) Creating standards for various fruits which alone could receive the mark of national guarantee;

(b) Organising the sale of produce through a great body of direct agents of this institute—the agents being scattered over all the important places in Europe.

The starting point of this system is the local Co-operative Society. All that a producer has to do is to bring his produce

every morning to the society. The produce is weighed and thereafter taken care of by the society.

Italians under the lead of Mussolini have imbibed the spirit of co-operation and have realised that in co-operation alone lies their safety. No wonder that the Italians have largely succeeded in capturing foreign markets greatly at the expense of France.

While French exports of horticultural produce in 1928 amounted to 90% against 10% from Italy, in 1930 the French exports went down to 15% against 85% from Italy.

Among the means that the Foreign Governments are adopting to develop the fruit industry of their countries may be mentioned a few such as Laws to regulate the production of nursery plants for sale in Egypt, free supply of nursery plants in Egypt, Palestine, Italy; remission of land revenue in Italy for a number of years to those adopting an approved system of fruit gardening; subsidies to encourage fruit gardening and fruit preservation in Italy and Switzerland; and various others.

—From *Fruit Industry of Italy and Sicily Island* by S. S. Lalsingh, B.Sc., M.Sc., California Fruit Specialist, Lyalpur, Punjab.

The influence of co-operative societies on the dairy-farming of Denmark is too well known to call for a detailed account.

Minor Industries

On account of its focal position the town has been a centre for cottage industries like potteries and basket-making, which do not now-a-days find sufficient market in any single village. Their location only in certain parts of the town is an interesting feature.

Earthenware has always been used by the poorer classes for all their needs, each village having its own potter. When the new settlers came here, they naturally purchased their pots, tiles and such other things from the nearest village, now known as Old Guntur. So even to this day only this part of the town has potteries, although the clay required, is obtained from distant tanks, the black tank (T in the map) included.

The basket weavers have found it more convenient for their business to be as close as possible to the junction of the various roads leading into the town.

Wherever millets are largely grown for food, plenty of fodder is available for cattle. Large numbers of them are reared and

they, in return, supply food to the farmer's family and manure to his fields. The womenfolk look after the cows and calves and the she-buffaloes. Dairy-farming has been the occupation of the women-folk. Every year large quantities of ghee, worth several lakhs of rupees are exported from this town, especially to Calcutta.

This has given rise to the tin-making industry.

To meet the demand for flesh in the town, about 100 goats, sheep and cattle are slaughtered each day. This has led to the setting up of a tannery. Lime, the principal tanning material is obtained from the limestone quarries (L in the map) nearby. Most of the tanning barks can be had cheap from the forests of the district.

Ground-nuts have to be husked before being exported. Oil Mills have been set up for pressing the oil out of the seed. There are seven of them in the town this day. The oil is for both local consumption and export. Oil cake, sold at about Rs. 13 per ton of 500 lbs., is used as manure for rice and sugar-cane, and also exported to Europe where it is used for feeding cattle.

Much of the rice from the neighbouring areas under wet cultivation, is milled here chiefly for local use. There are eight rice mills in the town.

Cotton is ginned and pressed into bales for export. This trade as already noticed, is gradually on the decline.

All these mills have been using only steam power. A licensed company for supplying electric power has recently been started. But the high rate charged has been an impediment to the free use of this power by these mills. The proprietor does not readily come forward to replace the steam engine by an electric engine, as it requires fresh investment.

A number of tobacco handling firms have been started. Over 8000 labourers, from the town as well as the neighbouring villages, find employment in them each day.

Conclusion

The economic prosperity has brought in its trail some evil effects. The sanitation of Guntur is in peril. The smoke from the factories has contaminated the atmosphere. The labourers' quarters are much overcrowded. Cholera and small-pox levy their annual toll. For want of a proper drainage system, mosquitoes are freely breeding and threaten to become a pest. Malaria is taking firm root in the area.

Along with the supply of cheap electric power, the government should see to it that the factory-owners make free use of it. A well-controlled supply of water, coupled with a proper drainage system, is the most urgent need of the town. Provided these are ensured, Guntur is bound to be a far healthier place and before long a fine city.

A nodal town and consequently a busy trading centre, a railway junction, and the headquarters of the district, Guntur has developed by leaps and bounds. But the ryot, the true foundation of all society, has always remained what he was centuries ago. His condition has not a whit improved, if it has not actually deteriorated. He looks forward anxiously to the national Government for his uplift.

Crop	Cost of production per acre		Yield per acre in candies		Selling price	Value of yield per acre	Net income per acre
		Rs.					
Chillies	Tilling	8		Past	Rs. 30 per candy	Rs. 90	Rs. 77
	Plantation	5		Present	,, 60 per candy	,, 60	,, 47
	Total	13					
Ground-nut	Tilling	3					
	Seed	8		4 candies			
(first years)	Harvesting	9			,, 1/12 per maund	,, 140	,, 120
	Total	20					
	Tilling	3					
(present)	Seed	3		1½ candies			
	Harvesting	3			,, 10 per maund	,, 19	,, 10
	Total	9					
Tobacco							
(a) Country leaf	Tilling	8					
	Plantation	5		2 candies			
	Harvesting	5			,, 40 per candy	,, 80	,, 62
	Total	18					
(b) Virginia	Tilling	8					
	Plantation	6					
	Total	14				,, 30	,, 16
	Leafing & curing	30	(unable to afford this, the ryot sells away the raw leaf)				
Millets	Tilling	3					
	Seed	2					
	Harvesting	3				,, 35	,, 27
	Total	8					

Sugar Cane Cultivation in India*

By

George Kuriyan, B.Sc. (Lond.),

Department of Geography,
University of Madras.

The name Sugar is applied to more than hundred substances having distinctive properties and scientific names; for example sucrose, glucose, maltose, fructose etc. Of the numerous sugars which occur in plants, sucrose is the most abundant and has been extracted commercially from the sugar cane, sugar beet, maple tree, Indian maize, sorghum grass and several species of palms. As it occurs in solution in the sap or juice, the task is only to extract the juice and convert the dissolved juice into the marketable crystals—the sugar of popular parlance. Therefore, cane-sugar, beet-sugar, maple-sugar etc., consist essentially of sucrose admixed with small percentages of impurities derived from the plant juice. These impurities account for the differences in colour, odour, and flavour of raw cane and beet sugars. When refined, these sugars are odourless and colourless; have equal sweetening power; contain about 99·8% of sucrose and cannot be distinguished from one another by chemical analysis. After further purification in the laboratory, they contain about 100% of sucrose.[1]

Sugar is a necessary food crop and apart from wheat, rice, maize and potato, forms the greatest item of mankind's dietary obtained from the vegetable raw materials. Cane sugar however is not indispensable. By trebling the area in sugar beets, the world demand of sugar could be met. Moreover, several of the palms could be utilised so that the output of sugar could be enhanced considerably. Maize and Sunroot (Helianthus tuberosus) are rapidly becoming serious competitors thereby gravely threatening the leadership of cane.

* A paper contributed to the Geography and Geodesy Section of the 26th Session of the Indian Science Congress, Lahore—January, 1939.

1. Vide *Encyclopædia Brittanica.*

Barrett says that the sugar cane was first domesticated presumably somewhere in South Eastern Asia or the East Indies.[2] Sugar cane is a perennial grass, the cultivation of which is confined to the warmer regions of the earth. In all probability it is of palaeo-tropical origin and South Eastern Asia is assigned as its home by economic botanists.[3] Etymologically sugar is of Indian origin, the earliest forms of the word being Sharkara[3a] in Sanskrit, Sakkara in Prakrit, thence it can be traced through all the Aryan languages as Schakkar in Persian, Sukkur in Arabic, Suicar in Assyrian and Phoenician, Saccharum in Latin, Azucar in Spanish and Portugese, Zuchero in Italian, Sucre in French, Zucher in German and Sugar in English. It is of interest to note that sugar cane was known to India for the last 2,000 years. The earliest reference to this in western countries dates back to 627 A.D. when sugar figures among the spoils taken by the Byzantines after their conquest of Dastagerd in Persia. Again it is recorded that the Chinese Emperor Tai Tsung sent a batch of Chinese students of agriculture to study the methods of cultivation of sugar cane and the manufacture of sugar. Several Mahomedan writers have stated that sugar is of Indian origin. The sugar cane plant is indigenous to India[4] and it yields a higher proportion of sugar than any other plant,[5] beet coming next to it and the date palm after beet; the maple tree of America may be regarded as the fourth in importance. Sharkara is mentioned in the shastras as one of the five 'Amritas' or celestial sweets. All this suggests that the cane was indigenous to India and sugar was first manufactured from the cane in India.

2. Barret, *Tropical Crops*, page 112.

3. Proceedings of the 25th Indian Science Congress, 1938, Calcutta, Part 2, page 271. "The fact that such widely varying types (sacharum spontaneum) exist in parts of India even to this day is perhaps indicative of certain of them being the primary centres (or centres of origin) for this species."

3a. It has subsequently been suggested to me that Sarkarai is a Tamil word. In Tamil, Karai means coast and Sarkarai therefore means that which came by the coast.

4. Vide, Proceedings of the Indian Science Congress, 1938, Calcutta, Part 2, page 270. "Members of this group (sacharum spontaneum) occur in the wild state throughout India and are found growing wild in places that are liable to severe drought in summer and flooding during the rains. They are at home on river banks and tank beds which dry up in summer.

5. *Encyclopedia Brittanica.* Record production of beet was 2.19 tons of commercial sugar per acre in Germany in 1910-11, and for cane, 5.5 tons per acre in Java in 1925-26, or about 2½ times that for beet. The corresponding crops were 12 tons of washed beets and 42 tons of cane per acre.

Nevertheless the cane was found growing in Polynesia and the Hawaiian islands by the first European visitors. Ethnologists assert that these islands were settled from the South Pacific at a very early date and probably these early migrators brought the cane with them.[3a] The presence of the plant in the South Pacific at a very remote time is thus indicated, suggesting thereby that the cane is indigenous to both South Eastern Asia and the South Pacific.[6]

A mere enumeration of the principal sugar growing tracts of India would lead one to infer that all kinds of soils answer for the growth of sugar cane, including as they do the archaen soils of Chota Nagpur, the old alluvium of Bihar, the new alluvium of Eastern Bengal etc. "Cane can be grown successfully on a great variety of soils. Typical cane lands have a heavy texture—good clay loams and rather heavy alluvial soils are among the best of course, much depends upon the nature of the sub-soil. A fairly light top soil if underlain by a good clay sub-soil will be very satisfactory for cane. Very heavy top soils on the contrary are better if the sub-soil is somewhat open, since this makes for better drainage which is a matter of first importance. Different kinds of cane have different soil requirements."[7]

Sugar cane has a preference for lowlands and volcanic soils. The character of the soil is indeed of prime importance, the best being loams rich in humus and derived from volcanic, coralline or crystalline rocks. Phosphates are greatly valued as a manure, but where the land is annually renovated by silt, no special manuring is necessary, nor is it of much use. In India it is found that the best canes grow at the junction of old and new alluvia on the sides of streams and rivulets. These are mostly the red clay loams specially rich in mineral matter. For growing the superior varieties of cane, the two principal considerations that should guide one in the selection of a site are:—(1) Is the land close to water from which it can easily be irrigated? and (2) Is the land above inundation level, and easily drained, yet level?

It has been found that lime is an essential constituent of the soils, most appropriate to the cane; in calcareous soils, the most

6. This suggestion is made more probable when the marked difference in habit between the Indian canes and those of the Otaheite and other Polynesian islands is remembered.

7. Earle, *Sugar Cane*, page 193.

robust canes are grown and they afford the sweetest juice. The physical properties of the soil are as important as the chemical constitution; it demands a deep and free soil. Deerr recognises 4 types of soils,[8] the Indo-Gangetic and other alluvial deposits, the Black Cotton or the Regur soils, the red soils of the Madras Presidency overlying the metamorphic rocks, and the laterite soils. Generally all the soils contain large quantities of iron and alumina, with ample supplies of potash and magnesia. Lime, phosphoric acid and nitrogen are usually low.

Sugar cane is a plant that requires a high temperature and large quantities of water. The limits of its cultivation are best defined as lying between the mean annual isotherms of 68°F. In most of the cane growing regions, the temperatures of the coldest months are not much less than 60°F and in the warmest month they may be as much as 83°F approximately. Nevertheless, the cultivation of sugar cane though typically tropical is not confined to the tropics. Louisiana, Argentine, Spain, Southern Japan, New South Wales, the Punjab and upper United Provinces are well outside the tropics, and some of these regions experience freezing weather, sometimes of considerable severity. Since the buds of the growing cane are killed even by a slight frost, the stalks intended for seed have to be protected with cane trash and earth. The standing cane can be utilised for the mill after the buds have been killed by light freezing, but a heavy freeze however, renders it worthless, so that the harvest has to be hastened making the grinding season as short as possible. The worst disadvantage of all these extra-tropical climates is that all the crop has to be made on immature cane. A frost sufficient to kill the standing cane does not usually injure the roots and such fields can be ratooned, although fewer ratoon crops are usually taken in extra-tropical regions.

As the cane is grown in countries widely differentiated both as regards latitude and altitude, there is a wide variation in the conditions under which it is produced. By actual measurements in Hawaii, it has been shown that the rate of growth of the plant during the cold season was decidedly less than during the dry season. The period taken for the cane to ripen is also dependent upon the temperature; with a higher temperature, the period of growth is less.[9] Walter in his book on the Sugar Industry of Mauritius has shown that the product obtained by the multiplication of the

8. See Noel Deerr, *Cane Sugar*, page 71.
9. See Noel Deerr, *Cane Sugar*, page 24

excess of the daily mean temperature over 70° F with the number of days is constant and is equal to 1350. The cane usually takes 12 to 14 months to ripen; the average annual temperature is important, 75°F being desirable with a summer of nine months duration.

Sugar cane can be grown successfully in all parts of the tropics where sufficient moisture is available, either from rainfall or from irrigation. Where the average rainfall reaches 50″ per annum, it can usually be grown without irrigation,[10] but where the rainfall is much under this figure additional water will be required to obtain profitable yields. "With rainfall alone, 100″ a year, if properly distributed will usually give as good or better results than any greater quantity."[11]

The effect of rainfall is more than a matter of total fall, its distribution being of equal importance. The 50″ mentioned above would be entirely inadequate if equally divided among the 12 months of the year. "Climates with a pronounced dry and wet season are much better than those where the rainfall is equally distributed throughout the year, (contrast Java) especially where there is salt in the air or in the soil or in both. While harvest time should be dry, the growing season should receive more than 60″ of rain."[12] It is worth noticing that every part of the cane growing regions of India has a pronounced wet and dry season.

The rainfall of the tropics when averaged over a number of years, may appear to be very even both as regards periodicity and quantity, but nevertheless in several cases, the seasonal rains fail and cause prolonged drought. Likewise, prolonged spells of wet weather are also common, but the damage they occasion is small, compared with what is due to a prolonged drought. Conditions in the cane growing regions of India are no better than elsewhere. In the report of the Agricultural Department of Bihar and Orissa, it is stated that the season under report has been exceptionally dry and most unfavourable...."although the total amount of rainfall was not very different from what we had in the last two years. Our

10. See Earle, *Sugar Cane*, page 191.
11. Earle, *Sugar Cane*, page 192. The humidity of the atmosphere is also important; as it grows less, the greater becomes the quantity of water that is transpired from the leaves, and the greater becomes the demand on the soil supply.
12. Lyde, *An Atlas of Economic Geography*, page 70. Note that the figure 60″ is higher than that of Earle.

total fall this year was 37·19″ as against 39·59″ and 40·83″ in the preceding years, but only when we look at the actual distribution of the rainfall—the real state of affairs becomes evident. About 50% of this year's rainfall was confined to one month, i.e. August, which was the real wet month of the year causing great havoc in the form of floods etc. Deficient rains in July and September coupled with practically nil in June and October has made the year 1935, one of the worst agriculturally."[13]

The main effect of drought on the crop is reduction in tonnage; what crop is harvested will contain a high percentage of fibre due to the restricted length of the internodes and to the evaporation of water from the cane by increased transpiration.

The temperature change has a very important bearing on the composition of the cane. In those places that have a uniformly high temperature and no cool season, an impure cane low in sugar content and high in reducing sugars, is almost invariably harvested. In such a case there is opportunity for continuous vegetation growth and the crop will consist of ripe and over-ripe canes. The non-sugars present will consist of products in process of metabolic change and of degradation product formed by the breaking down of cane sugar. In extra-tropical climates like Louisiana the limited period of growth affords a cane that does not have an opportunity to reach maturity. A juice low in solids, sugar and purity, and high in reducing sugars results, the latter bodies representing material in process of transformation to cane sugar.

A sweet and pure cane is found in those regions where a longer period is taken for maturity, combined with a season sufficiently cool as to check the vegetative vigour of the plant, whereby, its energy is directed towards the elaboration into cane sugar, of material already in process of transformation. Those localities lying on the confines of the tropics present these conditions and when as in the Punjab and the United Provinces, water can be withheld from the plant, and that in the plant allowed to transpire, the sweetest and purest material results. (The same procedure can be adopted in Madras also although it lies inside the tropics).

It would not be unreasonable to suppose that those areas lying in a zone of nearly constant rainfall would afford a cane of low sugar-content. Such however is not the case. On the other hand,

13. Report of the Agricultural Department, Bihar and Orissa, 1935-36, page 41.

the effect of the heavy rains during the crop season is seen in a diluted juice for several days after the fall.

"The ideal distribution of rainfall and temperature for an annual cane crop in the Northern Hemisphere would be somewhat as follows:—During the crop period (December to April) a cold dry season should prevail with showers of sufficient frequency to maintain the vitality of the cane without interfering with the harvest operations. During the next six months (May to October) there should be a high temperature combined with a heavy and well distributed precipitation. The rains should fall at the rate of about 2″ or 3″ a week, with absence of excessive falls or prolonged periods of drought. For one month prior to harvest, the rainfall and temperature should both decrease in order to stop the vegetative growth and allow the cane to ripen, but complete absence of water is not desirable. Finally it may be mentioned that early rains after harvest give a cane that itself ripens early."[14]

In a large sub-continent like India, there are wide variations in climate from place to place, but nevertheless there are certain remarkable features of similarity in the whole region. In winter, the North West Frontier Province, the Punjab, and upper United Provinces enjoy cool climates, sometimes even freezing—while the south is distinctly hot, right through the year. In summer however, there is a complete uniformity of temperature, no part of the whole of India having a temperature less than 68°F (excepting some of the hill resorts). Temperature seems to play only a very minor part in delimiting the area under cane cultivation.

The seasonal distribution as well as the total quantity of rainfall varies from place to place; in Assam and the West Coast it is more than 100″ while in South West Punjab, Sind and some other tracts it is less than 10″. The rainfall statistics of the several parts of India are given in Appendix 1. In general it may be said that everywhere in India, May to October is the season of heaviest rains, July and August being the two months of maximum rainfall (except the Madras coast). December to April is the dry season in India (except the Frontier Province).

The differences of climate met with in India have a direct bearing on the type of crops grown. Sugar cane is moreover grown in a series of separate tracts over the length and breadth of India. As a rule, it is grown as an irrigated crop (about 60% of the total

14. See Noel Deerr, *Cane Sugar*, page 29.

crop in India is grown under irrigation) except where the general flow of water raises the water table.[15] In the North West of India in the semi-arid tract of the Punjab, with occasional frost in winter and intense heat during the summer months, the canes met with are some of the smallest and most fibrous in the world, although such juice as exists, is distinctly good. Proceeding towards the south east along the line of the Himalayas, the climate becomes less and less arid, till in Bengal and Assam it becomes extremely humid. In direct response to the variation of climate a change takes place in the class of canes grown, till in Assam and Bengal thick tropical canes are met with. Similarly towards the south, in Mysore and Madras the canes improve in quality and where sufficient water is available, thick canes almost equal in quality to the best canes found anywhere else in the world are met with.

Roughly then in India there are two main belts of sugar cane to be distinguished differing from one another in as remarkable a manner as possible. The first is a belt in the north. 200 to 300 miles wide running along the line of the Himalayas increasing in density towards the middle (United Provinces) and thinning out at each end. This belt almost entirely consists of thin hardy indigenous canes, differing often greatly from one another but which have been collectively called Saacharum Barbarei. The second belt lies in the Peninsula where in Bombay, Madras, Mysore, and Hyderabad, wherever sufficient water is available, thick tropical canes (Saacharum Officinarum) are the chief forms grown. Here and there under unfavourable conditions, the indigenous types are still met with, but they are merely thicker kinds of the northern types and gradually decrease in number towards the south and finally disappear altogether.

This naturally suggests a great development of the industry in the Peninsula which however is not the case. In India much the larger area under cane lies outside the tropics (vide statistics in Appendix II). More than half the total acreage is in the United Provinces (51·1%), the Punjab accounts for about 14·4% and Bihar and Orissa for 12·3%. Bengal has about 7·67% of the total acreage. All these provinces lying outside the tropics together account for nearly 85·5% of the total. Madras has only 4% of the

15. In Bengal the irrigated crop occupies about one-tenth the total acreage under cane; in Bihar and Orissa the proportion is more than 1/3, the unirrigated crop being confined strictly to the river valleys. Vide Appendix II for the importance of irrigation for the crop.

total acreage, Bombay less than 2·5% and the other parts of tropical India have still smaller proportions. In India therefore, sugar cane is essentially a crop of extra-tropical regions!

The two main reasons for this apparently anomalous distribution are (1) the presence of rival food crops in the south and (2) the greater cost of growing the tropical canes. In the south, water is comparatively scarce and dear and practically all is used up in growing rice; in the north, wheat is grown as a winter crop, and thus there is no real competition with the sugar cane for water. It is only in Bengal in the north that rice becomes an important crop, but here no scarcity of water is felt, so that both rice and sugar cane can be grown.

As to the cost of growing the two kinds of cane, the thin northern canes thrive under the greatest of neglect and very little money is spent on its cultivation; it is often merely grown as a crop on which the farmer can raise a loan and once the bargain is concluded, it is left to itself. The season for active growth is rather too short, (4 to 5 months) as the temperatures are occasionally too low in winter for even the hardy northern forms to thrive. In the south, on the other hand, sugar cane is one of the most expensive of crops and for a ryot to start growing it is taken as an emblem of success. Much manure in the form of cake is needed; water is costly and attention is required all the year round. Added to this, there is always the danger of water failing during the drier seasons of the year and sometimes disease appears and the whole crop is thus liable to be lost. It is therefore only the better class of agriculturists who attempt a cultivation of the cane in the south. "Sugar cane growing is typical of the most intensive cultivation which the Deccan ryot pursues, and one which causes him great expense in water and manure. In Deccan it is confined to those regions where an assured supply of water is available."[16] Again it has to be remembered that the cane usually takes one year or more to ripen and the South Indian ryot, can in the same period, with the same amount of water, have two or three other crops. The supply of water has to be assured in the case of cane while in the other cases, it is not so imperative. In the south, the difficulties of irrigation are greater, due to the prevalence of the lift system. In addition, sugar cane is a crop which is more or less a gamble from the point of view of the ryot as the price of jaggery or gur is liable to very serious fluc-

16. Simkins, *Agricultural Geography of the Deccan Plateau*, pages 55 and 56.

tuations,—much more than that of any other food crop. The technique in the manufacture of gur is rather specialised; such technical experts are confined to a few families in the South and there is thus a dearth of technicians. Indifferently prepared gur has very poor keeping qualities. It is a result of all these various factors that the south has not become an important area for the cultivation of sugar cane.

Irrigation is general wherever the cane is grown in India.[17] The land is usually watered before planting, after which irrigations follow at first every five days and afterwards every eight days. The water is obtained from wells, tanks or canals as the case may be. The system usually adopted is the furrow irrigation.[18] From the time of planting up to about three months before harvest, it is the object of the plantations to irrigate the area once every week, though frequently the available supply of water is insufficient. During the three months preceding harvest, only enough water is supplied to maintain the vitality of the cane and during this time, it actually evaporates its own water. Irrigation in hot weather has been found to give better yields. "It has also been found that three irrigations, about two acre inches each, given during the period between the third week of April to the beginning of June, provide the plant in advance with an equipment of foliage and surface roots that would be serviceable immediately on the advent of the rains; the possibilities of a quick response and a faster growth during the rains are thus promoted. Where the cane receives no irrigation during the hot season, it reaches the rainy weather poorly provided with the requisite foliage and lateral roots, so that its

17. Vide, Appendices II and III.

18. *Furrow Irrigation.* From the supply ditch water is led to the level ditches laid out at intervals of 150′ to 200′ and with a fall from ½ to ¾% grade. From the level ditches, lead the water courses laid out at distances varying from 30′ to 75′, the distance depending upon the nature of the soil and on the grade. Parallel to the level ditches and at right angles to the water courses are the cane rows from 5′ to 6′ apart down which the water flows. The furrows in which the cane is planted should be with advantage laid out with the level and on their accuracy depends much of the efficiency obtained in the application of water. On very level land it is possible and on porous soils advisable to allow the water derived from the water courses to flow both ways in the furrow, thus halving the length of the travel. "Trench planting of cane does not result either in better cane or sugar yield per acre as compared to planting flat in furrows. On the other hand, it is much costlier." Vide, Report of the Agricultural Department of Bihar and Orissa, 1935 to 36.

phase of quick growth is delayed—a feature of considerable importance in those parts[19] where the main growing season is generally restricted to the rainy weather. It appears that if the hot weather irrigations are properly timed and applied in accordance with the needs of the plant, three irrigations might prove to be the best."[20]

Sugar cane harvesting and planting can proceed for eight months in the year, i.e., September to April but the best time for harvesting is December to February, and the best month for planting the cuttings is February. Harvesting and planting in September and October are advantageous in that high prices are obtained during the Pujah season and sprouting of the cutting also takes place freely during this season as the heat and moisture are both sufficient for the young plant. The cold weather that follows retards the growth and makes the nodes of the cane very short. From November to May as many as twelve irrigations may have to be given to keep the plants in proper condition; from February the growth is again normal and there are no short nodes formed, but as a rule, the time and expense from September to February are wasted, except for the high prices fetched for the chewing cane during the Pujah season. The sprouting is very tardy if planted between November to January and they make no more progress than those planted in February. By planting in March, one irrigation can be saved, but the growth of the cuttings planted in February are better. In Bihar & Chota Nagpur, March planting answers because March is a cool month. The principle of planting in mild temperatures after the cold weather has well passed off, but a good while before the rains set in, can be followed with advantage in every locality. Planting in May or June is very risky except in free and gritty soils as water logging or even heavy rainfall when the plants are still short, is injurious to sugar cane. Sugar cane is benefitted by heavy rainfall if it commences after the plants are about a foot high.

Recent research in Bihar[21] has shown that the soaking of seed selts in ordinary water for 12 to 14 hours before planting ensures full and quick germination and results in better subsequent growth.

19. This statement applies equally well to every other cane growing region in India.

20. Report of the Agricultural Department of Bihar and Orissa 1935-36, page 75.

After January, early planted cane has an advantage over the late planted one, so that where large areas have to be planted, it is best to start early rather than prolong plantings into late March when soil-moisture conditions may not be adequate for good germination."

"The optimum planting distance between rows in the case of early varieties (Co. 299, 313 etc.) is 2½' while that in the case of mid-season and late varieties (Co. 213, 331 etc.) is 3 feet. Wider spacing does not give higher yields."[21]

The best manures are 40 lbs. of Nitrogen and 50 lbs. of phosphoric acid in addition to a basal dressing of green manure. Where the soils are poorer, the Nitrogen may be increased to 60 lbs. Both Nitrogen and phosphates are best applied in two doses, half at planting time and the other half at earthing up before the rains. When castor cake is to be applied as a manure it is advisable to compost the cake a few days ahead and then thoroughly to incorporate it in the furrows before planting.

Dr. Mirchandani of the Bihar Agricultural Department suggests that there is no manure as good as farm yard manure, and wherever possible it should be used freely, care being taken that the manure is well rotted before it is put on the land. Organic matter—be it farm yard manure, compost or green manure—in some form is absolutely essential for the soils and the best cane crop can only be grown on land adequately supplied with organic manure. In the Irwin Canal area in Mysore, free use of fertilisers is made and this accounts for the high yield.[22]

(To be continued)

21. Report of the Agricultural Department of Bihar and Orissa, 1935-36, page 76.

22. Department of Agriculture, Mysore, Bulletin, *Development of the Sugar Industry in India.*

APPENDIX I

RAINFALL.

Province.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total for the year.	Total rain-fall in Dec-Apr.	No. of rainy days Dec-Apr.	Total rain-fall in May-Oct.	No. of rainy days May-Oct	Remarks.
Assam ...	0.67	1.53	4.00	9.00	12.08	18.23	18.74	16.83	12.50	5.66	0.90	0.35	100.49	15.55	about 12	84.07	about 80	The rainfall during the growing season is very heavy and there is a danger from over-precipitation. Normally there is no need for irrigation except as a protective measure in partially dry seasons. Even during the harvesting season *the Rainfall* is too heavy.
Bengal ...	0.34	0.95	1.67	3.25	7.64	14.62	15.14	14.26	10.80	5.08	0.79	0.16	74.79	6.37	9	67.63	75	
Orissa ...	0.22	0.44	1.17	1.08	1.38	3.31	9.83	13.01	13.09	8.96	4.88	1.52	58.80	4.29	8	52.99	63	For the 4 months, June to September, the rainfall is both well distributed and adequate. The need for irrigation is less than in the United Provinces. It is only during May and October that irrigation becomes essential during normal years. The region gets drier as the cane ripens.
Chota-Nagpur ...	0.14	0.77	1.15	0.93	0.70	2.13	8.97	12.91	13.77	8.10	2.92	0.39	52.83	3.69	8	46.08	63	
Bihar ...	0.09	0.42	0.69	0.47	0.60	2.27	7.78	12.36	12.31	8.80	2.32	0.29	48.60	2.97	8	46.04	63	
United Provinces East ...	0.23	0.63	0.55	0.32	0.19	0.67	4.78	11.55	11.33	6.87	1.87	0.19	39.17	1.91	4-5	37.07	43	During the growing season, rainfall is adequate and well-distributed. During July, August and September, the total amount of rainfall varies and irrigation is necessary. During the harvesting season, there is a diminution of both temperature and rainfall.
United Provinces West ...	0.26	0.96	0.89	0.61	0.30	0.68	4.06	11.47	11.14	5.96	0.88	0.15	37.46	3.12	4-5	34.19	43	
Punjab East and North...	0.44	1.21	1.02	0.91	0.56	0.62	2.02	6.22	6.37	3.30	0.38	0.13	23.18	4.14	9	18.61	53	Rainfall is inadequate right through, particularly so during the growing season, i.e., May to October. Irrigation becomes necessary without therefore, the cultivation of the crop is rendered impossible. It is only N. & E. Punjab and Kashmir which have even a moderate rainfall, S. & W. Punjab being a dry area. Cultivation of the cane is found only in N. & E. Punjab.
Punjab South and West...	0.21	0.50	0.53	0.64	0.52	0.42	0.81	2.46	2.56	1.11	0.10	0.08	9.95	2.40	9	7.47	58	
Kashmir ...	1.07	3.71	3.54	4.60	3.45	1.93	2.53	7.26	7.86	3.60	1.05	0.48	41.98	18.27	8	23.25	53	
North West Frontier Province ...	0.54	1.23	1.19	1.89	1.54	0.77	0.86	2.58	3.16	1.18	0.33	0.28	15.60	6.44	19	8.88	8	The rainfall is completely inadequate and irrigation thus becomes particularly important.
Berar ...	0.39	0.39	0.35	0.33	0.24	0.54	6.05	9.12	6.91	5.80	1.57	0.57	32.26	1.70	about 5	29.99	about 50	In the Central Provinces, rainfall from May to October is just sufficient so that irrigation is more a matter of protection than of dire necessity. In Berar and the Central India States, it is on the contrary, a matter of prime importance as the rainfall is too low.
Central Provinces West...	0.30	0.65	0.71	0.59	0.31	0.59	7.39	13.41	12.91	7.60	1.82	0.56	46.87	2.56	5	41.75	49	
Central Provinces East ...	0.29	0.46	1.11	0.60	0.73	0.79	9.32	15.27	14.93	7.61	2.55	0.49	53.74	3.19	5	50.15	49	
Bombay Deccan ...	0.28	0.39	0.15	0.08	0.15	0.62	1.35	5.22	7.85	5.44	5.61	3.02	30.79	1.29	...	28.49	48	In Bombay, the variations in rainfall are very great. On the Konkan Coast the total fall is more than 105". In the Bombay Deccan, it is in the neighbourhood of 30". June, July and August are three months of heavy rainfall. During the remaining 9 months, irrigation is necessary. Rainfall is insufficient and the crop has therefore got to be irrigated. The distribution of rainfall, however, is well suited to the crop. Same as for Hyderabad and the Bombay Deccan Rainfall is ample and irrigation is unnecessary.
Hyderabad North ...	0.36	0.16	0.25	0.37	0.51	0.73	5.51	8.00	7.23	8.10	2.30	0.77	34.29	1.65	3	31.87	48	
Hyderabad South ...	0.22	0.18	0.24	0.42	0.81	1.02	4.35	6.24	6.31	6.82	3.02	1.06	30.67	1.87	3	27.74	48	
Mysore ...	0.45	0.12	0.13	0.31	1.46	3.58	4.80	7.15	5.23	5.18	5.30	2.42	36.13	2.47	6	31.24	50	
Konkan ...	0.13	0.10	0.05	0.06	0.36	1.55	25.31	39.09	23.99	12.53	4.30	1.01	108.46	0.70	12	106.77	82	Rainfall during the growing season is sufficient (except for the two months September and October). During the hottest parts of the year, there is a scarcity of water and irrigation is a matter of essence.
Malabar ...	1.86	0.92	0.57	1.50	3.84	7.39	21.50	12.16	7 85	11.33	7.76	1.86	100.10	8.69	12	84.05	82	
Madras South East ...	3.38	0.98	0.47	0.51	1.29	2.53	1.56	2.19	3.61	4.48	7.10	7.47	35.57	6.63	6	24.47	56	
Madras Deccan ...	0.41	0.30	0.14	0.21	0.62	1.67	2.36	3.21	3.91	5.75	4.18	2.18	24.84	1.58	6	21.08	56	
Madras Coast North ...	0.85	0.38	0.39	0.50	0.93	2.10	4.91	6.61	7.07	6.96	6.75	3.69	41.14	3.05	6	34.40	36	

Geography of the Casuarina Plant in South India*.

By

T. P. Venkatachari, M.A., L.T.,

Introduction.

The Royal Commission on Agriculture has struck a note of warning against the colossal waste of farm-yard manure as fuel, and has laid on the Agricultural Department the burden of making the cultivator utilise the farm-yard manure for its proper purpose and it has further laid stress on the fact that any propaganda can never be effective unless an alternative fuel specially suited to the needs of the Indian house-wife is suggested. Casuarina is a fuel which can best be substituted for the cowdung fuel. In an agricultural country like India the problem of manure is of the greatest importance, and if it could be solved to any considerable extent by solving the problem of fuel, which in itself is not a minor problem, then it is imminent that it is studied soon and a solution got at.

In this paper an humble attempt is made at a study of the geography of the casuarina plant and its possibilities in the solution of the fuel problem of our country.

The Casuarina

An exotic plant, the Casuarina has so well taken to the country, that it has come to be commonly believed to be an indigenous tree. It is a single genus of about twenty or twenty-five varieties occuring in Australia and the neighbouring islands of New Caledonia and East Indies, from where, the species 'the casuarina Equisitefolia' has been brought into India early in the last century, and developed all over the country, especially in South India. And another species, 'the casuarina Muricata' has been introduced by about 1830 from Chittagong and Tenassarim coast where this species thrives best, into the Deccan plateau through Assam and Bengal. This plant has not been developed only in the North-West —the Punjab. There is a belief that the tree was a native of

* A paper contributed to the Geography and Geodesy Section of the 26th Session of the Indian Science Congress, Lahore—January, 1939.

Persia and that it has travelled from there to Australia. But this belief is not so dependable as there is not much of a conclusive evidence. It is, however, a fact that it is wide-spread in the old world tropics.

Migrations of the Casuarina

It is believed that the casuarina has spread northwards from Australia and the neighbouring Islands, through the East Indian Islands, Malaya, Burma and Chittagong into India proper. It was sent to Calcutta in the memorable year 1858, by Dr. Buchanan from Chittagong. From Calcutta it has spread northwest as far as Ambala and south into the Deccan. Simultaneous with the spreading of this plant from Burma and Assam, the Horti-Agricultural society of Madras got down seeds from the Queensland Acclamatization Society in 1875 and developed it north and south of Madras along the coast and in the west coast of Madras. There is another version that the Casuarina came down to us from Japan and this also is plausible as the plant might have taken another route in its northward movement. from whence some seeds might have been brought to India.

It matters little from where it came. It is a proven fact that it is an exotic plant which has taken well to a large variety of otherwise useless soil in India. The object with which Horti-Agricultural Society of Madras brought the plant to India was to improve the sun-beaten, sandy and barren appearance of the shore. This has no doubt been achieved; for the Casuarina is a hardy plant that grows well in the sandy region and stands the saline breeze from the sea. Noticing the bushy growth of the plant, the Military Department of Fort St. George had three parallel plantations formed in the foreshore as a defence and strategic measure, as also to mask the batteries. The childish nature of the scheme was long discussed in the Madras Mail (1890) which pointed out that the plantation only served to prevent the sea breeze and that it served no other purpose. So the plantation was clipped and made to form a beautiful hedge along the foreshore which has harmonised well with the general appearance of the coast.

Description

The branches of the casuarina resemble the feathers of the bird *Cassowary*, and hence the generic name to the plant. But the vernacular names have been derived from its resemblance to the tamarisk (Latin) a feathery-leaved evergreen common at sea

APPENDIX II

Provinces and states.	Total area under sugar cane.	Irrigated area under sugar cane.	Percentage of irrigated crop to the total crop.	Distribution of the crop in the provinces expressed as a percentage of the total crop.	Distribution of the irrigated crop in the provinces expressed as a percentage of the total irrigated crop.	Total cultivated area excluding current fallows.	Acreage under sugar cane expressed as a percentage of the total cultivated area.	Total irrigated area.	Irrigated area under sugar cane expressed as a percentage of the total irrigated area.
United Provinces and States ...	1,844,580	1,161,745	63.0	51.1	55.9	36,533,209	5.04	10,812,326	10.7
Punjab (states and agency included) ...	520,339	406,680	78.4	14.4	19.6	32,863,925	1.59	17,496,097	2.3
Madras (states included) ...	138,568	121,012	87.4	3.84	5.83	35,731,016	0.39	10,802,918	1.1
Bombay (states included) ...	83,473	82,232	98.5	2.32	3.96	34,543,746	0.24	5,224,661	1.6
Bengal (states included) ...	276,200	31,835	11.5	7.67	1.53	23,357,000	1.19	1,699,448	1.9
North-West Frontier Province.	42,844	42,799	99.9	1.31	2.22	2,199,328	1.24	959,828	2.7
Kashmir ...	8,144	3,157	38.8	0.10	...	1,923,212	...	754,526	...
Bihar and Orissa ...	444,700	152,293	34.2	12.3	7.34	24,131,800	1.84	5,102,453	2.98
Central Provinces and Berar ...	28,890	26,768	92.4	0.80	1.29	24,668,067	0.12	1,045,694	2.8
Central India States ...	22,411	22,297	99.5	0.62	1.07	5,011,721	0.45	375,198	5.95
Rajaputana States ...	12,074	11,452	94.9	0.34	0.55	7,355,834	0.16	1,329,894	0.86
Gwalior ...	7,907	7,740	97.8	0.22	0.37	4,530,561	0.17	228,373	3.4
Hyderabad ...	50,580	50,580	100.0	1.40	2.44	28,370,264	0.18	1,391,300	3.6
Mysore ...	45,525	45,525	100.0	1.26	2.19	6,064,856	0.75	992,268	4.6
Baroda ...	2,278	2,192	96.0	0.06	0.11	3,296,697	0.07	131,361	1.7

APPENDIX III

Provinces and States.	Total area under sugar cane					Irrigated area under sugar cane					Remarks.
	1930-31	1931-32	1932-33	1933-34	1934-35	1930-31	1931-32	1932-33	1933-34	1934-35	
United Provinces (states included) ...	1,511,347	1,603,320	1,798,504	1,744,432	1,844,580	1,124,720	1,179,643	1,299,706	1,103,835	1,161,745	More than 20 per cent increase in total acreage with a negligible increase in acreage under irrigated crop. The increase in the total acreage is nearly ten times the increase in the acreage under irrigated crop.
Punjab (states and agency states included) ...	436,088	532,442	529,284	521,650	520,339	379,251	450,884	500,563	407,680	416,680	The total acreage has increased by about 20 per cent, while the irrigated acreage has increased by 10 per cent. About half the increase in acreage is due to the improved irrigation facilities.
Madras (states included) ...	126,47	126,515	134,131	134,554	138,568	111,995	113,205	117,978	117,287	121,012	The increase in total as well as irrigated acreage is less than 10 per cent. If the Madras states are eliminated, it will be seen that the whole area under the crop is irrigated.
Bombay (states included) ...	66,697	72,044	78,362	76,832	83,473	65,801	70,743	77,361	75,700	82,232	The total acreage has increased about 25 per cent while the area under irrigation has increased by more than 25 per cent. The increase in acreage is therefore due to better irrigation facilities.
Bengal ...	198,500	233,400	233,200	256,600	276,200	63,171	26,681	26,585	28,200	31,835	Total acreage has increased by 40 per cent while the irrigated acreage has diminished by 50 per cent. Increase in acreage is entirely independent of irrigation.
North-west Frontier Province...	46,877	44,268	53,212	49,391	42,844	46,866	44,263	53,173	49,359	42,799	The total acreage is very variable and has shown an actual dimunition. Abcut 100 per cent of the crop is irrigated.
Kashmir ...	8,924	9,459	9,750	6,596	8,144	3,708	5,072	5,573	2,638	3,157	The irrigated acreage has shown a corresponding dimunition. Same as for the North West Frontier Province.
Bihar and Orissa ...	284,000	302,846	301,700	418,000	444,700	138,099	145,510	150,320	146,028	152,293	The increase in total acreage (57 per cent) is nearly 1 1/2 times the increase in irrigated acreage 37 per cent). The increase in total acreage is therefore independent of irrigation.
Central Provinces and Berar ...	21,354	22,842	27,965	28,896	28,890	19,396	20,044	25,220	26,230	26,768	The increase in total acreage (35 per cent) is almost equal to the increase in irrigated acreage (40 per cent). The increase is therefore due to better irrigation facilities.
Central India States..	9,566	10,779	16,295	9,855	22,411	9,909	10,668	16,238	14,919	22,297	The acreage seems to be extremely variable. The whole area under the crop is irrigated. The irrigated acreage in 30-31 and 33-34 are greater than the total acreage.
Rajputana States ...	7,010	10,057	11,056	10,250	12,074	4,855	9,933	11,747	9,288	11,452	An increase of more than 70 per cent in total acreage and about 130 per cent in irrigated acreage is seen. The increase in acreage is due to better facilities for irrigation as more of the originally unirrigated area has been brought under irrigation.
Hyderabad ...	34,477	35,393	40,212	46,472	50,580	14,388	15,438	39,322	46,472	50,580	The above remark holds good in this case also Total acreage increased by 50 per cent and irrigated acreage by 250 per cent.
Mysore ...	37,734	36,676	42,093	40,334	45,525	37,734	36,051	40,265	40,616	45,525	The whole area is completely irrigated and shows an increase of more than 20 per cent. Increase in total acreage equal the increase in irrigated acreage.
Assam ...	32,994	31,332	32,007	35,485	35,934	...	...	...	...	...	The crop is totally unirrigated. The increase is less than 10 per cent.
India ...	2,886,215	3,102,899	3,445,870	3,424,072	3,635,518	2,035,257	2,122,638	2,382,905	2,085,633	2,174,635	

side. It is an extratropical hardy plant which grows well on a wide range of soils from pure sand on the edge of the sea to clay soils and sandy loams in the interior. It grows wild even in higher altitudes as in Mysore and Coorg and on the hills of Travancore.

Casuarina is a tall, straight tree growing up to even 100 feet, resembling the coniferous type. The Equisitefolia species resembles the Larch fir, while the Muricata species resembles the pine. It is an evergreen tree. The bark is smooth and brown and the branches are scattered. Its leaves are needle-shaped verticled, slightly furrowed, jointed in 6 to 8 scales and pointed and woolly. Flowers grow on all the verticles and the seeds are small with a wedge-shaped membranaceous wing. The branchlets with the internodal toothed sheaths of connated scales droop and perform the functions of the leaves. It is a distinctive plant, grouped with the walnut, which it resembles only in the nature of the simple flower and peculiar fruits, besides being uni-sexular. A full seasoned tree, say 15 to 20 years old, shows a deep brown colour, and at breast height—5 feet—has a girth ranging between 3½ feet to 4¼ feet. It burns well and quickly with a high caloric value, and the ash further retains the heat for a long time. Though not noted for its timber, it is hard and durable, so long as it is not approached by white-ants.

Generally trees 10 years and below, when cut, appear white or reddish white with a brown streak in the centre. Even these are hard and they only warp, crack and split. But this tendency to split can be overcome if the timber is seasoned slowly. It is difficult to cut through it and compared to many trees Casuarina is strong and tough and at the same time it is also elastic. The timber is hard and not easy to work. It is not durable when exposed to air, though fairly durable under covers. It weighs 50 lbs. per cubic foot and has a transverse strength of 7·4 tons per square inch. It is stronger than even teak.

Distribution

As has already been mentioned, the casuarina plantations have been raised all over India except the N.W.—Punjab. However, the plantations on the plains alone yield good results, 50 tons per annum per acre,—while those in the interior plateau region yield only 28 tons or thereabouts per annum per acre. A fast growing tree, it is found in the natural state on the sandy coast of Chittagong, Arakan especially in the vicinities of Kyanpya, Tenasserim and the Andamans. In South India fine plantations have been raised and are maintained in the Carnatic Districts of Chingleput,

South Arcot and Nellore, in the Tanjore District, in the West Coast Districts of Malabar and Kanara, and in the Tinnevelly District. In the other districts of South India casuarina has been grown as way-side avenue. Casuarina has been introduced in Travancore and there it runs wild and grows to over 100 ft. In two administrative divisions there are about 142 acres under casuarina.

The growing need for fuel in the metropolis and the transport facility and cheapness afforded by the Buckingham Canal have increased the acreage under casuarina in the Carnatic Districts mentioned above. In these districts the plantations have extended to inland areas, especially along the banks of the Pennar, and the Palar, where the soil is sandy loam. But the percentage of culturable waste that has been utilised is very low. It is really a woeful state of affairs that such a large area of culturable land should be lying idle. It is the duty of the forest department conjointly with the Agricultural Department to develop the casuarina plantations and help the poor ryot to conserve his useful farm-yard manure.

Life History of the plant

Casuarina is propogated by seeds and cuttings of partly ripened wood. There is a general opinion that the Casuarina Plantation neither coppices nor renews itself freely. But scientific investigation has proved that when the trees are cut, leaving a stump of 2 feet, the tree coppices well. And again if the casuarina is not pruned, it throws decumbent horizontal branches which develop roots and fix in the sand. And these throw up shoots if left undisturbed after the trees are cut. Thus the forest can naturally be renewed. The general opinion has been formed as the planters neither have ever allowed the decumbent branches to lie on the earth and develop, nor cut the trees leaving stumps.

The casuarina produces seeds early and copiously. It is however desirable to collect the seeds just shortly before the nursery operation is started, for it is said that the seeds lose their vitality and do not germinate if kept long; and further they are easily attacked by ants, and to preserve them carefully is a hard task.

Culture, Nursery and Plantations

The casuarina plantations are never raised direct from the seeds by the planter. And for a planter to have his own nursery, the estate has got to be considerably big. So there are nurseries which specialise in raising Casuarina seedlings for sale to planters.

There is an important nursery centre in Cuddalore supplying seedlings for large areas round about. Such nurseries have been started in a number of convenient centres.

For a nursery, a loamy soil free from white ants is chosen, ploughed after the rains have stopped. Seeds collected from 6 to 8 years old trees, and ripening during December to April, are sown generally in January or in February (occasionally in March or April too) and covered by leaves and twigs to avoid direct contact with sun. Till the plant grows to 1" and 1½", hand-watering is advised. The seed germinates in 8 to 10 days and grows to 6" in two months, and at this stage there is trans-plantation to another nursery, in which the plant grows to 2 to 3 feet in 5 to 6 months and the seedlings are now ready for plantation purposes.

The planters purchase these seedlings and plant them at a distance of 4½ to 6 feet on either side, the usual time of planting being during the rains. But in places where the water is likely to stagnate it is better to plant them just after the rains. In lands covered with grass, weeding is essential. In the case of red soil, the land has to be ploughed twice or thrice and thus the earth loosened. The plants are laid in 9" pits, and that better, if laid in baskets. This will facilitate growth of tap-root quickly. The plantation has to be watered in the first one or two seasons. Even in the second season it may not be necessary in regions where there exists better hydro-graphic condition. In any case after the 2nd season, there is no need for watering. About the end of the second or third year the soil between rows of plants is loosened by a country plough.

From the fourth year the lower branches are lopped off. Generally from the fifth year bad trees and diseased ones are weeded off until in the 6th year the plantation is reduced by 25 to 35 per cent and there are only 1500 plants in an acre. This yields good results in wood capacity at the end of 10 years. Generally, in Madras Presidency the trees are never allowed to stand for more than 10 years, the normal period being between 7 and 8 years. But, however, even for fuel purposes 15 years' standing yields very good results.

Conditions requisite for optimum results

It has already been observed that the casuarina thrives best on the foreshore of the sea. The soil being sandy the inference that had been drawn by lay people was that the casuarina can thrive only in sandy regions. However it has been scientifically

and practically proved that the casuarina can thrive well in a very wide range of soils. Then the question arises what are the conditions required for optimum results.

An analysis of the conditions of growth of the plant in the fore shore of the sea would enable us to enunciate the conditions for optimum results more easily. The soil being sandy, the tap-root can easily find its way to the water table which is definitely within 4 feet to 6 feet from the surface. And here the supply of water is plentiful. Only the water is brackish. But the casuarina being a hardy plant, it can stand the brackish nature of the water. Now it is evident that the casuarina requires a good supply of water, and a soil which would enable the quick penetration of the root. Then the secret of success of the casuarina in the foreshore is the looseness of the soil, the nearness of the sub-soil water to the surface, and the rich decayed organic matter, in the apparently barren sands of the sea. So it is that casuarina has been found to thrive even in swampy tropical west coast of Africa.

"Casuarina imported from India to west Africa is a complete success. It requires a sandy soil, tropical climate and takes admirably to the borders of west African coastal swamps where the Eucalyptus has failed. And it flourishes also on the embankments at Lagos. In a short time, Africa is expected to be studded with casuarina as the Coramandel Coast." (Indian Agriculturist 1893).

The conditions for optimum results, then, are;

(i) Sandy loam covered over by one or 2 feet of drift sand.

(ii) Water table at a depth of 4 to 6 feet; and if the soil cannot hold sufficient moisture, water table should be at a depth of 3 feet.

(iii) Tap-root must be directed down straight which is possible by growing it in baskets in 2nd nursery stage and transplanting it in whole, with the basket in plantations. This also saves wastage in plants during the transmission from the nursery to the plantation.

(iv) If planted in June, and in drier regions, the casuarina has to be watered for two seasons.

Plantations raised in sandy regions, where the water table is not near the surface, have been found to suffer from drought, until the tap-root has reached the water table. And in such cases watering is necessary for a longer period.

(v) Fencing is absolutely necessary to prevent the removing of the fallen decumbent branches. For they are of high value, (a) to the plantation itself in that they preserve the humus, (b) to the land in that they fertilise it, and (c) to the planter in that they naturally re-afforest the region.

(vi) The plantation has to be protected from goats whose refuse is very hot and affects the tender plant, and from a number of germs. But the grown up trees are prone to a disastrous fungus disease, and the tree has to be safely protected against this disease.

(vii) Mr. Hutchins of the Forest Department is of the opinion that in the Madras and Mysore Areas 12 feet on either side in smaller estates where profit alone is the consideration is suitable and that in larger estates 15 feet on either side is the best distribution. He says, however, that the popular distance is 6 feet and that some plantations are distanced 4 feet and 3½ feet as well. Casuarina, he says, is such a light loving plant, that it is injurious and uneconomical to plant at short distances.

But, there is a general opinion regarding the interrelation between height of growth, thickness of the plant, weight, and closeness of the plantation. In a close plantation the trees grow tall and the tendency to branch off is lesser. Though, in wider plantations the trees are likely to grow somewhat stouter at first, the increase in girth does not compensate for loss of weight due to short stature and there is wider branching off. Hence the practice seems to be to have a close plantation enabling first the development of height, and in the fifth or sixth year to weed out inferior trees, enabling the lateral development of the trees.

It is for the agricultural botanist to study comparatively and tell us as to the best distance consistent with optimum results.

(viii) Lastly the period of keeping a plantation consistent with optimum economy is again a problem. Whether a long period viz., 15 years and over, the medium period viz., between 10 and 15 years or again a short period below 10 years is profitable has to be studied. In the Madras Presidency, as has already been mentioned the usual period is 7 to 8 years. It is occassionally that we find plantations standing for over 10 years. If wood capacity alone is the consideration, then 10 to 15 years is considered to give the best results. But if the consideration is the better use of casuarina as timber, then periods over 15 years is most advised. But, however, if mere material profit is the consideration, 10 years period is most normal. But the anxious planter arguing in the economy of reinvestment prefers short periods 7 to 8 years. To make the planter realise the ultimate benefit, he has got to be guided by a marketing information bureau, especially in regard to the prices for various grades of the developed trees.

Adjustability of the plant

It has been clearly shown that the casuarina thrives on a wide range of soils, otherwise useless; and it has also been shown that the casuarina wants a good supply of moisture and loose soil. It has further been shown that it grows well in the sandy regions of the Coramandel Coast as well as the swampy regions of the West Coast of Africa. All these clearly show to us how adaptable the plant is to different environments. It will be interesting to note how the casuarina develops long fine roots to draw moisture from a wide range in the apparently dry land and how it throws out long adventitious roots, in water-logged acres, which float even in 3 to 4 feet of water and obtain the air required. These adventitious roots come down to the surface of the ground and develop as ordinary roots when the water subsides. The casuarina adjusts itself to the various types of soil compositions also, from alkaline to brackish and saline soils, and from clay soil and red soil to pure sand drift soil. The stomata lie in the furrows of the branchlets which serve the function of leaves and thus enable the tree to stand the wild winds of the sea. Again, the casuarina takes in nitrogen from the atmosphere, more than is necessary for it, the excess of which it fixes to the soil as leguminous plants do, by means of clusters of nodules (bacteria) formed at the roots.

Some hold that in water-logged areas, due to excess of water some alkali-toxins are formed which are injurious to plants and that the plants do not thrive in water-logged areas. But experience in Africa seems to be otherwise. So also in the deltaic region

of Tanjore. Still this is a problem for the agricultural scientists on which they should divert their research and give us the results.

Uses of the Plant.

The main use for which the casuarina is grown is to supply fuel for various purposes—house, railways, sugar and jaggery factories, Brick kilns etc. It has been found to possess high caloric value besides the property of the ash to preserve heat. Capt. Campbell Walker has estimated casuarina to be 4 times as valuable as fuel as any tree in France.

Casuarina, growing tall and straight and possessing strength and elasticity, is highly useful for poles for pandals, sheds and other temporary structures, for scaffolding in the building industry, and as derric poles for boring. For these uses, the trees have to be left for longer period to season and cut when they have grown to greatest thickness and weight. Sold for such purposes, casuarina fetches very good price viz., Rs. 25 per ton, more than double the price for fuel. Yet it is cheaper than the cheapest native timber in South India, viz., the mango timber which sells at Rs. 50 per ton.

Light, thinner trees are seasoned and used for rafters in tiled buildings. They are serviceable only in drier regions, for when exposed to dampness, they are easily attacked by white ants. The poles are also used for masts, spars and felloes of country carts. In the west coast the trees are left longer on the plantation and planks 1 inch thick and 1 foot wide are cut and used for making tile moulds and shelves in the tile factory.

It is the rapid growth of the casuarina, besides its other qualities, which has made it popular in India as an important tree for fuel and for roadside avenue in the plains. Further, when the plants are clipped and left stunted in growth, they form good hedges. It has been considered as good mask for batteries when triple avenue plantations are formed, for they can be kept to any height and made to intertwine and form efficient entanglement.

All casuarina can be pollarded for cattle food. It is much relished by the cattle and it has also been found to possess good value as cattle fodder. Not only the pollarded casuarina, but also the casuarina pods are of high value, for the same purpose. This use has not become popular, in spite of the fact that this was suggested as early as 1866 by the Punjab Horti-Agricultural Society, probably due to the lack of education of the agricultural and pastoral people of our country.

As early as the first quarter of the last century, a Frenchman, M. Jule L'Epine, of Pondicherry extracted a brown dye from the bark and showed that the tannin contained in it was of considerable value. Later it has been found by Mr. Birdwood of Bombay and Mr. Birdie of Madras that this tannin is useful in leather tanning and that it gives a good brown colour to leather. Mr. Wardle has remarked that the shades produced by the bark formed good mordant and as such is widely used in Bombay. It has been considered that the casuarina bark is a very good dye stuff for dyeing fishing nets. The casuarina yields a considerable quantity of gum also.

On the authority of Dr. Gibson, Mr. Kitkar and Mr. Basu have included the casuarina in the "Encyclopaedia of Indian Medical Plants." The bark is slightly astringent and its infusion is useful as a tonic. And, besides, it is a readily available astringent, useful in the treatment of chronic diarrhoea and dysentery. Powdered bark is also useful for dressing wounds. Burnt ash, according to Mr. Smith is a good base for household soaps.

The hardness of the casuarina makes it unfit for use in delicate and fine art work. The cost of working it is enormous. Again its weight is so great that it is not possible to use it as timber. The Javanese use casuarina for beating mulberry bark to soft fibrous material out of which tap cloth is produced. It can be used for a similar purpose to beat cocoanut shells to convert it into fibre. Thus the fact that casuarina could be put to varied uses has made Mr. Drury to include it in his "Encyclopaedia of the useful plants of India".

Land Utilisation.

As the casuarina is found to suit the coastal regions, the entire sandy coast has become culturable land. Further it prevents sand drifts in coastal places; and this fact has been availed of in the Tinnevelly District, where casuarina has been planted to prevent the drifts in the south-west monsoon season. The casuarina plantations have made it possible to bring under culture sandy regions for human benefit. The lands with established casuarina plantations is littered; and this top-dressing left undisturbed fertilises the soil. If the plantation is not very dense, that is not closely laid, many useful dry crops could be raised in the land on the lee-ward side of the plantation. Here ground-nuts and similar crops grow very well. As an after-effect of casuarina plantation much of the land

which otherwise would have remained a waste has been brought under cultivation.

Economics of the Plant: Cost and Income

Even as early as 1881 there have been speculations and exaggerated notions regarding the very high profitability of casuarina plantations. Interested parties began to estimate the gross expenditure for a six acre plantation to be Rs. 1,400. And that 18,000 trees on that plantation was the cut-turn in 4 years, yielding a net profit of Rs. 7,600 working at 550%. But this was contradicted by the Secretary, Horti-Agricultural Society who with personal experience showed that casuarina plantation was a profitable concern, no doubt, only if worked on large scale, the period of waiting being about 12 years and the planter being careful to reduce the costs to the lowest level. According to his estimate the most successful plantation of 6 acres would yield a net profit of Rs. 1,440, the gross expenses of Rs. 1,400 being met from the periodical thinning. A report of the Department of Agriculture, Madras, of about the same time gives an estimate of cost accounting and shows a profit of Rs. 980 in about 8 years from a 6 acre plantation. And another estimate of the 2nd decade of this century shows a profit of Rs. 420 per acre in 10 years. So varied have been the estimates of profitability. But an estimate of the present decade as given in Madras Agricultural Journal 1934 shows a profit of Rs. 560 to Rs. 750 per acre by the sale of 1500 trees, left after the final thinning at the end of the 4th or the 5th year, at as. 6 to as. 8 per tree, the entire cost of seedlings, planting, watering etc., being recovered by the sale of the thinned-out trees, about 25% to 35% in the fourth year, and the periodical sale of the loppings.

Economic Bearing of Casuarina on the Life of the People in the Carnatic Districts

The Carnatic Districts of Nellore, Chingleput and South Arcot alone are responsible for over 40% of the land under casuarina in this province. These Districts supply the growing need of the metropolis, and thus the land utilisation of the culturable waste for casuarina is on the increase. In these districts a sort of distributed periodical felling is followed. The plantation is generally divided into 5 to 7 regions, one region being felled every year, and replanted. This system solves the problem of having to wait long for the return. Only in the first instance there will be some waiting. The Reddis of the Nellore District especially consider casuarina plantations as a definite and safe source of annual income. These

districts are served by the Buckingham canal and the cost of transport is considerably low. Thus we find the casuarina affords certainty of income to the cultivator, the serious difficulty of having to wait long being got over as stated above, solves the fuel problem and thus secures and conserves the farm-yard manure for its more proper use as fertiliser, and is of high value in the reclamation of waste sandy tracts. In this Presidency there need be no culturable waste land. Casuarina can be raised in red soil areas which are deficient in nitrogen and thus the soil can be nitrogenated. And when a soil has reached a stage of exhaustion, casuarina serves to re-fertilise the soil.

Conclusion.

In this Presidency of Madras out of about 80 million acres of land 13·5% forms culturable waste of which, again, only about 3% (2·86%) have been utilised and that under casuarina. It is really pitiable to find in most parts of the interior of the Presidency, still much of the farm-yard manure is wasted and the fuel problem is a really serious problem. While this magic solver-casuarina, with its adaptability to all kinds of soils is available, it is really woeful to find only 3% of the culturable waste land under it. "With casuarina and its possibilities there should be no waste lands in this Presidency", said the Madras Horti-Agricultural Society as early as 1883, and it has maintained that "the reclamation of land, properly speaking, belongs to the Forest Department and to them the task should be entrusted". What was said more than 50 years ago holds good to-day. It is a matter of concern for everyone interested in the well-being of the farmer, to see that the Forest and the Agricultural Departments jointly work to bring more and more areas under casuarina and make it possible to bring the cost of transport very low.

The Royal Commission on Agriculture has said that the limiting factor in the solution of the fuel problem through casuarina, is the cost of transport by road or rail and that co-operation with Railway Authorities should be sought and obtained. Thus with transport facilities established, export to the interior districts would be easy and plantations could be developed and practically the whole of the culturable waste lands could be brought under casuarina. Or it would be advisable, as suggested by Mr. E. P. Stebbing, the Forest Officer, that every ryot is given a small area of waste land adjacent to his own field, rent-free and encouraged to grow casuarina for fuel. Or again as the Royal Commission on Agriculture has suggested, the canal and river banks might be widened and

casuarina planted for fuel purposes, and managed jointly by the Forest and the Irrigation Departments. This would also enable the rivers to maintain their definite course without changing it now and again, and thus prevent also the deposition of coarse sand and gravel on fertile riverain land. This last method is most suitable for solving the fuel needs of the people in the irrigated areas.

Thus under the able guidance of a rurally minded government many problems could be solved by bringing almost the whole of the culturable waste lands under casuarina. Not only need there be, no waste land in the country, there need be no such heavy unemployment. Only the approach must be sympathetic and on proper lines so that all factors are co-ordinated.. And this would enhance greatly the national wealth and dividend of the country.

News and Notes

The XIVth Annual Meeting of the Association was held on Saturday the 24th February 1940 at the Meston Training College, Royapettah. After passing the XIVth Annual Report, the results of the elections of the Office-bearers for 1940 were announced.

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Three ordinary meetings of the Association were held in this quarter. In the first of them, held on 27-1-40, Mr. S. V. Ganapati, M.Sc., Water Analyst in the Health Department of the Madras Corporation, read a paper on "*The Geographical Aspects in relation to the Chemical and the Biological Conditions of the Red Hills Tank.*" A summary of the paper will be published in the next issue of the Journal.

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In the second meeting, which was held on 16-2-40, Mr. M. P. Rajagopal, B.A., L.T., Dip. Geog., opened a discussion on "*Class Tests in A Group Geography.*" A lively and interesting discussion ensued.

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In the third meeting, held on 16-3-40, Mr. T. K. Swaminathan, Editor, Indian Colonial Review, who visited Mauritius as a Representative at the time of the Centenary Celebrations, delivered an interesting lecture on "*The Indians in Mauritius,*" illustrated with views.

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As in previous years, *a Summer School of Geography* will be conducted by the Association in the Geography Department of the Teachers' College, Saidapet for a month from 6th April 1940. The Executive Committee has decided to have another shorter course at Ambasamudram in May next, if there is a demand for it.

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For the Tenth Geographical Conference of the Association to be held at Ambasamudram in May next along with the Provincial Educational Conference, Mr. T. S. Sundaram Ayyar of that place has been elected President. He is a veteran geographer that re-

tired after working as an enthusiastic teacher of geography for over a generation in the local Thirthapathi High School.

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At its meeting held on 17-1-40 the Council of the Association decided to have a class of student members of the Association, paying a subscription of 1 Re. per annum and having the same privileges as associate members.

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At the same meeting, Mr. M. Subrahmanya Ayyar, B.A., B.L., one of the founders of the Association who had done so much for it in the first few years, was elected Honorary Life Member.

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Mr. N. Subrahmanyam, M.A., L.T., F.R.G.S., Lecturer in Geography, Teachers' College, Saidapet retired from 14-1-40 after a service of 33 years; and his place was taken by Mr. S. Muthukrishna Ayyar, M.A., L.T., Dip. Geog. It is expected that Mr. Subrahmanyam will now be able to give all his time to the Association and its Journal, for which he has already done so much.

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In the vacancy caused by the retirement last year of Mr. V. Jagannadha Rao, M.A., L.T., Lecturer in Geography, Government Training College, Rajahmundry, Mr. B. M. Thirunaranan, B.A. Hons., of the Department of Geography, University of Madras, has been appointed.

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We have much pleasure in congratulating Prof. M. B. Pithawalla of Karachi, upon whom the University of Bombay has conferred the degree of Doctor of Science for his pioneer geographical research on the Lower Indus Basin (Sind). Prof. Pithawalla is an indefatigable worker, who has produced several monograms on various aspects of the geography of the lower Indus basin, on which he has become a great authority.

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The Indian Science Congress held its 27th session in Madras from January 2 to 8, 1940. The Geography and Geodesy Section of the Congress was presided over by Dr. S. P. Chatterjee of the Calcutta University, whose Presidential Address on "*The Place of Geography in National Planning*" is summarised elsewhere in this issue.

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Several useful papers were read and discussed in this and the Geology Sections; and there was an interesting popular lecture delivered by Swami Pranavananda on "Lake Manasarovar and the sources of the Indus and the Brahmaputra" which was illustrated with views taken by him on his tours.

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As part of the programme of the Congress, some short and three full day alternative excursions were arranged. Of the latter, which were to Madura, Mettur and Mahabalipuram, the last was the most popular among the visitors from Upper India.

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The 28th session of the Congress will be held at Benares early in January 1941; and for the Geography and Geodesy Section of it Prof. Tahir Rizvi, Chairman of the Department of Geography, Aligarh University was elected President and Dr. M. B. Pithawalla of Karachi Recorder.

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The Ceylon Geographical Society, which was started last year, celebrated its first anniversary on the 12th March 1940, after a record of useful work. It is hoped that the Society will in time grow to be sturdy and useful with a Journal of its own as an organ of its activities.

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Reviews

A New Geography of India, Burma and Ceylon. By L. D. Stamp. (Longmans, Green & Co., Ltd.), 1939. Price Re. 1 As. 12.

Longman's Regional Geographies of India, Part IV has been one of the very few satisfactory text-books of Indian Geography for schools; and it is well that Dr. Stamp has brought out a revised edition of it, considerably improved and brought up-to-date, and with some new features, so much so that it is now in its present form practically a new work. Recent political changes such as the creation of the provinces of Sind and Orissa and the separation of Burma from India necessitated no doubt the re-writing of parts of the original book; but, much new information collected on the spot by the author in his recent tour in the country has also been incorporated. While retaining the maps, diagrams, questions and exercises of the older edition, numerous useful pictorial illustrations have been included for the first time, thereby enhancing considerably the value and attractiveness of the volume, which is now increased in size by more than 100 pages. *The useful tables* at the end of the book have been brought up-to-date; Burma should, however, have been shifted to a separate place along with Ceylon in each of tables. We are glad to note that in spite of these improvements and the increased size, the price has been kept very near the old one.

Geography of the World (with a detailed treatment of India). By S. C. Chatterjee. (Longmans, Green & Co., Ltd.), 1939. Price Rs. 2 As. 12.

This is a new text-book of Geography for use in the upper classes of high schools as well as in the Intermediate classes of colleges, written by a qualified and experienced teacher of the subject. One of its chief features is the great emphasis that is laid on the Indian point of view in the presentation of geographical facts and illustrations. The book falls into two parts: Part I dealing with Mathematical and Physical Geography and Part II with Regional Geography of the world. In the treatment of the different aspects a proper balance has been observed; thus, Part I occupies a fourth part of the book, while in Part II India, which has been developed in a fairly detailed manner forms as much. It

is pleasing to note that geographical phenomena are explained in a strictly scientific manner; and the bearing of the geographical factor upon human progress has been brought out. The volume has been well illustrated with a large number of useful maps and diagrams.

Food, Clothing and Shelter Geographies: Book V—Asia, Australia and Africa. Book VI—North and South America and Europe. By L. McD. Robison. (Macmillan & Co., Ltd.). 1940. Price Re. 1·25 each.

In reviewing the earlier books in the Primary Series in a recent issue of this Journal, we had pointed out that the central aim of the whole series has been to bring out man's efforts to obtain food, clothing and shelter, as indicated in the general title. "The pupils observe the sparsely settled areas in their own neighbourhood. They apply their growing geographical knowledge to studying where and why man lives in small numbers and in large numbers in different parts of the world." This aim is more fully developed in these two books of the Post-Primary Series under review. They show the relationship between land forms, vegetation, climate and the distribution of population. In the first five chapters there is a broad general treatment, which becomes more detailed under each of the sub-regions in the succeeding chapters. The final chapters gather up the general facts under the heads of *Climates, Food stuffs and other materials, Communications* and *Geographical Regions*. The plan, though novel, is refreshingly original and interesting; and it is hoped that teachers will find it useful in getting away from the rut and infusing the pupils with genuine interest in the subject. The volumes are fully illustrated with maps, diagrams and pictures: and the exercises in Part B of each lesson serve as in the Primary Series both for revision and for further work.

A Map of Asia (for Middle and School Certificate forms). By A. Ferriday. (Macmillan & Co., Ltd.). Price 1sh. 9d.

The teaching of geography in schools has now-a-days ceased to be the dull, mechanical, bookish thing it was; and among the factors that contributed to it have been the books of the type under review.

This *Map of Asia* follows the plan of the previous books of the series, reviewed in earlier numbers of the journal, namely that of presenting the main geographical features in map form with

accompanying text on the opposite page. The questions included at the end of each lesson serve to test the pupil's capacity for illustrating his answers with sketch-maps. They include those taken from school certificate papers, being intended for school certificate forms though the more straightforward ones might be attempted by pupils of middle forms.

Elementary Geography—Five books: (in Canarese). By Gregory Menezes, K. Srinivasa Kini, M. N. Kamath and K. Panduranga Pai. (School Book Company, Mangalore). 1939.

This series of five books has been prepared in accordance with the recent syllabus in Geography for Elementary Schools issued by The Madras Educational Department; but, we had occasion to note that this syllabus has not been satisfactory, being far too logical and analytical, instead of having a psychological basis being synthetic and regional. To that extent we have to decry books written in accordance with that syllabus. But in spite of that disadvantage, the authors, who are all qualified and experienced teachers of geography, have succeeded in treating the lessons in an interesting manner in simple language, which is again graded to suit the class. The exercises appended to the lessons are suggestive and stimulating, and serve both for revision and for further individual work. The books are also illustrated with a good number of maps, diagrams and pictures, though some of the blocks could easily have been better.

The Glacial Period in the Territory of U. S. S. R. By I. P. Gerasimov and K. K. Markov. (Akademiya Navk: U. S. S. R.). 1939.

This large volume of over 450 pages in Russian contains, luckily for English readers, an English summary of 20 pages towards the end, which is both interesting and valuable. After a general preliminary discussion at some length, the Quaternary Glaciation of Plains and Mountains and the Quaternary Age in the Non-Glaciated Regions are first considered in some detail. Then follows a short account of the territory of the U. S. S. R. successively (1) in the Post-Glacial Epoch, (2) in the last Glacial Epoch, and (3) in the Inter-Glacial Epoch. The volume closes with the formulation of the following conclusions:—

1. Glaciation of mountains began at the end of the Piocene, glaciation of the plains in the Quaternary age.

2. Intensity of glaciation of plains and mountains diminished eastwards from regions with a marine climate to regions with a more continental climate.

3. Glaciation of the plains developed in various parts of the U. S. S. R. (Europe—East Siberia) and throughout the surface of the earth metachronically.

4. Glaciation was manifold, alternating on the plains with epochs (inter-glacial) of complete thawing of the sheet glaciation.

5. The number of glacial epochs differed in various regions.

6. Physico-geographical conditions (the number of glaciations and changes in the extent of sheet glaciation) were more variable in regions with elements of maritime climate in Europe, whereas in East Siberia they were characterised by a comparative constancy.

7. The immediate cause of Pliocene mountain glaciation was tectonic, the Quaternary glaciation of mountains and plains was due to general climatic causes.

8. The remote non-glacial regions of the U. S. S. R. were distinguished by comparative constancy of climatic conditions. Westwards and southwards in epochs synchronous with glacial and inter-glacial the variability of the climate increased.

9. In the Turan and West Kazakhstan in epochs of glaciation the amount of atmospheric precipitations somewhat increased (on account of intensification of cyclones) as well as the degree of the watering of the surface. This created *pluvial* phases.

10. In West Siberia and in the South of the European territory of the U.S.S.R. the degree of continentality of climate increased in epochs of glaciation. The landscape had the character of forest-tundra and cold forest-steppe, gradually passing into warmer forest steppe and steppe.

11. In inter-glacial epochs the general geographical situation resembles the modern, only differing by a milder (less continental) climate in the north and a more striking and more southern limits of forest-steppe, steppe and desert.

12. For the Post-glacial epochs two warmer phases (climatic optima-Late-glacial and Atlantic) are established in the north, divided by a colder (Boreal) phase. In the south there are traces of a later and dry phase (xerothermic), apparently concurrent with the Atlantic optimum. The general progress of climatic changes in Post-glacial time caused a shifting of the modern soil-vegetation zones.

Select Contents from Recent Periodicals

The Geographical Journal: December 1939.

Settlement and Land Utilization, Malacca—By E. H. J. Dobby.

The Geographical Journal: January 1940.

The Search for Oil—By G. M. Lees.
Formal Writing on Maps—By C. B. Fawcett.

The Geographical Journal: February 1940.

Plans for a National Atlas. Discussions opened by Prof. E. G. R. Taylor.

The Scottish Geographical Magazine: November 1939.

The Natural Geographical Region. By A. Steevens.
Gibraltar—By P. W. C. Dennis.

The Scottish Geographical Magazine: January 1940.

Agriculture in the Great Clay Belt of Canada—By J. R. Randall.

Economic Prospects in the Soviet-Polish Borderlands. By Arthur Geddes.

Geography: December 1939.

Finland and the Winter Freeze. By W. R. Mead.
The "Raw Material" Film. By W. L. Gilbert.

Geographical Review: January 1940.

Canterbury Landscapes—By Kenneth B. Cumberland.
Bolivia's Water-Power Resources—By W. E. Rudolph.
The Function of Meltwater in Cirque Formation—By W. V. Lewis.
Singapore—Town and Country—E. H. G. Dobby.

Indian Information: January 15, 1940.

Soil Erosion: Its Dangers, Causes and Cures—By Dr. R. Macagen Gorrie.

Indian Information: February 1, 1940.

India's Store of Minerals: Resources of Central Provinces and Berar.

Indian Information: February 15, 1940.

Lloyd Barrage Research: How to Predict Soil Behaviour.

Books and Journals Received

Elementary Geography—5 books: (Canarese). By Gregory Menezes, K. Srinivasa Kini, K. Panduranga Pai and M. N. Kamath.
A Map Book of Asia. By A. Ferriday.
Illustrations of Indian Sculpture. By F. H. Gravely & C. Sivaramamurti.
Guide to the Archaeological Galleries. By F. H. Gravely & C. Sivaramamurti.
Asia, Australia & Africa. By L. McD. Robison.
Britain against Hitlerism. H. M. Stationary Office, London.
Aspects of Poland. By M. B. Pithawalla.
Geography of the World (with a detailed treatment of India). By S. C. Chatterjee.
A New Geography of India, Burma & Ceylon. By L. D. Stamp.
N. & S. America and Europe. By L. McD. Robison.
Proceedings of the Royal Geographical Society of Australasia (S. Australia Branch for the session 1938-39).
The Glacial Period in the Territory of U.S.S.R. (Russian). By I. P. Gerasimov and K. M. Markov.
Report of the Operations of the Department of Agriculture, Madras Presidency for the year 1938-39.
Southern India Commerce: December 1939, January and February 1940.
Indian Information: December 1939, January, February and March 1940.
Kalaimagal: December 1939, January, February and March 1940.
Indian Culture: July 1939.
Scottish Geographical Magazine: November 1939 and January 1940.
South Indian Teacher: December 1939, January and February 1940.
The Visvabharathi Quarterly: November 1939, January 1940.
Geography: December 1939.
The Geographical Journal: December 1939, January and February 1940.
Journal of Indian History: December 1939.
Quarterly Journal of the Mythic Society: January 1940.
The Indian Journal of Political Science: January-March 1940.
The Geographical Review: January 1940.
The Adyar Library Bulletin: February 1940.

Report of the XIVth Annual Meeting

THE MADRAS GEOGRAPHICAL ASSOCIATION

The XIVth Annual Meeting of the Association was held at the Meston Training College, Royapettah on Saturday the 24th February 1940, with Mr. M. P. Rajagopal in the Chair. The XIVth Annual Report of the Association (*vide* Annexure) prepared by the Council was adopted (proposed by Mr. K. Sundaresan, and seconded by Mr. A. Tirumalai Ayyangar).

The results of the elections for 1940 (decided by ballot) were then announced as follows :—

President : Miss E. D. Birdseye, B.Sc., Dip. Geog. (Lond.).

Vice-Presidents :

Rao Bahadur C. M. Ramachandra Chettiyar, B.A., B.L., F.R.G.S.

Mrs. P. S. Sundara Raj, M.R.S.T., F.R.G.S.

Secretary : Mr. N. Subrahmanyam, M.A., L.T., F.R.G.S

Asst. Secretary : Mr. K. Ramamurthi, M.A., L.T., Dip. Geog.

Treasurer : Mr. M. P. Rajagopal, B.A., L.T., Dip. Geog.

Ex. Com. Member : Mr. George Kuriyan., B.Sc. (Lond.)

Other members of the Council :

Mr. K. Sundaresa Ayyar, B.A., L.T., Dip. Geog.
Mr. A. Tirumalai Ayyangar, B.A., L.T.
Miss H. T. Scudder, M.A., Dip. Geog.
Miss S. Koman, B.A., L.T., Dip. Geog.
Mr. P. G. Dowie, M.A., L.T., Dip. Geog.
Mr. T. R. Govindarajan, B.A., L.T.

The meeting then came to a close with a vote of thanks to chair.

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தமிழ்நாடு ஆவணக்காப்பக நூலகம்,
எழும்பூர், சென்னை-600 008.

தவணைத்தாள்.

சே எண் : 143633 ப. எண் :

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Printed by G. Srinivasachari, at G. S. Press, Narasingapuram Street, Mount Road, Madras, and published by N. Subrahmanyam, Gopalapuram, Cathedral Post, Madras.