The position of India in the iron industry of the world has been one of importance from very early times. The numerous slag heaps scattered throughout the country, bear testimony to the once prosperous iron smelting industry in this country. Indian wrought iron has been considered to be one of the best of its kind as is evidenced from the fact that the engineers concerned in the construction of the tubular iron bridge across the Menai Strait gave preference to the malleable wrought iron prepared in India. This high quality was attained not only in the case of wrought iron, but also in the case of steel. The famous 'Wootz' of Salem and some other parts of the Madras Presidency have been acclaimed to be the best of its kind ever produced. The high quality of the metal produced in India can be traced to the methods of production which involved the use of charcoal for reduction. (By trials it has been found that the excellence of the quality of the charcoal reduced iron cannot be equalled by the metal produced by using coke). The preparation of this was an important branch of the metallurgical operations in India.

DISTRIBUTION

The reason for this wide distribution of iron smelting industries in India can be traced to the distribution of iron ore in India.

Iron forms an important constituent of the igneous rocks; and this richness in iron manifests itself in their ferruginous minerals, oxides as well as silicates. Thus iron is almost always present in igneous rocks, and is found associated with sedimentaries derived from them. Peninsular India except for local exceptions is almost wholly composed of the igneous and metamorphic rocks of the archaean and dharwar systems (banded quartz-haematite and quartz-magnetite schists form an important type of rock in the dharwar system); and the wide occurrence of the rocks of these systems would serve to explain the indulgence of the natives in iron smelting operations.

Besides the archaean and the dharwar systems, the peninsula is composed of sedimentary rocks that have been derived from the surrounding archaean and dharwar rocks mostly, together with igneous intrusions. The Cuddapahs and the Vindhyans are the oldest of these (barring the dharwar). Quartzites, the most common rock type of the Cuddapah system very often contain

inter-stratified iron and manganese deposits (as in some parts of the Cuddapah and the Kurnool districts of the Madras Presidency).

The gondwanas, economically the most important rock formation in India, contain in the Iron stone shales of the Damuda series a valuable source of iron ore. The laterites, which are of such wide distribution in India, contain in their ferruginous varieties another source of iron ore, which has been much speculated upon. The gravels and sands of the bed of the rivers draining the metamorphic regions of India are another source of iron ore.

Regionally considered iron ores have a wide distribution in India, which is the result of the wide distribution of the archaean and dharwar rocks. The more important of the several occurrences and those that have been the object of attention and have been investigated on a practical scale are the following:—

(1) Iron ores of Salem District,
(2) Iron ores of the Iron belt of Bihar and Orissa,
(3) Iron ores of Kumaon,
(4) Iron ores of Birbhum,
(5) Iron ores of Chanda and Drug Districts,
(6) Iron ores of the Bababudan Hills.

SALEM DISTRICT

The iron ores of Salem District, magnetitic in composition are one of the largest ore bodies in the world and has been the subject of investigation for a long time past. The ore bodies are noted not only for their size but also and more for its richness. This richness in quantity and quality has been the driving force for the repeated attempts at their utilisation. Samples of them are sent to the Imperial Institute of London and analyses have pronounced them to be unfit for use in the blast furnaces of the present day. The chief drawback of this area has been the fuel problem. The ores lie in a region of crystalline rocks of extreme antiquity with no inliers of younger sedimentary rocks so that there is not the least hope of coal being ever found here. The question of freightage would kill any attempt at their utilisation with the help of the Bengal coal.

to be transported to the blast furnaces situated near the sources of fuel. The principal occurrences are (1) Par Hill, (2) Mangor and (3) Santow.

CLAY IRONSTONES

There are two important occurrences of ironstones in India, in the Raniganj coalfield and in the coalfields of Assam.

In the Raniganj area the beds containing the ironstone are of inconstant thickness and extend for over 33 miles from east to west and with an average width of 12 miles. The reserves are variously estimated (200 million tons to 6.4 million tons per sq. mile). On an average the ores contain 38.92% of iron 2.09% of phosphoric acid and traces of sulphur.

The ores were the basis of the Barakar Iron Works at Kulti for several years up to 1906 when these were abandoned in favour of the richer Kolhan ores.

The iron ores of Assam are clay ironstones taken from the coal measures and an impure limonite from the sub-Himalayan strata. The iron ores of the coal measures contain on an average about 40% of iron while favourable samples of the sub-Himalayan regions yielded from 35.2% to 32.6% of iron, but the average is considerably less.

The ores of the coal measures are not in sufficient abundance to afford a supply to a modern blast furnace, while that of the sub-Himalayan strata, though practically inexhaustible are too poor in quality.

LATERITIC ORES

Large spreads of ferruginous laterite often with 30% of iron are found from the Rajmahal hills to the Ratnagiri and from Central Indian highlands to the Carnatic plains of Madras. The laterite deposits of Birbhum had been the object of attraction. The ore occurs at the base of laterites but they do not seem to be of constant thickness for long distances. It has been fairly established however, that the ore is abundant and that it contains a high percentage of iron often as high as 60%, but generally it averages about 40%. But the richer and the better situated hæmatite deposits have thrown this to the background.

Such a wide distribution of good quality iron ores would naturally lead one to expect a prominent position for iron smelting operations in the industries of the country. The surmise would not altogether be wrong, for in the days gone by and till a few decades ago, India did give a prominent position for her iron smelting industry.

Before the introduction of modern industrial methods of production, the Indian iron smelter had reached a very high standard of perfection. Mention has already been made of the preference given to the Indian wrought iron in the construction of the tubular iron bridge across the Menai Strait. The famous iron pillar of 'Kutub' at Delhi is another instance testifying to the high skill of the men concerned. It is said to epitomise all the skill of the artisans required in the manipulation of wrought iron. "It is not many years since the production of such a pillar would have been an impossibility in the largest foundries of the world, and even now there are comparatively few where a similar mass of metal could be turned out", says the late Dr. V. Ball in 1879, and yet according to the most reliable information, this pillar must be at least 1500 years old. It has been suggested that this pillar must have been formed by gradually welding pieces together; if so, it has been done very skilfully, for not a single mark of such welding is to be seen. We have in this pillar, which, though it has always been exposed to the action of the atmospheric agencies, shows no sign of rust, the most complete testimony of the skill of the Indian iron-smelter of 1500 years ago.

The high skill of the labourers was not confined to the manufacture of wrought iron alone, but as in parts of Mysore and of Salem District attention was paid to the manufacture of 'wootz' (or Indian steel). The steel which was exported to European countries was subjected to critical examination so as to decide its quality. Mr. Stoddart, an eminent instrument-maker in England, stated that the 'wootz' in the condition in which it arrived from India was not fitted for fine cutlery owing to its inequality and impurity, but that by careful manipulation it was possible to improve it and bring it to a condition in which it was superior to English cast steel.

This production of high quality iron was not confined to any definite regions but has been scattered throughout India. The chief considerations for the establishment of an iron industry in those

days do not seem to have been as many as are necessary at the present day. They were fewer and far simpler and were confined to the availability within close proximity of iron ore, fuel (chiefly wood charcoal then) and flux. The combination of such a set of conditions was not hard to find in those days, and in the absence of foreign competitors there was a large internal market available for the home-made product. Thus the *agarias* or the native smelters seem to have played a leading role and their industry was a leading and thriving one. The very early development of sea-borne trade (which is traced to 800 or 900 B. C.) together with the prosperous condition of the industry gave rise to an export trade in iron goods.

Important and widespread as it seems to have been (judged from the wide distribution of slag heaps) at the present day, none of these, not even the more important of them figure as producers of the metal. The industry has been wholly crushed out of existence, owing to a variety of causes. The first of these is the fact that coal is not as widely distributed as iron ores. The Indian coalfields should be described, with reference to those for instance of Great Britain, as confined to a relatively small area, leaving large areas in the peninsular portion devoid of coal, not to mention the generally poor quality of the Indian coal. Hence coal could not be used in the reduction of the ore. In India, as in other countries smelting operations began first on the basis of wood charcoal and the use of wood charcoal in India was attended with results similar to those in Great Britain. The ruthless exploitation of the valuable forests led to their destruction, bringing about a fuel crisis. This destruction of forests went a long way in aggravating the situation.

The adoption in England and some other western countries of the use of coal as the fuel, the Industrial Revolution and the methods of factory production enabled them to produce iron more cheaply and place them also cheaply in foreign markets. In the 19th century the import of foreign made iron and steel goods into India gave the finishing touches to the strangling of the already tottering industry. The *agarias* found that it no longer paid them to prepare their products for sale and so discontinued their work. At the present day except in a few backward tracts, iron smelting by primitive methods is not being carried at all and the total annual production of all the primitive furnaces has been computed to be less than 1,000 tons.

It would be fruitful at this stage to study the conditions that go to the successful establishment of a modern iron and steel industry and see how far Indian conditions warrant such large scale enterprises as the Tata iron and steel works and similar works that have been established and that are projected.

A well-known metallurgist has said "Concentration of iron and steel industries is a natural consequence of the operation of a large number of factors of which location is but one, but not often the most important one. The complete transformation of the ore into finished iron and steel goods requires large quantities of fuel; the great bulk and low price of the ingredients as well as the end products and cheap transportation are of some consequence; the economy of mass production in single large units where all the stages of manufacture from the smelting to the making of the most highly finished products call for a large investment of capital, large organisation and a large population to supply an army of workmen." The bringing together of all these is in turn justified only when the supply of ore and fuel are large. The occurrence of any considerable number of these favourable conditions in any one place is rare, and hence the great importance of the 'Iron belt.'

The raw materials of such an iron and steel industry can be classified as follows:—

1. Iron ore
2. Fuel
3. Fluxes
4. Modifying metals
5. Refractory materials
6. Subsidiary materials

In the light of this classification let us proceed to analyse the position of India as regards these raw materials.

Iron ores.—The iron ore deposits of India have already been described and as a convenient means of recapitulation a tabular statement has been appended. (Vide Appendix I.)

COAL.

The reduction of iron ore (oxides etc.,) to metallic iron involves the use of some reducing agent and the chief reducing

agent in use at the present day is coal. It is only where there is an abundance of forests containing wood which is otherwise fit for no other purpose that wood charcoal is used. Excepting in Mysore all other furnaces in India use only coke and therefore our main consideration will be with coal.

India possesses vast resources of coal which is variously estimated, the estimates ranging from 54,000 M. tons to 75,000 M. tons. But large as it seems to be it is of no value to the iron industry. Coal is not used as such in the metallurgy of iron. Experimenters discovered in the earlier decades of the last century that by the destructive distillation of coal a new substance, namely, coke was derived which was able to withstand the conditions in a blast furnace better than coal. It was at the same time found that it was not all kinds of coal that yield coke on destructive distillation. The available quantity of coking coal would therefore be an important consideration in connection with iron and steel industries. Viewed from this point Indian resources are not very promising. Various estimates have been made of the available supply of coking coal in India all of which agree in India's poverty in that kind of coal. Coking coal in India is even less widely distributed than ordinary coal and this can be said to have decided the location of the black country of India in the vicinity of the "Iron belt" of Bihar and Orissa, for the small amount of the coking coal is distributed in two or three fields of the Damodar Basin, namely Giridih, Raniganj, Jharia and Bokara. The Assam coal, certain seams of which yield coke, is ruled out because of the high sulphur content.

The first three form the only sources of metallurgical coke-yielding coal in the whole of India. (Appendices III & IV.)

FLUXES.

The most generally used fluxes are limestone and dolomite; but in certain cases for special purposes apatite and fluorspar are also used.

Limestone is a mineral of wide geological and geographical distribution in India (they reach their maximum attainment in the rocks of the Cuddapah and Vindhyan systems) and hence there is an abundance of this mineral. But the main problem with the limestone is the supply of a cheap and uniform quality limestone, with a high percentage of calcium carbonate and comparatively free from silica and sulphur. Limestone of such a quality, usable

in the metallurgy of iron is not very widely distributed. The most important of the good quality limestones are :—(Appendix V.)

1. Katni limestone (lower Vindhyan)
2. Maihar limestone (lower Vindhyan)
3. Bisra limestone (Cuddapah)
4. Sylhet limestone (Kirthar)
5. Chela limestone (Khasi hills)
6. Wardha valley limestone
7. Dalli limestone.

Apatite.—This mineral is found in the Dalbhum district and the occurrence is sufficient for the iron and steel industry at the present rate of consumption.

Fluorspar.—This mineral occurs in sufficient abundance in the Kishengarh state of Rajputana.

MODIFYING MINERALS.

In addition to the three prime raw materials—the ore, the fuel and the flux—in the complete transformation of the ore into finished iron and steel goods, a variety of other materials which may be classed as modifying materials, refractory materials and subsidiary materials come to play a part. Let us take the modifying materials.

Modern age is an age of special steels where other metals play an important part either in modifying the physical characters or as purifiers and imparting certain special properties; and the following are the chief among them:—

1. Metals which are *modifying agents;* Chromium, Cobalt, Molybdenum, Nickel, Tungsten.

2. Metals which *induce changes in the physical condition and act as purifiers.* Manganese, Uranium, Vanadium, Silica.

3. Metals which act as *purifiers.* Aluminium and Titanium.

Distribution of the ores of the modifying materials:—

Chromite, the chief ore of chromium, is found in the Zhob and Pishen valleys of Baluchistan, the Kadukola district of the Mysore state and near Chaibasa in the Singbhum district.

Cobalt and Nickel have no ores in India.

Molybdenite and wulfenite, the chief ores of molybdenum, are found in Burma but is not in an economically profitable condition for exploitation.

Tungsten.—Wolfram is the chief ore and is found to occur in Kalimati in the Singhbhum district and Agagaon in the Central Provinces. But the most important occurrence in the Indian Empire is in the Tavoy district of Burma.

Manganese.—The full value of manganese in the iron and steel industry can be very well gathered when we state that according to a well-known metallurgist "steel cannot be steel if it did not contain 7% of manganese". It is estimated that over 90% of the entire world production of manganese is used in the steel work ; and in the light of this statement it is a deplorable fact to see the entire Indian production of manganese being exported. There are large resources of manganese in the Singhbhum district and the Gangpur state in Bihar and Orissa, in the Central Provinces, in the Bellary and Vizagapatam districts of Madras and in the Mysore state. The map shows the several regions.

Uranium is reported from the Gaya mica mines. The chief uranium minerals are Uranium ochre, Torbernite, Columbite, Zircon, Tripilite, etc.

Silica and fireclays.—Quartz and quartzite are the chief raw materials for the manufacture of ferrosilica. These are of wide distribution in India and especially good quality clays are found around the western base of the Rajmahal hills, as underliers of coal measures and in a number of localities in the Central Provinces and Bengal.

Aluminium.—At present this metal is imported from abroad. Bauxite which is the chief ore of the metal is of fairly wide occurrence in India, widely distributed in the laterite cap of the peninsula, but the laterites richest in bauxite are those of the Central Provinces, (especially of Katni and Jabalpur) and of some hill tops in Balaghat district (which contain more than 50% alumina); others are Sarguja, Mahabaleshwar, Bhopal, and the Palni hills and some parts of Madras. As at present mined they are not valuable. There is no possibility of exporting alumina after refining and concentration, nor is it possbile to manufacture the metal in India, as in both

the processes a cheap supply of electric power is absolutely essential.

REFRACTORIES.

These are fire-resisting substances both natural and artificial which have been found suitable for the construction of furnaces, kilns, stoves, etc. There are upwards of a dozen different kinds of furnaces in use in the modern iron and steel industry, (coke oven, hot stoves, etc.,). It is not unusual for more than one kind of refractory material to be employed in the different parts of the same furnace. These linings do not last indefinitely but require periodical renewal. The better the material, other conditions being the same, the longer is the life of the furnace, before repairs become necessary. The life of the lining depends upon the uses for which the furnaces are to be put. Blast furnaces used in the basic process of manufacture of steel require more frequent renewal of their furnace-lining than acid open hearth furnaces; and the furnaces preparing ferro-manganese require still more frequent renewals than the basic open hearth furnaces. The linings of a blast furnace, if the most suitable materials are placed in their correct positions, may last for several years on continuous workings, while with faulty materials more frequent repairs become necessary.

The chief materials in common use are:—

1. *Bauxite*, whose raw materials are the bauxitic laterites which are of wide distribution in India.

2. *Chromite.*—Already dealt with.

3. *Dolomite.*—Much of the Indian marbles are crystalline dolomites (Rajputana, Aravalli), Mekrana, (Jodhpur), Kharwa (Ajmer), Maundla (Jaipur), Dadikar (Alwar), Narbudda gorge (Jabalpur) and Motipura.

4. *Fire-clays.*—Widely distributed; kaolin in the vicinity of Rajmahal hills; but there seems to be no attempt at manufacture of firebricks on a large scale for blast furnace purposes.

5. *Graphite.*—This is found distributed in parts of Travancore state, Tinnevelly district, Kalahandi, Patna state, Ajmere-Merwara and other places in India, but their utilisation should

await the introduction of the electrical osmosis process for the purification of impure graphite.

6. *Magnesite.*—Occurs in the Chalk hills of Salem, Kadukola in Mysore, in Rajputana and in Baluchistan. Most of the Indian production is exported.

7. *Silica.*—Large deposits of quartz reefs and pure white quartz are found in various parts of India. The Kharagpur hills represent one such instance in the vicinity of the iron belt. Essential qualities of quatzite or quartz for use in the iron and steel industries are they should contain 96% of SiO_2, 2% Fe_2O_3, 0.5% of alkalies.

8. *Zirconia.*—Zircon and Badeleyite are the chief ores. The chief quality of zirconia which make it fit for use in the iron and steel industry is its small co-efficient of linear expansion (it can be plunged into water at 1000°C.). Zircon is an important constituent of the monazite sands of Travancore. It is estimated that the monazite contains about 10% of zircon. Thus zircon would become a cheap by-product of the monazite industry.

9. *Sillimanite.*—This satisfies the conditions required of an ideal refractory almost completely. Its melting point is above 1830°C, and it does not soften below this temperature, having very low co-efficient of linear expansion; it is a chemical of great stability, and being neutral in composition is practically immune to the attacks of acid or basic substances at all temperatures below its melting point. Massive sillimanite is one of the strongest and toughest minerals known. In the form of fibrolite it occurs in large quantities in the Khasi hills of Assam and this is one of the largest occurrences of the mineral known in the world.

10. *Kyanite.*—A mineral of the same composition as sillimanite and occurring in the Manbhum and other districts of Bihar and Orissa can be substituted for sillimanite, because if exposed to a temperature of 1320°C. to 1380°C. it paramorphoses into sillimanite which change is attended with an increase in volume counteracting the shrinking of the clay.

The rapid survey of the distribution of the raw materials of an iron and steel industry, where all the processes of manufacture connected with the conversion of the raw materials into finished

iron and steel goods are undertaken, reveals to us a concentration of such raw materials in and around the 'iron belt'. The 'iron belt' has got the best possible situation in the whole of India for the cheap assemblage of the raw materials and the distribution of the finished products. The prime raw materials—iron ore, coal and flux are all found within the region itself while the other materials—modifying, refractory and subsidiary—are either found in the vicinity of the region or can be easily imported. Quartz, apatite, limestone and kyanite are found within the region. The belt is conveniently situated with reference to the port of Calcutta for the importation of magnesite from Salem and Kadukola, Chromite from Mysore, zircon from Bawdwin in Burma and cassiterite from the Malay peninsula. The early development of the coal-fields of Bengal with the consequent earlier advent of transport facilities, the convenient situation with reference to the raw materials, the proximity to a first-rate harbour like Calcutta and to the densely peopled region of Bengal capable of supplying an army of workmen, all these have contributed to the localisation of the industry in the 'iron belt'.

Among other regions Mysore has had the proud privilege of starting an iron industry based on the hæmatite deposits of the Bababudan hills, the limestone of the Shimoga district and wood charcoal prepared from the woods of the forests. The industry had the benefit of the valuable by-products of the wood distillation which served as props to the main industry. But with the universal slump in world trade the Mysore Iron Works find it very difficult to dispose of their by-products and seem to be (from what their representative had laid before the members of the Steel Enquiry Committee) much more in need of the much discussed protection than even the sister firms in Bengal. If sufficient protection is granted so that the industry can tide over the critical world slump, the government would have done something substantial towards ensuring the success of such an important industry. The proposed harnessing of the Gersoppa falls would have far-reaching effects on the industry. Already the industry is the largest of its kind in the British Empire, and it is famous for the quality of the pig iron it produces. The hydro-electric development and the adoption of electric smelting would make it possible for Mysore to rank on a level with the Swedish iron and steel industries as regards the quality of the metal produced. Finally the acquisition of a port for the state on the west coast would enable it to compete with Sweden as a producer of excellent steel.

All the other important occurrences of iron ore in India are not similarly situated with regard to other raw materials. Though they have been the basis of iron industries in the past, at the present day conditions are so changed that they are not so well situated at all for the establishment of a modern iron and steel industry. The fuel problem has accounted for the Kumaon ores, the Salem ores, the Gwalior ores and the Goa ores not being worked, while the poor and variable quality of the Assam ore is a drawback for its utilisation. The Drug district ores are held as a reserve, while the Chanda district ores do not have the same advantages as the ores of the iron belt. It is a curious thing to note that all the modern iron centres of India are based on iron ore occurrences discovered recently.

Of all the several occurrences, the Goa ore may be said to have a chance of development by virtue of its situation close to a harbour. An iron industry similar to the one at Bilbao in Spain and Cleveland in America can be built up here. The Salem ores, at least certain portions of them, have been pronounced to be unfit for use in the modern type of blast furnaces, so that there is no immediate hope of its being utilised on modern lines. They should await development till such time as a process is invented whereby they also could be used. What Gilchrist Thomas did for the Lorraine ores remains to be done for the Salem ore. The interior location of ore is a great drawback. If they have a situation similar to the Goa occurrence they would have been developed long before. Just as in Lake Superior region the ores can be smelted at a convenient centre by means of coal brought from Bengal, the empty steamers taking the ore to the industrial regions of Bihar and Orissa by way of ballast. But the interior location of the Salem ores on the other hand operates against such a development. The cost of transport of ore from Salem to Madras the nearest port would kill any attempt at exploitation of the ore. The same thing applies also to the problem of importing coal from the coal fields of Bengal. Anyway at some future date the ores are sure to be exploited, for with the decreasing importance of the now important ores attention would be turned upon these, and measures would be taken to utilise them. Such a thing will not happen in the near future; for as has been pointed out already, at the present rate of consumption the ores in the iron belt are estimated to last for about 100 years; and then there are the Birbhum lateritic ores and the Drug District hæmatite which are nearer to the industrial regions of the iron belt than that of Salem. Till then South India cannot

boast of an iron industry excepting perhaps that of Mysore. Even if an industry were to be developed in these places it is doubtful if they can draw away the importance of the iron belt. In addition to the favourable situation for the assemblage of the varied set of raw materials, there will be the geographic momentum to carry that on.

CONCLUSION

That India has large resources of iron, enough to support a large scale iron industry would have been brought out in the preceding pages. There is the tradition behind it and the only thing wanting till recently in India was impetus, and the adoption of western methods of production. The failure of the many early attempts at the introduction of modern methods should be taken as a note of caution in the deciding of sites for future iron works. The enormous resources of iron cannot all be utilised except at a few places, till some such time when a process is invented which can help in the utilisation of the ores without the use of coke or other fuel. India is also rich in other raw materials and subsidiary materials for an up-to-date iron and steel industry and other associated industries and with a view to strengthen the foundation of these industries measures are to be adopted for the conservation of raw materials like chromite, manganese ore and magnesite, which are at present being exported on a large scale to other countries.

Some of the subsidiary materials like zinc and accessory materials like Tungsten are found occurring in the province of Burma. India's present political relations with Burma is an advantage for her in the matter of supply of these materials, and as long as this relation continues India will continue to enjoy this privilege. The present attempts at separating Burma may snatch away this advantage, which the Indian Iron and Steel Industry is now enjoying, as some people think will be the case with regard to Burma's oil resources. Well-wishers of India's industrial prosperity should therefore take the matter in hand and fight for the retention of the present political relations, at least with this selfish motive.

Lastly, there is ample scope for the development of a ship-building industry especially in the vicinity of Calcutta.

Provided these improvements and undertakings are adopted, India will soon be in the forefront in the world of Iron and Steel Industries.

APPENDIX I.

(Raw materials: Iron ore.)

Type.	Deposits.	Reserves.	Composition Fe. %	P%	S%	Remarks.
[illegible]etite	Godumala Kanjamalai, Salem Dt.	Estimated in thousands of millions of tons: No precise figures.	55	0.3 to 0.62	0.028	Said to be unsuitable for use in blast furnaces. All coke must be imported from Bengal fields.
Laterite	Mallarpur Rajmahal hill	Large: unknown	43	1.5 P_2O_5	?	Centre of the old iron industry of Birbhum.
	Kanhwara hills	49 m. tons	53	0.146	0.02	Suitable for blast furnaces: lack of fuel.
Clay ironstones	Raniganj coalfield	At least 400 m. tons.	38 to 46	0.09 to 0.41	Trace	2.5 manganese oxide. 2% (up to) Lime & Magnesia. 5 to 9% Alumina. 10 to 13% Silica. 10 to 12% Combined water; used till 1913 in the Barakar Iron Works at Kulti.
Haematite	Mayurbhanj Bonai & Keonjar Bonai Singhbhum Keonjar	16 m. tons 280 „ 656 „ 1074 „ 806 „ 2832 „	60 to 68	0.08	Trace to 0.6	Average Kolhanore. 64% Fe; 0.05% of MnO_2. 2.1% S_1O_2; 0.05% P; 0.02% S; 0.5% Ca O; 0.18% Mg O and 1.25% Al_2O_3.
„	Singhbhum & Orissa	2832	60 to 68	0.08	Trace to 0.6	These ores lie within 150 miles of the coalfields of Bengal with coking coal capable of yielding metallurgical coke.
„	Lohara chand C. P.	100 m. tons at least.	61 to 67	0.005	0.12	Pilpagaon deposit not included. Local limestone good. Wardha valley does not coke. Operations in 1875 unsuccessful.
„	Rajhara Dondi Lohara Drug, C. P.	10 m. tons estimated.	66	0.058	0.108	Limestone at Dalli. Coke must be imported; held by the Tata Iron and Steel Company.
„	Bababudam hills Mysore State	25 to 60 m. tons	42 to 64.5	0.044 to 0.105	Trace	Iron works were erected in 1922. Using charcoal for the production of pig iron.
„	Ramgarh and Dechani Kumaon	Not known	43 to 60	Not known.	„	Ramgarh ore siliceous, Dechani ore aluminous; attempts in 1857 and 1877 failed through lack of fuel. No local coal.

APPENDIX II.

World's Resources of Coal.

	Actual Resources. Class of Coal.			Probable Resources. Class of Coal.			Total
	A	B	C	A	B	C	
	Anthracite coal including some dry coal.	Bituminous coal.	Sub-bituminous coal, Brown coals, and Lignites.	Anthracite coal including some dry coal.	Bituminous coal.	Sub-bituminous coal, Brown coals, and Lignites.	
BRITISH EMPIRE							
Great Britain & Ireland	11,344	130,155	..	13	48,021	..	189,533
Canada	675	29,161	..	1,483	254,500	563,482	1,234,269
Newfoundland	..	..	..	..	500	..	500
Australia	99	1,971	..	560	130,279	32,414	165,542
New Zealand	..	389	..	..	522	1,863	3,386
British North Borneo	..	5	..	..	70	..	75
India	..	221	..	..	76,178	2,377	79,001
Africa	2	343	..	11,660	44,690	..	56,769
OTHER COUNTRIES							
United States	..	..	..	19,684	1,955,521	1,863,452	3,838,657
Germany	..	94,865	384,968	..	315,110	4,068	423,356
Austria-Hungary	..	2,974	..	..	38,121	1,923	55,603
France	581	3,622	219	2,690	9,058	1,331	17,583
Belgium	..	..	612	..	11,000	..	11,000
Russia	..	57	301	..	20,792	1,646	60,106
Spain	1,050	4,776	..	37,599	1,590	373	8,768
	..	..	12	585	..	..	
	..	..	394	..	..	..	

APPENDIX III.

Supply of Coal

(In millions of tons.)

		All kinds of coking coal.	Good quality coking and non-coking coal.	Total coal of all kinds.
Giridih	..	40	45	60
Raniganj	..	180	875	22000
Jharia	..	1160	480	20500
Bokaro	..	485	360	1520
Ramgarh	..	..	..	3
Karanpura N.	..	..	360	8900
Karanpur S.	..	..	..	75
Aurunga	..	..	..	20
Hutar	..	Some	16	9
Daltonganj	..	..		9
Talcher	..	..	36	44
Rajmahal Group				210
Totals	..	1865	2172	53350
Makuni	..	90	..	90
Namchik	..	90	..	90
Darangin	..	..	..	76
Nazira	..	..	..	20
Totals for Assam	..	180	..	276
Satpura	..	Some	..	100
Korea Rena, etc.	..	..	..	200
Wardha Valley	..	..	..	400
Total for C. P.	..	..	..	700
Grand Total in m. tons	..	2045	2172	54326
Available quantity allowing for 1|3 less in extraction, etc.	..	1400	1400	36000

APPENDIX IV.

Coking Coal in India.

Quality.	Field and Seam.	Amt. in m. tons.	Remarks.
I. Highest grade metallurgical coke.	Giridih	9	Specially low in P. and also suitable for making iron of Bessemer quality.
	L. Karharbari	9	
II. Good metallurgical coke.	Jharia 13, 14-A, 14, 15 and 17.	732	Good quality coal. Total estimated 1100 m. tons. Allowance of 32 1|3%. Best coke from coke stack.
Ditto	Giridih L. Karharbai	30	Excellent coke. Sometimes rather high in ash, particularly if made from coal stack.
Ditto	Raniganj Laikdih and Ramgarh	50	This coke has been utilised in the Kulti furnaces; all allowances made only 5 m. tons in each.
	Total	812	
III. Fair Metallurgical coke.	Jharia 10, 11, 12, 16 and 18.	800	Some of this coal is as good as class II. Total estimated 1200 m. tons. 33½% allowances. Best used by carefully mixing with 17 seam all allowances made. Some of this is known to be of good quality class II coal. But there is a little uncertainty about the ash in the remainder. All allowances made.
Ditto	Raniganj		
	Dishargarh	48	
	Sanctoria	36	
	Beguna	25	
Ditto	Bokaro		
	Kargar	365	
	Total	1274	
IV. Good coking coal but not of metallurgical quality.	Assam fields	600	Very high in sulphur content. If this impurity can be improved this can be placed in class I or class II.

APPENDIX V.

Resources of Limestones (the important occurrences).

Resources.	Composition. Ca Co_3	Mg CO_3	Al_2O_3 Fe_2O_3	Silica and insolubles.	Other constituents.	Remarks.
Katni, Jubbulpore, (Central Provinces) Lower Vindhyan.	Practically inexhaustible. Composition somewhat variable, but uniform locally.	94.65	2.98	1.79	0.58	Extensively worked. These limestones strike steadily eastward and are being worked in Bihar at Rhotas and near Sassaram.
Maihar (Rewah) Upper Vindhyan.	Practically inexhaustible, uniform locally, but the quality varies along the strike.	96.03	1.75	1.15	0.11	Largely used for lime.
Bisra (Gangpur State) Cuddappah.	Very large, but interbedded with bands of dolomitic material: composition variable.	95.15	1.57	1.87	0.34	
Sylhet (Assam) (Kirthar Series)	Practically unlimited. Used for all domestic purposes.	95.4	1.81	0.58	0.49	

APPENDIX V. (*Continued*).

	Resources.	Composition.					Remarks.
		Ca Co_3	Mg CO_2	Al_2O_3 Fe_2O_3	Silica and insolubles.	Other constituents.	
Chela (Khasi hills)	Very large (unknown).	98.6	0.55	0.3	0.55	..	
Panchet hill.	Large but limited.	45.05	11.53	0.28 (F_2O_3)	39.28 (Insoluble)	3.6 0.7	Ferrous carbonate, Phosphoric acid. upper bed.
	Do.	63.40	14.41	0.62 (Fe_2O_3)	19.28 (Insoluble)	4.15 0.12	Ferrous carbonate, Phosphoric acid. lower bed.
Hanspathar	Do.	83.43	0.78	..	16.18 (Insoluble)	0.68 0.02	Ferrous carbonate, Phosphoric acid.
Dalli Drug, C.P.	Very large.	83.5	2.0	0.9	13.6	..	
Kandara (Chanda Dt., C. P.)	Unknown.	94.5 to 96.8		3.0 to 1.2	2.0 to 2.5	Traces of Phos.	

APPENDIX VI.

Imports into India of Iron and Steel goods during the years 1924 to 1928.

		1924	1925	1926	1927	1928	Average.
Cutlery	..	5,72,36,344	5,56,79,585	5,58,83,246	5,67,52,492	5,85,55,191	5,68,41,392
Machinery, etc.	..	15,53,44,993	15,95,48,216	15,13,37,077	16,57,87,417	21,04,39,807	16,84,91,502
Railway Plant, Rolling Stock, etc.	..	8,39,15,058	7,53,44,065	7,14,94,159	8,44,57,576	4,21,41,648	6,74,70,501
Iron bars / Pig iron — Rs.	..	32,46,182	28,96,335	23,12,530	25,16,634	20,75,394	26,09,415
Iron bars / Pig iron — Tons	..	18,001	17,775	13,503	19,455	14,657	16,678
Iron and Steel beams, Sheets, Pillars, Rivets, etc. — Rs.	..	16,68,06,548	15,47,92,396	16,63,32,509	18,25,16,326	18,81,48,943	17,17,19,344
Iron and Steel beams, Sheets, Pillars, Rivets, etc. — Tons	..	6,82,369	6,68,920	7,38,950	8,71,813	11,13,458	7,95,102
Steel Bars, Angles, Ingots, Blooms, billets, etc. — Rs.	..	3,55,87,206	1,79,31,685	2,41,14,554	2,76,83,218	2,66,84,083	2,64,00,149
Steel Bars, Angles, Ingots, Blooms, billets, etc. — Tons	..	2,56,549	1,47,788	2,28,455	2,60,389	2,42,954	2,27,227
	Rs. ..	50,21,36,331	46,62,92,282	47,14,74,075	51,97,13,663	50,80,45,066	49,35,32,283

APPENDIX VII.

Exports of Pig Iron from India.

To		1924.	1925.	1926.	1927.	1928.	Average.
United Kingdom	..	8,828	28,708	15,314	21,140	8,920	16,582
Germany	..	...	11,595	3,166	9,926	8,542	6,646
Japan	..	1,49,697	1,58,713	2,30,913	2,65,226	3,21,010	2,25,112
U. S. A.	..	97,791	1,77,180	49,760	67,685	57,897	90,058
Others	..	14,759	25,598	16,009	19,983	32,256	21,721
		2,71,055	4,01,794	3,15,162	3,83,960	4.28,625	3,60,119
	Rs. ..	1,79,78,296	1,98,66,537	1,42,19,549	1,74,28,304	2,01.50,789	1,79,28,695
	£ ..	12,93,402	14,93,724	10,61,160	13,00,619	15,03,790	13,30,539
		£ = Rs. 13.9	£ = Rs. 13.3	£ = Rs. 13.4	£ = Rs. 13.4	£ = Rs. 13.4	

A meeting of the Association was held on Saturday the 2nd December 1933, at the University Geography Department, Wesley College, Royapettah, when **Mr. V. Kalyanasundaram, B.A. (Hons.) Dip. in Geo.** read a paper on **"The Geographical Basis of the Indian Iron and Steel Industry"**. **Mr. K. C. Ramakrishnan, M.A.**, University Lecturer in Economics, presided.

The Chairman in his introductory remarks said: "On the subject of to-day's lecture, I do not think it requires anything to be said, except that it is an extraordinarily important industry, which we should study. There is no other industry to which greater importance is attached in modern times than the iron and steel industry. It is said to be the key industry, at least one of the several key industries, of a country.

There was a little joke about it in the Joint Select Committee and some people were questioning on the subject of commercial discrimination—whether at least in respect of the key industries there should be some kind of discrimination against British citizens residing and doing business in India ; and not clearly understanding the point, Sir Samuel Hoare said that the key industries were those where munitions of war were prepared, and he could therefore class iron and steel industries as key industries. I do not think there would have been any dispute of that.

Munitions of war are not the only important things. They may be the most important in times of war. In emergencies they may be the mainstay of the country. But besides munitions of war, there are so many uses of iron and steel. The present age has really been called an Iron age, where machines are being used, machines made mostly of iron and steel, like the railways, steamships, etc., and iron and steel are being used more and more even in a backward country like India. From the point of view of the very great uses to which the products are used, nobody can question the importance of iron and steel industry.

Further they give rise to a number of other industries. If once you install iron and steel works, a number of complicated machines have to be set up. You have to utilise the various by-products. For instance in the process of distilling wood into charcoal, you get a number of by-products. You have to find a market for them. I wish to point out to you, in conclusion, that there are no other industries, so important and complicated in their nature in respect of the enormous uses to which they are ordinarily put and in re-

pect of the most essential uses, in times of war, and for which you require a very high class of equipment, a large amount of capital and organised enterprise, than the iron and steel industries. For the study of this subject nothing is more important than an essential knowledge of Geology." With these words the Chairman requested Mr. Kalyanasundaram to read the paper.

Mr. Kalyanasundaram then read the paper printed above.

In the course of a lively discussion which ensued after the paper was read Mr. B. M. Thirunarayanan said that some more prominence should have been given to the various factors that would lead to a localisation of the iron and steel industry. The greatest drawback to the proper development of the iron and steel industry in India is the want of adequate transport facilties. An important factor for the localisation of the iron and steel industry is enough supply of coal, fuel or charcoal. It is in the neighbourhood of forests and woods where sufficient supplies of fuel may be obtained and also in the neighbourhood of local supplies of iron ore that the industry could be localised. But with the development of modern transport facilities this aspect of the question changed. With the coming in of coal for smelting iron, iron industry has centred itself in and near places where coal fields were situated.

Further, there is the question of the technique of the industry. Originally when iron was smelted with coal, the largest quantity of raw material required for the industry was coal. It has been estimated in Great Britain towards the end of the 18th century that about 3 to 3½ tons of coal were required for the production of every ton of metallic iron. But with the modern improvements in the technique, the centre of gravity has shifted from the coal-fields to the areas where iron ores could be found; and this change was augmented by the developments in transport facilities. In the United States and Great Britain there is just now going on a shifting of the industry from the coal fields to the regions where iron ore could be had. Perhaps the location of the Tata Iron Works should be taken as a parallel instance in this case.

Then there is another thing which struck me in the course of the lecture, namely, the little attention paid to the decline of the iron and steel industry in India and the disappearance of the ancient technique. Perhaps the most important and most powerful need for a country was weapons made of iron and steel. One of the many reasons that probably led to the decline of the iron and steel

industry in our country was the disappearance of the manufacture of weapons of warfare due to the coming of the Pax Brittanica. Practically, I think, iron and steel industry grew from out of this military necessity. Before the coalfields were discovered, there were certain ordnance factories existing in Bengal, maintained by the East India Company working at iron and steel. So it was the stopping of the manufacture of weapons of warfare that acted as the main cause for the decline of the iron and steel industry.

In winding up the proceedings the Chairman, Mr. K. C. Ramakrishnan said:—"The entire material for the lecture has been taken from books describing the past and forecasting the future. That tremendous industry has been displayed is quite evident from the exhaustiveness of the paper. It would have been better if the author of the paper had devoted a large portion of it to tracing the present conditions and difficulties that lie in the way of the localisation of the iron and steel industry in India. It is of course an exhilarating thing to deal with the glorious past than to detail the inglorious present. But an understanding of the present difficulties is more essential to shape the future; and for that we must face our present difficulties, explore them in detail, find out the remedies and thus help to shape the future.

The real success or failure of an iron or steel industry depends to a large extent on how far we are able to market the by-products that would result from an iron and steel industry. It is the problem of by-products that is the puzzling question. These should have been dealt at more length in the lecture. Further, if the Government had manifested some more goodwill, an iron industry could have been established in and around Bengal. The author should have dealt at some more length the present circumstances of the industry and the effects of scientific discourses. It would have been better if persons who have not studied the science has had it explained to them the different processes in the manufacture of iron and steel goods in a simpler language and at some greater length. Still, I am sure that when the paper is finally printed in the Journal it would be considered a very able and useful thesis.

But let me revert to some details. It has been said in the course of discussion that electric smelting is a misnomer. But I would like to know how far coal and charcoal are reducing agents and how far they are heating agents. If they could be used for heating, then electricity could also be used. To that extent electric heating, if not electric smelting, would be a proper term. In the Thalamalai, Kan-

chimalai and other hills near Salem, there are forests in abundance, though not like the thick forests of Malnad and charcoal could be had in plenty from those forests; and so it would not be a difficult thing to have a well-developed iron industry near Salem. In this connection, I remember a contribution to the Geological Journal of Mysore saying that in Salem there is no prospect of improvement of the Kanchimalai iron ores. Some millions of tons of iron could be obtained from the Kanchimalai,—which is richer in iron ores than the iron mines of Northern India and richer than the regions of Lake Superior. But the ores could not be utilised for lack of coal. In that article it was stated that there was not adequate coal in Salem and that Salem could also not have enough supplies of charcoal because the forests near Salem could not be so regenerating as the forests of Malnad due to climatic conditions. In Malnad there were plentiful rains. But if hydro-electric power could be brought to the area, if the immense potentialities of the Mettur project could be well utilised, then I am sure that the iron mines of Salem could be developed to an enormous extent.

Take again the case of the Tata Iron and Steel industry. Nearly 27 crores of rupees had been sunk into it. It is not merely the question of obtaining the raw material necessary for the industry that makes or mars the success of that industry. Transport facilities should also be taken into consideration. One of the greatest difficulties with the Tata iron works at present is that their contract with the B. N. Railway has terminated; and pending a new term of contract, the Government have requested the Bengal Nagpur Railway to keep up to the terms of the old contract. The Tata works had to get their coal from other places as distant as 180 miles. Freight charges would be heavily against them. That is why the iron and steel industry should have transport facilities. Many of the iron companies in the United States had their own steamships. They had a smelting industry on both sides of a river and with their own steamships, they had no waste of traffic either way. They could carry their coal to iron and iron to coal and the finished products overseas. The different interests of the industry are harmoniously organised as a single unit there and that made for large profit. Further they had big international trusts, cartels and combines to market their finished product. What India requires to develop her iron and steel industry is transport and marketing facilities.

In concluding my remarks, I would like to point to the depression in the iron and steel industry of Mysore. Mysore has always been in the grip of depression. True, that Mysore is a region with far greater rainfall than Salem and as such her forests could regenerate more quickly than the forests at Salem. But the greatest difficulty of the Mysore iron works is to market their by-products. Even in America, the iron works attempted charcoal as a medium of smelting. But they soon found that it was difficult to market the by-products that resulted from the manufacture of charcoal. That difficulty should be much more in a country like ours especially in Mysore where those by-products could not find a ready market. Actually large quantities of tar were thrown into the river in Mysore since they could not find a market for that. If they could find a market for their by-products, then the iron and steel industry of Mysore could thrive well. It started in depression, has been in depression throughout and the depression is getting keener day by day there. Before sitting down I wish to point out that the reader of the paper has put in a lot of industry and with some rearrangement and a little omission the paper would be a very useful one for the Journal.

With a vote of thanks to the Chairman and the lecturer, the meeting came to a close.

"Our Mysore Excursion"

BY

MR. N. SUBRAHMANYAM

Under the auspices of the Madras Geographical Association, **Prof. N. Subrahmanyam,** delivered an interesting lecture on "**Our Mysore Excursion**", in the University Geography Department, Wesley College, Royapettah, on Saturday the 11th November, 1933. **Mr. K. A. Nilakanta Sastriar,** University Professor in Indian History, presided.

In his opening remarks, the Chairman said, it was expected that Mr. N. S. Subba Rao, M. A., Bar-at-Law, Director of Public Instruction, Mysore would preside. It would have been ever so fortunate if Mr. Subba Rao had presided, but as the main business for which Mr. Subba Rao had to go over to Madras from Mysore was postponed, he could not be present and as such in the unavoidable absence of Mr. Subba Rao, he consented to preside. He then requested Mr. N. Subrahmanya Aiyar to deliver the lecture.

THE LECTURE*

Ladies and Gentlemen,—I and my party were very much anxious to broadcast our experiences in Mysore because our excursion was partly in the nature of an experiment. I have had a number of excursions with my students during the last quarter of a cenutry and in recent years after I became connected with Geography in the Teachers' College, the number of such excursions had increased. The peculiarity of this excursion lay in the fact, that it was for 10 days consecutively—the largest period on record, the previous longer excursions being for six or seven days only. A second way in which this excursion was experimental, was that three or four institutions joined in getting up the party, all the members being teachers and students of Geography at the same time. The institutions that participated in the excursion were the Lady Willingdon Training College, St. Christopher's Training College,

*** The lecture has been very briefly summarised, as a full account of the excursion is given in the next article.—*Editor.***

the Teachers' College, Saidapet and the University Diploma Class in Geography. In a third way the excursion was experimental, and that was, it was a mixed party. We were like members of one family throughout the 10 days of the excursion.

On every one of the days, we had something very important to do; and doing that, everyone of us felt that even if it had been for that one thing the excursion was worth having. In the end we all felt that we derived a good deal of consumer's surplus, especially in view of the fact that the whole *per capita* expenditure, all told, was only Rs. 38 without any kind of railway concession.

On the first day we visited the Kolar Gold fields. At Oorgaum we were received by the Assistant Inspector of Mines. The most thrilling experience for our party there was that we went 4,800 feet underground in two minutes. The various processes by which gold was extracted—namely the powdering and mixing with water the amalgamation process and lastly the cyanide process—were all explained to us. The gold obtained by those processes was taken together once in a week or 10 days, melted in a crucible and gold bricks were made. As luck would have it, the melting was done on the very day we reached Kolar and we had the opportunity of witnessing the process.

The second day we went to Bangalore, where all the visits were arranged by the Secretary of the local branch of the Geographical Association. We first saw the Imperial Agricultural Dairy Farm. Then the Science Institute. In the evening we saw the Government Porcelain Works, Lal Bagh and the Bugle Tower. In the Imperial Dairy Farm we saw the process of making butter and cheese hygienically. At the Institute of Science, every one of the research workers was working from dawn to dusk, deeply interested in his work and unmindful even of his food. At the Government Porcelain Works we saw an instance of how in Mysore the industries and activities were co-ordinated. In an electrical State like Mysore, they want plenty of insulators; and instead of importing them, they manufacture them themselves. Out of the waste from the manufacture of insulators, chinaware, etc., were made. The only thing they imported was Plaster of Paris. From the Bugle Tower we had a birds'-eye-view of the entire city.

The third day we went to Sivasamudram waterfalls by bus. Right along the way, we had a number of worthy objects to see, which we would have missed if we had taken the railway route.

There are falls on either side of the island: one falling in the British territory and the other in the Mysore State. It was the Mysore falls, which were harnessed. (The power-house, the river, the penstoke and the inclined trolly lines were then projected through the Epidiascope.) One noteworthy feature was that the electricity so obtained from the falls was utilised even in the rural areas.

On the fourth day we travelled from Bangalore to Shimoga. It was interesting to notice the railway line running along a divide with head streams of different rivers on either side. We went to Malnad and found that it was on a lower level, and there we saw the valleys of the Tunga and the Badhra. In Malnad extensive areas of unirrigated paddy cultivation in terraces was the chief feature. At Sagar, sandal wood was the main item of export.

On the fifth day, our party went to Gersoppa to see the Jog Falls. The Mysore Government wanted to harness the falls, but the British Government feared that the beauty of the falls would be spoiled, if it was harnessed. (Views of the four different falls were shown on the screen.) Gersoppa. was one of the most wonderful beauty spots and the thrill of it was so great that none of us had any mind to come away from it.

Seeing the Badhravathi Iron works formed the sixth day's programme. It was a very interesting place from many points of view. The co-ordination of industries and the utilisation of all by-products were the most important things to note. They get iron ore from the Bababudan hills, 20 miles off. Here iron was smelted with the aid of charcoal. In fact, it is one of the few places in Asia where iron was smelted with charcoal. For this purpose, all the wood obtained from the extensive forests in Mysore could be utilised. This was another example of co-ordinated activity. Again by the creosoting process, huge trunks of forest trees were made rust proof and white ant proof to be used as wiring posts instead of iron posts. Pipe foundry was another interesting thing to see at Badravathi.

The seventh, eighth and ninth days of our excursion, we spent in Mysore. We saw the Krishnaraja Sagar dam at Kannambadi where a beautiful terrace garden was laid out; and travelling seven miles along the Cauvery, we saw the monuments at Seringapatam. We went up the Chamundi Hills and saw the palace and temple there; we then saw the Exhibition, the Zoo and the Jaganmohana

palace. The last thing we saw was the palace illumination and Darbar. Through the kind help of one of the officials we were taken very near the Darbar and immediately after seeing the Darbar we rushed to the station to be back to Madras. We could not adequately express our feelings of gratitude for the unfailing courtesy and kindness we received at the hands of the Mysore officials who helped us in our tour.

Mr. K. A. Nilakanta Sastriar, in winding up the proceedings, said:—Ladies and Gentlemen,—It is a very interesting discourse to which we have been treated—frank, full and a very animated narration of experiences. I am sure that the members of the party feel extremely grateful to Mr. N. Subrahmania Aiyar, for the extreme care and foresight with which he provided for their personal comforts at every step of their, after all, not very adventurous journey. Mysore is a very civilised State with a well-established Government. It is a beautiful and progressive State, a State of which we have every reason to be proud, for there we can see how an energetic and benevolent administration has done everything to the best advantage of its inhabitants. The lecturer has so vividly described his and his colleagues' experiences in Mysore, that he has created in us all an unconquerable desire to take an excursion to Mysore. I thank you all for the great honour you have done me in asking me to preside on this occasion.

With a vote of thanks proposed by Mr. M. S. Sabesan, the meeting terminated.

An Account of the Excursion to Mysore

BY

MR. V. KALYANASUNDARAM, B.A. (HONS.), *Dip in Geo.*

I have made an attempt in the following pages to give a detailed account of the excursion to Mysore. In writing this I have made use of information collected not only during this tour but from what was collected during the geology excursion of 1929 and the knowledge which I had gained from books like the Mysore Gazetteers and reports of the Mysore Geological Survey. These sources I have drawn upon only as far as it is necessary to present the essay from the present viewpoint—the geographers'—and so have omitted much of geology which would be superfluous and which would not fit in with the theme properly.

I am much indebted to Mr. Subrahmanyam, for, without his untiring and never-failing efforts, the tour would not have materialised and I along with the others, would not have had the proud privilege of studying the regions from the purely geographical viewpoint. It was a revelation to us to know how much geography one can study from things which appear most commonplace to a casual observer; and it was all the more striking to me who had an opportunity of seeing the regions earlier before I had got the geographic outlook. My thanks are also due to Mr. G. K. Krishnamurthi of Bangalore, the Amildar of Sagar and Mr. Solomon Sekhar of Shimoga for the valuable tit-bits they gave us about their own regions.

Lastly, I am indebted to Mr. Subrahmanyam again for the synthetic view of Mysore—the Maidan and the Malnad—which we being young and inexperienced, were not able to get; and also for the comparison of the Maidan, the Malnad, the East coast and the West coast and the study of the reactions they produce upon the people.

The Salt Range of the Punjab has been called the field museum of Geology in India. In a way Mysore formed the field museum of Geography for the students of the L. T. and Diploma classes last September.

Before going to the details I would like to give a short description of the State of Mysore. The triangular plateau forming the Native State of Mysore is the southernmost portion of the Deccan plateau bounded on the east by the so-called Eastern Ghats and on the west by the Western Ghats, the two meeting at the Nilgiris. On the east the plateau descends rapidly to the level of the plains of the Carnatic, while on the west the Western Ghats give place to the narrow west coastal plain—the Konkan. The general elevation of the plateau is over 2,000 feet above the sea-level so that the plateau enjoys a milder climate than the Carnatic plain.

Structurally, the plateau does not show much variation. The gneisses of the Archaean system form the country rocks here; and

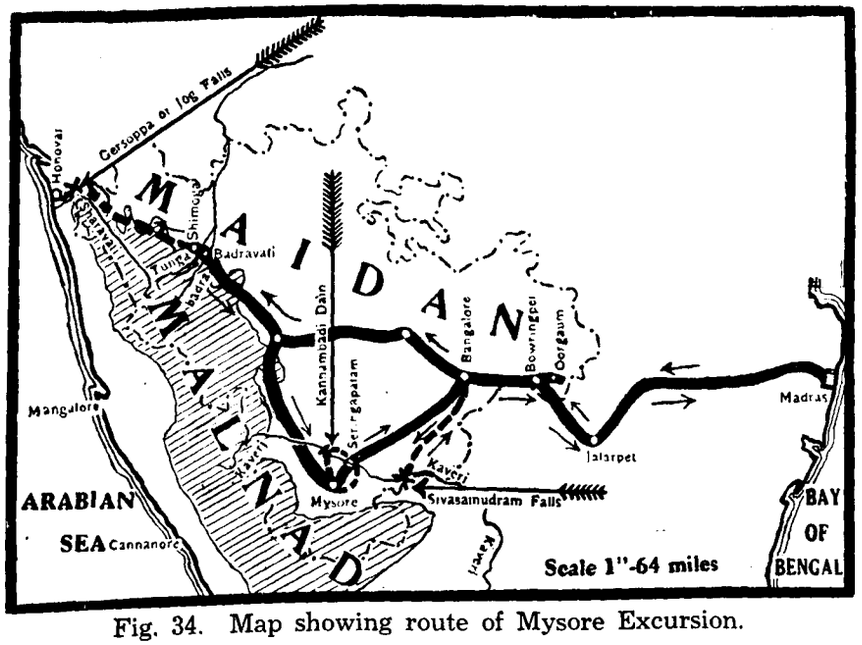

Fig. 34. Map showing route of Mysore Excursion.

intruded among them, as narrow lenticular bands, are the hornblende and the quartz Haematite schists of the Dharwar system—economically the most important next to the Gondwanas (being the chief mineral bearing rocks of India as a whole). The plateau is shut off from the rain-bearing winds of both the monsoons and is a region of *rain-shadow* receiving on an average about 40 inches of rainfall per year. This is reflected in its agricultural products, Ragi and Jowar forming the main crops here as also the staple cereal, yielding place to rice and cocoanuts along the banks of rivers and below the bunds of tanks. Other products are castor, tobacco, and

areca with coffee on the hill-slopes. Teak forests and sandal abound in the forested hills of the Western Ghats.

The people are all Kanarese-speaking; but the adaptability of Tamilians has led to their being found in places as far away as Bhadravathi and Shimoga, so that in such places Tamil too is understood.

Regionally the state can be divided into the eastern *maidan* and the western *malnad*, the one differing from the other in several respects; but in essentials in a general way they are related. More of this will be given in the last section of the essay and so we pass on to the detailing of the excursion.

Arriving at Bowringpet we changed into the Kolar Railway. It was a change in every sense of the word—from the fairly comfortable main line passenger train we boarded the 18th century type of carriage such as one is likely to find only in Salem branch railway, etc. The noise made by the engine was not proportional to the speed and there was a lot of jolting. This together with the anxiety to see Midas' food made us look forward with eagerness to the sight of Oorgaum station. The rock round about is the typical archaean gneiss or gneissic schist granitic in composition; but as we were nearing Oorgaum we discovered the lenticle of the hornblende schist replacing the gneiss. That very moment we entered the gold field, for the gold occurs only in this hornblende schist in quartz veins. The vegetation is of the scrub jungle type and as we approached still nearer to Oorgaum even the little patch of vegetation was getting thinner. We could see at the distance the cyanide hills—the landmarks of the gold fields.

KOLAR GOLD FIELDS

The gold here occurs as incrustation in quartz running in the form of a vein dipping down into the rocks at more or less steep angles. The associated minerals are galena blende and in the quartz veins are to be seen good crystals of tourmaline. On account of the dip of the vein the works are going deeper and deeper and at Oorgaum the boring has gone to 7,000 feet below surface level—a depth comparable to those of S. Africa.

The descent into the underground works are by means of vertical shafts worked by electricity up to about 4,800 feet and below this either by means of vertical or inclined shafts. There are

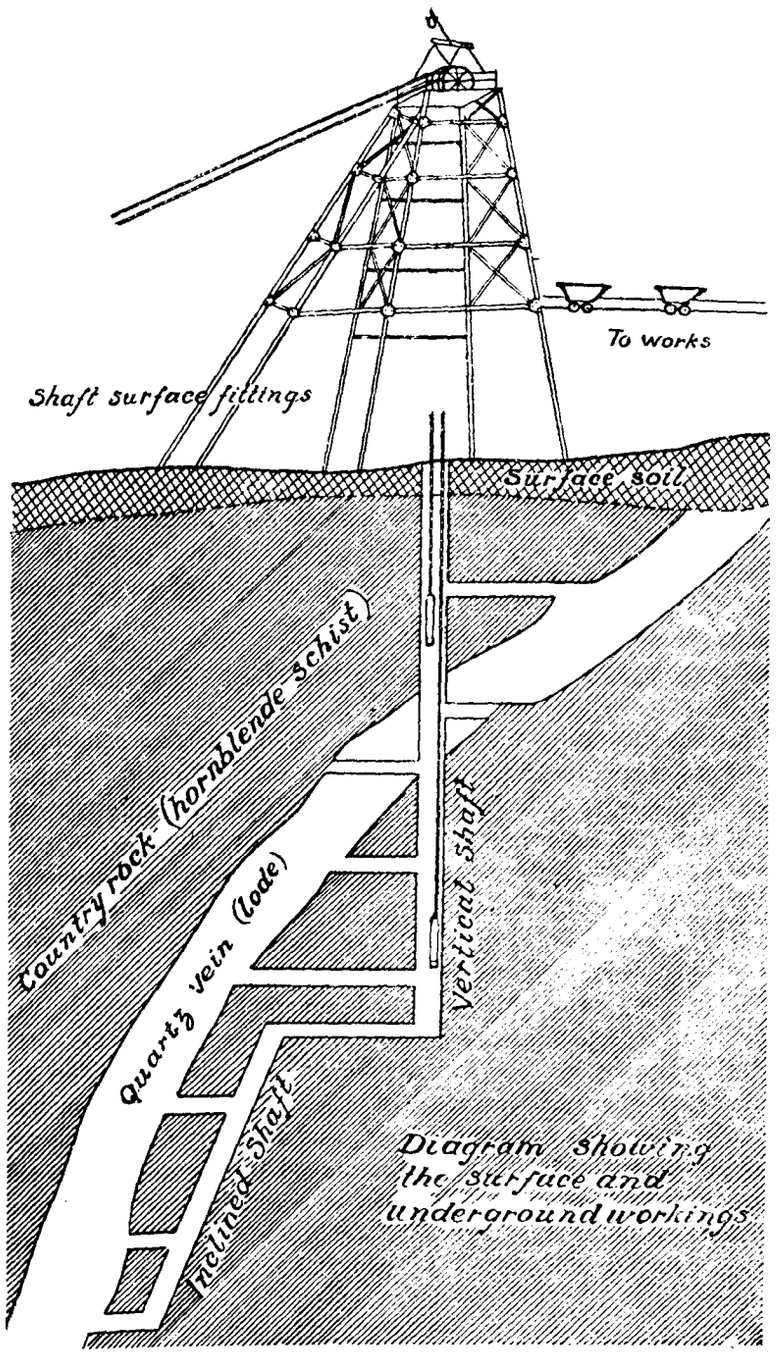

Fig. 35. Diagram showing the surface and underground workings in a Gold Mine.

various levels where the workings were originally being carried but which have been traced down to lower levels. The scenery of the underground is a radiating intersecting system of tunnels, dark alley ways in the bowels of the earth. It is said that the total length of all the tunnels in the Kolar area is about 100 miles. The veins are worked by blast and when a certain stage is reached the blasting is stopped and the walls are supported by wood props. This removal of solid rock necessitates a readjustment of the forces, which readjustment manifests itself in the form of rock bursts. Less frequently there have been fires from the wood props. The situation was anxious, at least to me, when I just lost myself in reveries thinking about what would happen if the rock burst were to take place just then. For some others it was a trying ordeal.

The ore—the blasted rock—is conveyed to lift level by means of trolleys hauled by manual labour and then hauled up to the surface by the lift. From the shaft the trolleys are transported to the works along rails and drawn by rope ways.

PROCESSES OF THE EXTRACTION OF GOLD

The first stage in the extraction of gold consists in the breaking of the large boulders into smaller pieces either by means of manual labour or by means of machines. The broken rocks then travel round in a continuously moving belt on either side of which are a number of coolies standing. Their business is to remove the pieces of hornblende schists if any in them. This done the rock pieces are passed on to a mill where they are crushed to powder and made to mix with water and flow away. This is done as follows: The apparatus consists of a huge steel piston working in a cylinder of a similar metal, a contrivance resembling the pestle and mortar used by toothless old persons for powdering and mixing the ingredients of Pansupari. While the piston is working water is made to pass through the cylinder and this serves a double purpose, it serves to cool the machine and at the same time its main function is to form an intimate mixture with the powdered rock. It should not be understood to be a solution, it is merely a mechanical mixture in which the solid material remains in a fine state of suspension.

This mixture of water and the finely powdered ore is then allowed to pass over a metal trough covered with a blanket, the trough itself being inclined at a convenient angle. The rate of flow

of water and the angle of inclination of the trough are such that when the water passes over the blanket the heavier gold particles (gold being six times as heavy as quartz) are arrested and the lighter silica and the associated minerals (galena and blende unless intimately associated with gold) flow away.

The separation of the gold is not complete in this process. Some gold does pass away without being arrested and to recover it in part the solution (for want of better or more appropriate term I am using this, not in the strictly technical sense) is allowed to pass over a second set of trays or troughs containing mercury-coated plates. The gold present forms an amalgam with the mercury and the silica and other minerals pass down. In order to aid this process there are persons who manipulate the flow of water and work with their hands on the mercury plate to ensure the process of amalgamation.

It should be understood that in this stage too the separation of gold is not complete, the final process being completed in the cyanide vats stage. But at an intermediate stage by an ingenious contrivance of the inclined trough and flowing water the separation of iron is effected.

The third stage in the separation of gold is the cyanide vats stage. The rich slimy mud is put into large vats—huge concrete tanks resembling oil tanks but open at the top—containing a solution of Potassium Cyanide and is allowed to remain there for two to three weeks. During this interval the gold is acted upon by the cyanide solution, the resulting product being Potassium auricyanide, the silica remaining as a sediment. The solution is then pumped into smaller tanks where gold is precipitated by the use of zinc shavings. The sediment left in the cyanide vats go to augment the size of the cyanide hills.

The gold in the blankets is washed out by a powerful blast of water and mercury gold amalgam is distilled ; the mercury sublimes away which is then cooled and collected for future use.

The gold obtained in the three processes then goes to the final stage where it is molten and made into ingots. The gold from the three stages is put into refractory crucibles and heated by means of oil burners. The gold melts and forms an ingot, the silica in it crystallising as glass. We had the unique opportunity of seeing an ingot being taken out from the stove, weighed and marked. That

was the first of a series of incidents which showed that "luck was dogging our footsteps". The truth of the statement could be realised only by the people who know the circumstances of our excursion.

The cyanide sediments and the shaft heads form landmarks of the gold fields. The cyanide hills, flat-topped and without any vegetation on their sides, provided us a good example of the destructive action of water and examples of land forms known as bad lands.

The feelings of the members of the tour party were beyond all description due to the sight of two huge lumps of Midas' food worth thousands of pounds, the novel and thrilling experience of going down into the interior of the earth—4,800 feet in 2 minutes—the dark passages in the interior, the quartz vein carrying the gold, the thought of rock-bursts and our safe arrival at the surface and the excellent arrangements which our host had made at Oorgaum. That single item alone was worth the expense—members began to say.

That afternoon we bade good-bye to our host and the gold fields and arrived at Bangalore city to spend a most enjoyable time under the able guidance of our untiring and selfless host there Mr. G. K. Krishnamurthi. We were comfortably lodged, the male members in the Central College Hostel and the ladies in the Vani Vilas hostel.

The next morning, thanks to the foresight and the excellent arrangements made by Mr. G. K. Krishnamurthi, we started out at 8 a.m. to see the Imperial Dairy Farm. We saw the various breeds of bull and cattle and breeding bulls. The methods adopted for the proper preservation of fodder during the dry months, learnt about the food contents and the digestive contents of the various kinds of fodder and saw the process of cheese manufacture, butter manufacture, the cold storage room, etc. This finished, we made a long hop to the other end of the town where the Indian Institute of Science is situated. We were led round the institute by Mr. Varadachari of the Bio-Chemistry section and saw the various departments. Things of special interest to us were the telegraphic transmitter and receiver together with the jumbler and resetter, wireless transmitter and receiver, step-up transformers and generators, ice manufacturing machines, the Plant Nursery and Plant investigating section, the bio-chemistry section and the liquid air plant. In the afternoon Mr. Varadachari showed us round the activated sludge plant whereby refuse water is made usable and he compared it with the old fashioned process.

The next item in our programme was the Mysore Government Porcelain Factory. This is a direct outcome of the enterprise of the State. The harnessing of the water power at Sivasamudram and its distribution require a large number of insulators. The State has a good supply of the ingredients of porcelain. Thus, the impetus to the industry was given by the electric development of the State.

The three ingredients are quartz, felspar and kaolin all of which are available in the neighbourhood itself and within easy assemblage. In the initial stage the quartz and felspar are ground to powder, the powder is then intimately mixed with kaolin in the presence of water into a slimy paste. This paste is then allowed to remain in that condition for a period of not less than two months before it is taken for use.

The prepared clay is then pressed into moulds and the annular rings of the insulators made on it by mechanical means and after this process it is removed from the mould and passed to the stove. In the process of preparing the insulators there is a large amount of the clay that falls into bits and these have given rise to another industry, namely, the models and the cups and other related porcelain articles. The process of preparing cups is very simple. An intimate mixture of the clay in water—a colloidal solution is poured into moulds. The water in the solution soaks into the particles of the mould and thus a thin film of solid clay is formed on the inner sides of the mould. The solution is then poured off and the mould allowed to stand for some more time whereby the water in the thin film is all absorbed by the mould and the cup comes out by just shaking the mould. The handles are afterwards separately attached. Similarly for models also.

The prepared models are then baked either in a hot air stove or in an electrical stove. The hot air stove consists of a cylindrical chamber capped by a conical structure and heated at the bottom by means of coal. The walls of the stove are lined with refractory bricks and the door is also of a non-conducting material. The models are arranged inside the stove which is then fired, the changes taking place within being viewed from without as also the temperature. After a certain temperature the doors are opened and the

charge removed. The furnace alone costs Rs. 7,000, while the electric stove costs about Rs. 3,000. The only material that the factory gets from abroad is its supply of plaster of paris for making moulds. This is one of the many instances to show the development of natural resources in the Mysore State.

The next item in our list was the bugle rock. This is the highest eminence in the city of Bangalore; and standing on the platform one gets a view of the whole of Bangalore city—the interesting way in which the city has developed. Here the archaean gneiss outcrops as a single solitary hill which has been improvised into a sort of watch tower.

Lal Bagh, the last item in our programme at Bangalore, was gone through in a hurry. Unfortunately we could not do full justice to the most beautiful place in Bangalore. The tall towering silver oaks and pines arranged symmetrically around the statue of the late Maharaja of Mysore have left a lasting impression in our minds and it is not easy to forget the other beauty spots in the place.

Sivasamudram Falls formed the next item in our programme. The motor journey from Bangalore to Sivasamudram gave us a nice view of the country we were traversing. The change in altitude was perceptibly felt. We were feeling hotter as we wended our way slowly towards the falls. The vegetation was mostly of the scrub jungle type, but along valley axes and where easily irrigable lands are found the character of the vegetation changed. The ground was levelled and brought under the plough. Cocoanut and paddy fields mark the water region. Terrace cultivation of paddy was to be seen at places. But the predominant crop, I think, was Cumbu and Jowar.

Geologically the route lay through the same archaean country as we found in the Kolar area. The coarser type of granitic gneisses (without much of accessory minerals) disintegrates into a fine white clayey soil. One could see this clay formation at several places along the roadside where a stream had cut its way and at one place a basin-like area, which is probably the drainage area for the surrounding country, was completely covered with this and it was a striking contrast to see the bare white formation immediately after the green verdure of the fields lying close by but separated from it.

On our way we passed by the Malavalli tank and could see the Mallavalli hill in the far background, whose neighbourhood, our

professor told us, was the scene of a battle sometime during the Muhammadan rule of Mysore.

Nearing the Cauvery, a turn to the left carried the road over the supply channel and in another half a mile we were at the Falls. We could hear the Falls and see the foam rising above but could not get a clear view of the same. Everyone was eager to get the first view and all of us walked down a distance of a furlong and a half to get a close up of the Falls.

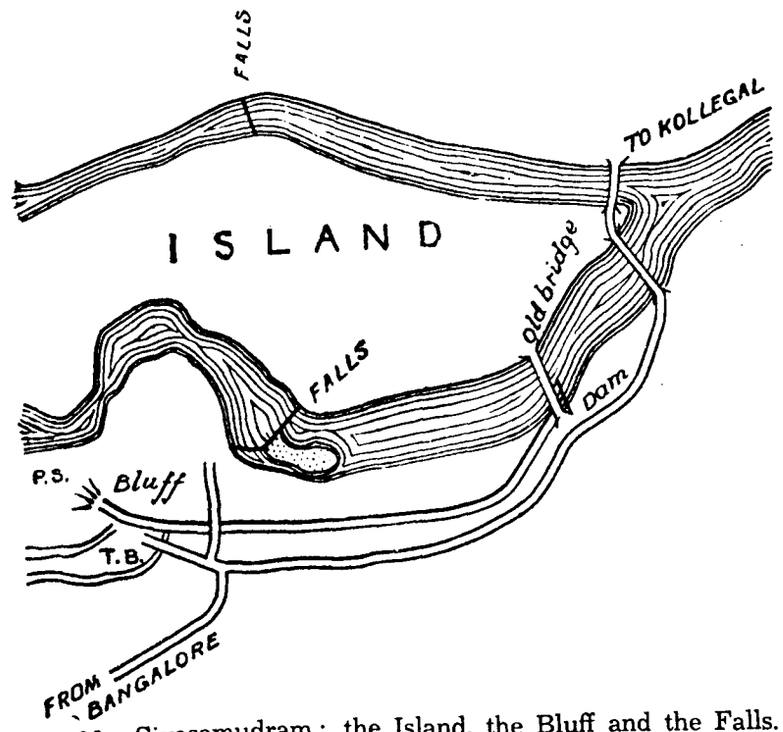

Fig. 36. Sivasamudram: the Island, the Bluff and the Falls.

The Cauvery river flowing over the gneissic rock which, as has already been seen, forms the bedrock in most of Mysore, divides itself into two branches at a point a mile or two above the Falls. One of the branches goes through the British territory, the other through Mysore State before joining its cousin below the Falls. Both the branches leap over the edge of a gneissic cliff 320′ high at the Falls of Sivasamudram, a name historic in the development of Mysore and a household name in almost all the villages of S. Mysore. That branch of the river which takes

the leap down the cliff in the Mysore territory is bifurcated into two by a lenticular mass of the gneiss and so falls in two branches. The river has cut a deep winding gorge which stands as a monumental specimen of the slow but sure and steady work of nature's moulding agents.

Fig. 37. The Falls, Penstokes and Power Station.

The island of Sivasamudram had been a place of historic importance—purely due to its location—but now it is nothing but a mass of ruins. The venue of importance has changed from the island to the Bluff—as the place is called where we have the modern colony and it is a clear evidence of the changing importance of things—characteristically geographic and marks geography as a dynamic science.

THE HYDRO-ELECTRIC POWER STATION

The Kinetic energy of the falls which was going to waste till recently has been harnessed and the mad fury of the waters in coming down the height is made to do something more usfeul than merely throwing itself down madly. The genius that has been responsible for this is none but the late Sir K. Seshadri.

The main considerations in the successful development of hydro-electric energy are the regular supply of water through the year round and a certain 'head' as it is technically called. The popular notion that the generator would be placed just at the foot of the falls had been clean wiped out when we came to the actual works. The first of the above considerations is fulfilled by the construction of a small dam at the site of the old stone bridge across the river at a point a mile higher up the river, from where a portion of the water is conveyed by a supply channel. The bed of the channel in order to conform to the level of the surrounding country is lowered in a step-like fashion so that there may be no undercutting of the bed.

The water from this channel is stored in a large tank at the edge of the Bluff from where it is conveyed by means of huge pipes 5 to 6 feet in diameter called penstokes to the power station situated below at the foot of the Bluff and in a level with the river. The amount of water flowing through the penstokes is regulated by the load and the excess water which is not utilised flows down another channel to join the main river. The head of the water column is 420 feet.

The essential units of the power station are the water turbines and the generators. Dynamos which produce electricity electromagnetically require some motive force to rotate them and this is supplied by the turbines. The water coming down the penstokes gain force in their descent and this force is made to rotate the vanes of the turbines and the axis on which the vanes move is coupled to the axis of the generator. Each turbine has a penstoke attached to it.

The Sivasamudram power station has eight generators, two of 6,000 K. W., two of 3,000 K. W. and four of 1,500 K. W. and one more is under construction. The current produced by the generators is raised by connection through a step-up transformer to 78,000

volts—this is absolutely essential in view of the fact that the current is not consumed in the immediate neighbourhood but has to be transmitted over long distances and this means wastage due to the resistance offered by the metallic conductors and the atmosphere. There are four routes of transmission respectively to My-

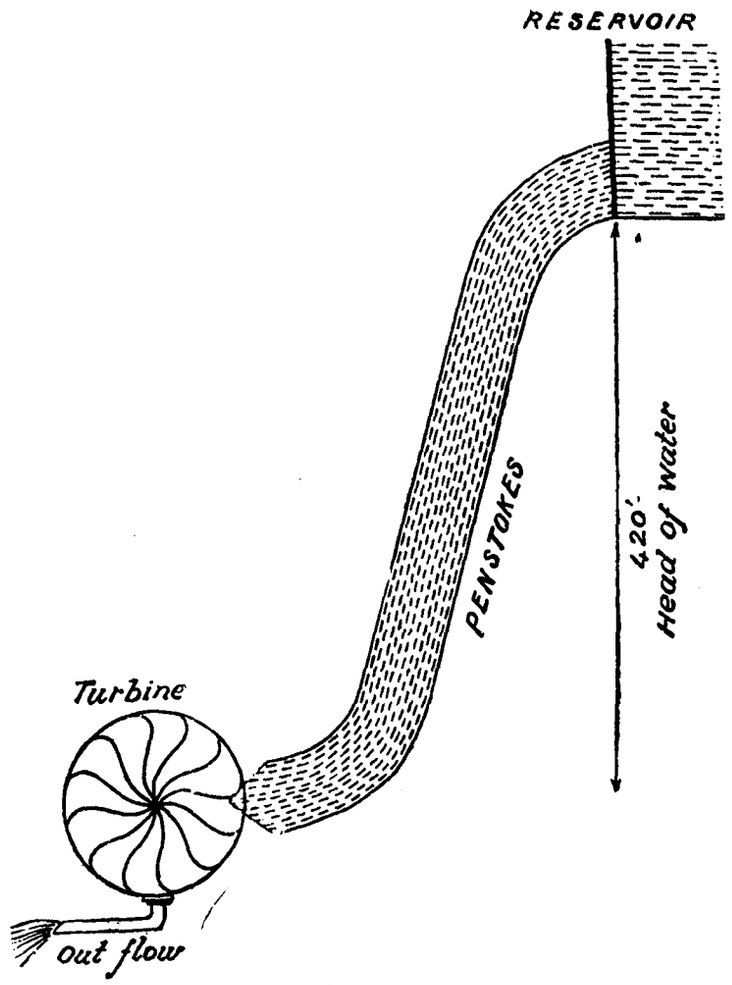

Fig. 38. Reservoir, Penstokes, and Turbine.

sore, Bangalore, Kolar and Mettur. Each route has a double line to serve in emergencies.

The power station is connected with the Bluff by an inclined trolley line and there is a similar trolley line but of lesser gradient to bring down the plant and machinery.

The cheapness of electricity has led to its being utilised for an innumerable number of purposes which a person in parts of Madras Presidency would never even have dreamt of. The Chennapatna silk factory and toy factories are worked by electricity and a number of places—mere unions—had electric lights. The electric lights, the artistic way of delimiting the towns and villages along the road with name boards and such things go a long way in enhancing the beauty of places which are already naturally well-endowed. We were told that electricity was used at places for pumping water for irrigation purposes. We were back at Bangalore that night and went to bed for a well-earned rest and to prepare ourselves for the long journey that was before us.

7 a.m. on 24th saw us off to Shimoga. The journey was by day and we utilised the interval in the best manner possible—by studying the landscape from the train. At first the route lay through the gneissic country and the whole maidan is studded with a number of hills and hillocks, the highest of which is the Sivagiri hill. It is a typically undulating area with the said hills and hillocks relieving the monotony of the rolling ups and downs; and the railway traverses the ups and other ridges by a number of cuttings. They would have been of importance from the geologist's viewpoint; but, for us they afforded an interesting study of rock-weathering. Passing from the gneissic the train enters the Dharwarian schist belt, a change which is strikingly felt. The Dharwars are one of the richest—economically—of the rock formations of India, it being associated with the ores of iron, manganese, gold, asbestos, chromite, etc. The iron ore mountain of the Bababudan—the steep south-eastern scarp of which could be seen as we travelled, is composed of the hornblende schist and the quartz haematite schist—formations typical of the Dharwars.

The railway line from Bangalore to Hubli traverses through an interesting country. It takes the water-parting between the Cauvery and the Penner till we reach Arsikere and then along the divide between the Hagari and the Cauvery. It was interesting to see actually the water divide between two river basins.

The natural vegetation of the divide is of the scrub jungle type, lantanas abounding—with palm as a variety; but the valleys are irrigable and hence cultivated. The valley axes present a verdure due to the paddy fields and cocoanut palms while on either side the paddy and cocoanuts give place to jowar, cumbu and the

palms which are finally replaced by the lantanas at the 'ups'. At Tumkur, the famous cocoanut marketing centre, we could see wagon loads of cocoanuts at the railway station.

In our progress westwards we were entering a region of increasing rainfall and the character of the vegetation consequently changed from scrub jungle to mixed scrub and woods and finally to forests. As we were nearing the hills of the Malnad, we could see the forested slopes from the train. The temperature, rainfall and soil conditions of these hill slopes are admirably suited for coffee and hence coffee is an important product of the region. Kadur—the headquarters of the district of the same name and on the railway line, is the market for the plantation coffee from the Malnad and is a very busy centre. The increasing rainfall gives rise to arecapalm and arecanuts form a large item in the export of Birur. The route from Birur to Shimoga lay through the same type of country, but more forested. There is a down gradient generally from Birur up to Shimoga and near Tarikere it is a continuous down gradient for over a mile and a half, a thing which very well explains the momentum gained by the goods train during the recent train smash.

After crossing the Bhadra and the Tunga, Shimoga was reached at 6-30 p.m. and we were comfortably lodged in the National Lodge. We were all in high spirits, eagerly looking forward for the sight which the morrow had in store for us; but it was not an unmixed joy, as we were having an anxious time of it owing to the indisposition of one of our party and were faced with the proposition as to how to arrange for the patient. But luck which had been in our favour was again in evidence. The patient got well enough next morning. This was not the only evidence of our luck. We were to learn that it had been raining in Gersoppa for some time but thanks to our luck, there had been no rain for three days past.

Shimoga.—The location of Shimoga served us well in studying the phenomenon of inversion of temperature. Its altitude is just about a thousand feet less than that of Bangalore and as one would naturally expect it is hotter during the day time. But its being surrounded by mountains on all sides accounts for the other phenomena—the cooler and misty nights which would at first sight appear inexplicable. The inversion is so pronounced at certain places that it is often 9 or 10 a.m. in the morning before the mist clears away.

VISIT TO GERSOPPA

On the 25th we were joined by Mr. Kuriyan, and we all left for Gersoppa which proved to be the most thrilling experience for all of us. The road lay through the maidan portion of the Mysore State till the foot of the Ghats and then crossed the Ghats in a picturesque and steep-sided ghat section, bursting into sight of the river almost before we could expect it. The road was an interesting study by itself clearly denoting the change in rock. For the first 25 miles the metal was the granite gneiss, the white road metal that people in Madura and parts of Salem district are acquainted with. This gives place to manganiferous road metal which manifests itself by its colour, resembling the older overbridge at Egmore just after it is covered with heavy crude oil. Still further west the manganiferous limonitic rock gives place to laterite of the Ghats proper—there is no surer indication than this to denote that we have reached the region of heavy rainfall. Laterite has entered into every phase of the life of the people. Their houses are built of this—on account of the ease with which it yields to chiselling; it is easily cut into blocks of required sizes in the quarry itself and placed one above the other with a little cement and the percolating water will do the rest; at other places the laterite mud is made use of in much the same way as cement or lime plaster is used in case of a brick wall, only here instead of a brick wall they have bamboo pillars and fences. All the houses are built of this material. If it happens to be a rich man's house, the laterite is cut into regular bricks and the roofs are covered with Mangalore tiles. It also serves as a ready road metal.

VEGETATION OF THE COUNTRY

For the first 20 or 30 miles the lantana thickets lined the road with a few trees further away. The fields were sown with jowars and a kind of grass for fodder purposes. As we progressed westwards we were entering a region of increasing rainfall. This has its influence on the vegetation. The lantana thickets give place to forests with bamboo thickets at certain places, the forests gradually becoming thicker. One could see tall trees towering above the slender shrubs with the wiry lianas turning round and climbing up their tall robust cousins and getting as much benefit of the sun as their powerful cousin. Further westwards the forests become very thick so that it is with difficulty that one could look through and the dominant note is played by teak trees both naturally and artificially grown. The sandal wood tree also is prominent.

But it is in crossing the Ghats proper that one could see the wonderful natural scenery associated with the Malnad. In the valleys and basins paddy and sugarcane are cultivated—an unirrigated crop grown in terraces—the lower slopes are covered with thick forests with gaily coloured orchids along the road cuttings, while the upper slopes and the highest portions are covered with grass. The forest-covered lower slopes and the grass-covered higher portions recall to one the typical Alpine scenery.

The region is one of very heavy rainfall receiving at certain places—we were told, an annual rainfall of about 200 inches on an average, for the whole of Malnad the rainfall would exceed 100 inches; and accustomed as we are to a maximum of 40 to 50 inches we cannot imagine what it would be like to have over 100 inches and that too crowded together in a few months. This is one of the main problems to be considered in the maintenance of roads. There is so much of soil erosion that the road to Gersoppa especially near the river resembled rather a rocky bed of a mountain stream in a dry country than a metalled road. In this connection one cannot help making this statement. The Falls themselves excepting the two minor Falls are situated in the British territory and the last 7 or 8 miles to the Falls is also in the British territory but the whole thing is maintained by the Mysore State. This speaks very highly of the attention paid by the State in the matter of accessibility to natural beauty spots and indirectly promoting a tourist industry. India has much to learn in these respects from western nations, especially Germany; and it is gratifying to note that Mysore is in the foreground in this as in so many other things.

The Falls.—Of the many rivers that drain into the Arabian Sea from the Mysore State the Sharavathi is one of the most important and may prove to be a household word in the electrical world of the days to come. Rising near Ambuthirtha, it flows in a north-easterly direction for half its course and then takes a westerly course to the Arabian Sea. On reaching the frontier between the Mysore State and Bombay Presidency the river precipitates itself down the celebrated Falls of Gersoppa. These form unquestionably the grandest beauty spot in Mysore, rich as it is in splendid scenery. They eclipse every other fall in India and have few rivals in any part of the world. While excelled in height by the Cerosoli and Evanson cascades in the Alps and the Falls of Arve in Savoy, the Gersoppa Falls surpass them in the volume of water precipitated; and while much inferior to the Niagara in volume, it far excels these celebrated falls of the New World in height

Cerosoli with a height of 2,400 feet, Evanson of 1,200 feet and the Falls of Arve of 1,100 feet are certainly higher than the Falls of Gersoppa 850 feet.

In the Falls of Niagara a river two miles across contracted to less than half of its normal breadth, is precipitated over a height

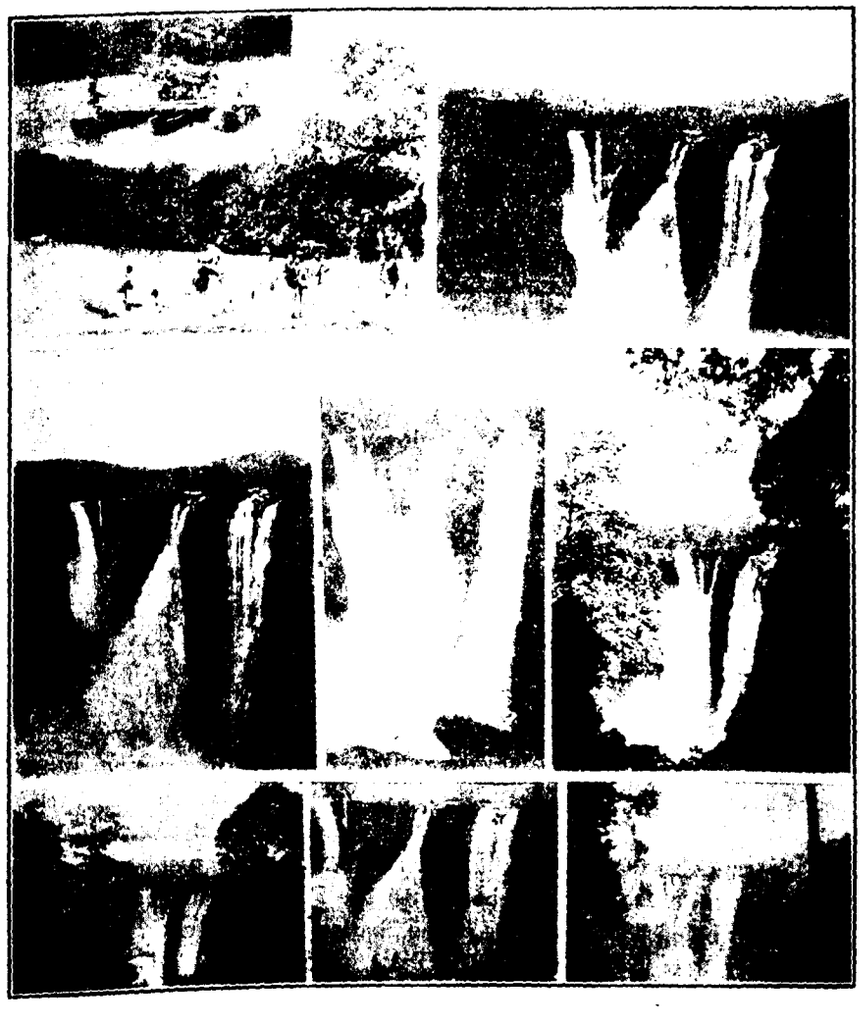

Fig. 39. The Gersoppa Falls.

of 164 feet in two horse-shoe shaped falls the volume and grandeur of which the Gersoppa cannot hope to beat. But L. Bowring says, "It may truly be called one of the wonders of the world, for al-

though the volume of water is less than that of the Cauvery, the immensity of height is almost without a parallel."

"The water comes down in four distinct falls, presenting a scene of transcendent grandeur and sublimity, whose effect is greatly heightened by the wild and beautiful country around abounding with a wealth of luxuriant vegetation. The Raja Fall pours in one unbroken column to a sheer depth of 830 feet. (This has been variously called Grand Falls, the Main Falls and the Horse-Shoe Falls). Half way down, it is encountered by the Roarer, another fall which precipitates itself into a vast cup and then rushes violently at an angle of 45° to meet its famous compeer. A third fall the Rocket, shoots downwards in a series of jets; while the fourth called the Dame Blanche is an Undine-like Cascade gliding quietly over the mountain side in a sheet of foam."

The bed of the river is formed by the archaean gneisses. The cauldron of the Rajah Fall is a sight worth seeing by itself. It is shaped like an unsymmetrical C with the Raja and Roarer occupying two sectors. The bare cliff exhibits the gneissic banding distinctly. The bottom of the falls below the Raja Fall is not always visible, but at certain times it is clearly visible. The depth of the pool is said to be over a 150 feet. Below the falls is a deep winding gorge 18 miles long through which the river slowly winds its way. The smallness (size) of the stream in the gorge as compared with the river above the falls lends colour to the popular view that there is an underground channel from the pool to a point in the river some way further down.

The Falls of Gersoppa have been figuring in the papers for some time past in connection with the Mysore Government's recent proposals to harness their portion of the Falls. Unfortunately the peculiar distribution of the Falls between the British and the State stands in the way of the scheme materialising just at present. The Rajah and the Roarer belong to the British, while the rest of the Falls belongs to the State. The British Government's objection is mainly that the beauty of the Falls would be lost if there were to be a dam constructed to take away a portion of the water. The State by a series of trial experiments had come to the conclusion that it is possible to harness the falls without in the least robbing off its beauty.

It is needless to say what such a scheme would have in store for the development of Mysore especially with the industrial centre

of Bhadravathi within easy reach. The materialisation of the proposal together with the proposed harbour for Mysore would go a long way in forging ahead the development of the iron industry at Bhadravathi. From the Falls we returned to Bhadravathi.

Bhadravathi holds a very important place in the industrial world of the British Empire. The Mysore wood distillation and Iron company's plants are situated here. The blast furnace with a total daily output of 60 tons pig iron is of the American type and uses charcoal for reduction purposes and among such charcoal blast furnaces it is the largest in the British Empire. The prosperity of Bhadravathi is in no small measure due to the foresight of Sir M. Visweswarayya, the brain behind the whole thing; and it is founded on firm foundations—as the iron ore at the Bababudan hills alone, it is said, at the present rate of consumption would last for more than a hundred years and iron ore is available at other places too; limestone and dolomite are quite in abundance and lastly the thick forests of eastern slopes of the Malnad provide the necessary fuel. The prospect of the Jog Falls being harnessed in the near future lends further strength to the scheme which had been boldly launched by the State.

Bhadravathi a modern town which has grown on the left bank of the perennial Bhadra, a head stream of the Tungabhadra, is a well-planned town, well-equipped with electric lights, filtered water, club, tennis courts, etc., and offers a striking contrast to the old town of Bankipur on the other side of the river, with which it is connected by a masonry bridge. The Mysore Iron Works are the pulsating heart of Bhadravathi and the new town owes its existence to it. All the people earn their living from the Iron Works and it is a counterpart in South India of Jamshedpour.

PROCESSES OF IRON MANUFACTURE

Iron does not occur in nature in the metallic condition (except as meteorites), but is largely obtained from a number of its ores. The quartz haematite schist capping the Bababudan hills is the basis of the Mysore Iron Works. The ores are mainly haematitic with a certain admixture of limonite and ochre but no magnetite. This together with a certain amount of siliceous haematite is brought from the foot of the hills in wagons along trolley lines and mixed with a certain amount of limestone and charcoal (prepared locally) and the blast furnace is charged with this mixture. The furnace is heated by means of hot air blasts which are themselves

heated by the flue gases. The blast furnace is heated to a temperature of 1500° F at which temperature certain complex reactions take place within, giving as end products metallic iron (pig iron), calcium silicate (slag) and a mixture of CO_2 and CO. The molten iron settles down to the bottom of the furnace and is drawn off at intervals of 6 hours; the slag which too is in a liquid condition is lighter than the metal and hence floats on the surface of the molten iron and so comes last and is diverted into a separate place where it is allowed to cool. The molten pig iron is allowed into channels made in sand and is allowed to cool there. The furnace works throughout day and night and the sight of molten iron with its liquid glow is simply grand during the night time. It lights up the whole works with a weird red hot glare which made us recall our conception of hell.

The pig iron drawn from the furnace is cut into pieces while yet in a plastic condition for handling in the subsequent stages. The pig iron thus formed is then passed to the foundry where it is remelted and cast into an innumerable number of things—things which include pipes of several sizes, iron fencing, gates, lamp posts, sign boards, name plates of towns and villages, etc. The foundry building is equipped with several costly appliances such as electric smelting furnaces, lathes, punches, drills, electric cranes which lift up huge cupolas or crucibles containing the molten metal, carry it from place to place and lift it into the moulds. By the operation of a lever the operator does the work of many men and that too within a fraction of the time required by human labour.

The Iron Works use scrap iron also in addition to the pig iron got from the iron ore by reduction. The scrap iron pieces are lifted by an electro-magnetic crane and put into another furnace where it is smelted. The molten metal drawn off in huge buckets is hauled up and taken to pipe casting sections by an electric crane.

Associated with the Iron Works at Bhadravathi one should note the following: the charcoal batteries, the apparatus for the separation of the by-products of destructive distillation and creosoting plant; the air pump, and the power station.

The wood from the forests around Bhadravathi brought by trolleys is packed in a steel carriage and pushed into the battery chamber the walls of which are lined by fire bricks made from local aluminium silicate. The chamber is heated by the burning of carbon monoxide from the gaseous by-products. The chamber is then closed by the double door and the wood allowed to remain

there for a certain period. During the period the hydro-carbons and nitro-gaseous compounds escape as gases leaving the pure carbon in the form of charcoal. The gaseous by-products contain among other things carbon monoxide CO which is separated and used for heating the battery. By a process of differential distillation a number of liquid products of varying density are separated chief among which are ammonia (separated as am. acetate), wood tar, wood alcohol, heavy wood oil and creosote. We were told that the by-products of the charcoal battery were more paying than the iron industry itself.

Creosote has got a peculiar use for it there. It is used for the creosoting (coating with creosote) of logs of wood for use as electric posts. The creosoting process hardens the wood and makes it less liable to rotting.

Attached to the works are two pressure pumps which pump air into the 4 hot air stoves. The stoves which look like iron cylinders are lined on the inside with fire bricks. The flue gases consisting of a mixture of carbon monoxide and carbon dioxide is allowed to burn here and heat the walls, and the air in contact with these heated walls get heated thereby. This use of the flue gases serves a double purpose (i) that of heating the hot air stoves with the minimum of expense; (ii) and the more important one than the first is that it thereby prevents the carbon monoxide from contaminating the air with its poisonous qualities.

That night we bade goodbye to Bhadravathi. We would have liked to remain there for some more time and enjoy the privilege of going up to the ore mountains through some of the most beautiful natural scenery associated with Mysore, were we not pressed for time on one side and the pinching of our pockets—a more potent influence—on the other side. The next morning we arrived at Mysore in good spirits. Our sick list was replaced by a list of good spirits.

MYSORE

The first impression that made itself felt on us was the hotter climate of Mysore. It was not so bracing as at Bangalore. The second impression was that caused by the buildings, roads, lights and the general lay out of the city as a whole which offered a striking contrast to that of Bangalore—a contrast which made itself more impressive as we saw more and more of Mysore. Mysore and Bangalore are both built on undulating platforms but the undula-

tions are milder and more subdued in the case of Mysore than in the case of Bangalore. The curving roads of Bangalore were absent in Mysore, where they are straight, broad and less steep, and arranged in a rectilinear fashion, cutting the city into a number of rectangular fragments—a feature which recalls the plan of Pondicherry.

Mysore is essentially a city of palaces and guest houses ; and Bangalore a city of parks and picturesque suburbs. The importance of Mysore is the fact of its being the capital of the State ; while Bangalore is the administrative capital.

MYSORE DUSSERAH EXHIBITION

The Dusserah Exhibition is nothing but a Park Fair Exhibition, but we could notice a peculiar feature as regards this. The exhibits on the electrical side, ivory section and toy (wooden) section formed the largest part of it. To a casual observer it would mean nothing. But, to a trained eye it was a meaningful sight. The electrical appliances had to be associated with electrical developments, the ivory works with the elephants in the state forests of Mysore and wooden toys with the industry of Chennapatnam. The exhibition was styled the All-India Exhibition ; but to me it looked typically a Mysore exhibition. I could not help associating the manufacture of incandescent mantles by an Indian gentleman, an assistant of Dr. Sir C. V. Raman with the geographic surroundings —the progressive state with many practical ideas, practical and original methods and the halo surrounding the name of Dr. Sir C. V. Raman. The mantle is claimed to be one step better than the best mantles we could get till then.

Chamundi Hill. The Chamundi Hill formed the item in our programme for the 28th morning. The distance of 2 miles that separated the foot of the hills from the hostel was done on foot, though to begin with we were given hopes of a tonga ride (which hope carried us to the foot). The Chamundi Hill is an example of the number of gneissic hills that are scattered all over the plateau. It is lenticular in shape with the axis of elongation in an east to west direction and gradually increasing in elevation from east to west. At the top of the hill are situated the Chamundeswari temple and the Maharaja's palace. Chamundeswari is the patron deity of the Mysore royal family and is also known as Mahishasuramardani from which the name of the city itself is derived. From the top of the hill one gets a full view of the surrounding country, and traces the development of the city in several directions. The city itself is at an elevation, with respect to the surrounding country. But within the city itself the development has been on a scientific basis. The sites of buildings like the palaces, guest houses, the aerodrome, etc., are on higher grounds, the lower ground being utilised for gardening purposes. As we were going to the foot of the hills from the city, we had a lake to one side of the road while on the other side there was a garden with cocoanuts and other vegetables in the lower level.

Beyond the city of Mysore, the land falls in height, rapidly in the direction of the Cauvery. In this direction one could see one continuous green patch. In all other directions there was the alternating ups and downs characteristic of the Mysore plateau with the slopes covered with fields and the higher ground covered with scrub jungles.

With a sweep of our eyes we could see the Nanjangod hills, the distant view of the Nilgiris and the line of hills that mark the eastern edge of the plateau—the eastern ghats.

Midway between the foot of the hills and the top is a huge monolithic bull about 12′ to 14′ in height. It was smaller than that of Tanjore and, I was told, than that of Lepakshi also.

There is an excellent motor road going up the hill and one could get to the temple gates in a car. The road begins the ascent from the eastern end of the hill and after a number of zig-zag bends arrives at the top after a length of 6 miles.

The sight of the hill is grander during the night than in the day time, as the lights arranged along its crest appear against the dark background as a line of bright stars.

The importance of the hill is in its temple and the palace. The temple is the counterpart of Tirupathi ; and every year thousands of pilgrims flock to see it. But it also forms an item of interest for tourists to Mysore, especially so during Dusserah when millions of people go to Mysore and not a few like us pay a visit to the hill, the temple and the palace. This ever present stream of devotees and visitors has given rise to a number of shops lining the way —sweetmeat shops, tender cocoanut shops and shops where one can get things for performing archana. These shop owners depend on the generosity of the people that come there and we also in

that capacity contributed to the sale of some 30 tender cocoanuts. The beggars also ply their trade here in large numbers.

After spending our morning on the hills we came back to the hostel at 11 A.M. That evening we had some difficulty in arranging for our conveyance to the Kannambadi dam and Seringapatam, but thanks to our luck, of which we have had our usual share, we managed to arrange for them. We were packed up, 14 of us including some heavy weights, in two 5-seater cars. But the objective was worth this inconvenience.

The journey from Mysore to Kannambadi is also a continuous down gradient and the features of the land which we had noticed from the eminence of Chamundi, we could corroborate now from close quarters. There was an impression among some of us that the inclusion of Kannambadi dam into our crowded programme knowing full well the short time at our disposal, was nothing short of having no sense of utility, no discretion and no idea as to how best to utilise the short time at our disposal. But impression vanished into thin air when we saw the beautiful fountains and gardens below the dam.

The Krishnaraja Sagara Irrigation Scheme of which Kannambadi dam is a unit has been one of the engineering achievements of the world of to-day and of epic importance to Mysore.

The Cauvery at the site of the dam flows in a valley between two hills while higher up there is natural high bund on either side. The idea of a dam is not of the modern times—it is said that Tippu Sultan actually began the construction of a dam at the present site —but it is the practical undertaking and successful completion of the scheme that is to the credit of our 20th century, a credit which goes to the grand foresight of Sir M. Visweswarayya. The river was dammed at the narrowest part of the valley and the waters of the Cauvery thrown back to form a huge lake of over 7 sq. miles in area and with a maximum depth of about 120′ just behind the dam. To feed the Cauvery below the dam a number of sluices have been constructed which when open throw jets of water 25′ away. Associated with the dam are other irrigation canals. The sluices are all operated by electricity. There is a road right along the dam so that it is possible for motorists to pass from one side to the other in the car itself.

But the most creditable thing, which is typically Mysorean, is the way in which they have made it an object of attraction. The

fountains and the gardens just below the dam cannot be adequately described in words. One should go there, sit and watch it for hours till one is practically fed up with it, which is not so easy. It is this association of a sense of artistic beauty with all their undertakings which I call typically a Mysorean characteristic. I have forgotten to mention one thing. Here again, as in the case of Sivasamudram the mad fury of the rushing waters can be harnessed for the production of electricity. Turbines and generators have been erected here to supplement (and as a reserve in a case of emergency) the Sivasamudram power works.

The taxi took us then to Seringapatam which place was reached at about 5-45 P.M. The number of items to be seen were many but the time at our disposal, 30 to 45 minutes, was too short so that we were compelled to fly through the items. But this flight has done some of us some good. It has left such lasting impression of the few things that we saw that it has given birth to a burning desire in us to go to these places once again and complete our sight-seeing and the reconstruction of the unrelated facts.

The first thing that we saw was the Fort. We entered it through the Bangalore gate and caught fleeting sights of the ruins of the one time stronghold of Tippu Sultan. Our destination was the swinging bridge, the De Havilland arch. Arrived here, we raced to the top of the bridge and jumped—the bridge slowly and majestically swinging. The bridge is a masonry construction and the cause of such swinging phenomenon in such a masonry construction has been the subject of discussion among scientists and engineers but no definite conclusion seems to have been arrived at yet. History goes to say that a certain French engineer in the service of Tippu Sultan built this to show his skill in engineering and Tippu rewarded him by cutting his thumb away so that it may not be of use to others. We rushed through the temple and then in the taxi we sped along the road to Daria Dowlatt. It was this that made us regret our inability, due to shortness of time, to enjoy the sight to the full. Of the internal beauties we could see very little, dark as was the interior, made darker still by the lateness of the day. The pool in front and the avenue along on either side of the pool brought before our mind a similar sight in the Taj Mahal. The situation, on the banks of the Cauvery, the beautiful parks and gardens bring the similarity much closer still.

From here we motored to Gumbaz to see the tomb of Tippu and Haidar. The architecture of this was beautiful like that of the

Daria Dowlat and we could only curse our stars for our inability to come earlier and have the benefit of taking some photos to help our mental impressions.

We slowly wended our way back towards Mysore which place we reached at 7 o'clock. A most spectacular sight was awaiting us. Some of us had a partial view of the palace lighting but the sight which was in store for us astounded us all. We could not see the building of the palace but the whole of it was covered and lit entirely by brightly coloured electric bulbs. There would have been some millions of these bulbs and the light of all these threw a lurid white haze in the sky which is strikingly and beautifully observable when there are some clouds. We have heard of flood lighting and other such phenomena in western countries and this is the South India counterpart of them. Such a huge consumption of electrical energy is made possible by the cheapness of electricity which in its turn reflects upon the foresight and thought of Mysore's Dewan in the development of Sivasamudram power.

A huge crowd had collected in front of the durbar hall to see the durbar that was in progress while an enormous stream of people was passing in and passing out through the gateway to gaze at the lighting of the palace. We too followed the stream and were making our way to a point of vantage wherefrom we could have a close view of the durbar but the fury of a passing crowd forced us back to the entrance and being caught in the stream we had no other go but to leave ourselves to their charge and get out, much as we liked to get in and catch a better glimpse of the lighting and the durbar. That night we returned to the hostel with our minds full of visions of the palace lighting.

Zoo. The next morning was spent in going round the zoo and the Jagan Mohan Palace Art Gallery. The zoo will be an eye opener for the person who has visited only the Madras managerie because of the wealth of animals and the name and habitat of each written on their cage. There are so many species that are present there which have their habitats in India but which we do not know that it is really an eye opener shedding light on the wealth of the Indian fauna. The attempt of the authorities concerned in giving conditions similar to their natural habitat is a pleasing factor and reduces the quality of the sin committed in depriving them of their freedom.

The Jagan Mohan Art Gallery contains one of the finest collection of Art pictures, paintings and the like. There is much of local history in the pictures there.

The evening of the 29th, the last day of our stay at Mysore, had in store for us the grandest spectacle (barring Gersoppa) of the excursion. The procession is said to be unique of its kind in India and people from far and near including hundreds of Europeans congregate to the city to see this. This is the concluding item of the Dusserah festivities; and this over, the curve changes. The constant influx of people into Mysore gives place to an efflux, an efflux so rapid that it is impossible to get accommodation in the trains. The procession consists of a long march past of the Mysore regiment followed by the state officials of importance preceding the Maharaja, the Yuvaraja and the heir in a gorgeously ornamented elephant, the relatives of the Royalty followed by the vanguard bringing up the rear. The day is one on which all the people pay their homage to the Maharaja. The numerous offerings to the Maharaja by the peoples and the thunderous cheers which the Europeans gave, are still dancing before my eyes and ringing in my ears. The procession would be a mile in length.

The more fortunate members of our party had the good luck of going to the destination of the procession and enjoy the sight there, but I happened to be one among the unlucky lot and did not have the privilege of seeing that.

The night of 29th saw us off from Mysore. The amusing incident that happened at the station we can never forget. All our things were inside in a reserved compartment, tickets had been purchased and two of our party were there but the rest of us could not get in, in spite of the fact that we had the tickets with us. It was then that our host Mr. N. S. Subba Rao turned up. He went and brought an Inspector to lead us in. A charge to the left, an elbowing to the right and a passage was made for us in the surging crowd at the entrance and then the gates were opened wide to admit us in.

The distance of 82 miles was done leisurely enough and we arrived at Bangalore city at 6-30 A.M. We were all looking forward for a happy time at Bangalore and had already drawn up programme for the day, when down came the news like the bolt from the blue that we were going direct to Madras. We had no other alternative but to accept it and so we entrained for Madras. The disappointment had robbed us of much of our spirits, and the

thought of our being in the Madras train, and that we were going back 'to home, sweet home,' made us home sick and induced in us a sense of expectancy. The party was unusually silent, the punster was lacking in his ready wit and humour. The silence and the home sickness made the time dreary and the members spent the time as best as they could either in reading something or simply dozing. We arrived at Madras at 2-10 P.M.

Synthesis. Mysore consists of two regions, the malnad and the maidan. Before the tour we had only very vague notions—partly untrue—of the malnad. We took it to be only the western extension of the maidan proper, an extension into a region of heavy rains of the monsoon track and consequently forested. The true picture of the malnad dawned upon us only when we traversed the region ourselves. The maidan, as has already been seen is a region of gentle undulations intersected by a line of hills—the rounded boulder hills of the gneissic rocks. The downs are clothed with cultivated fields growing cumbu and jowar generally, with palms as the natural vegetation while along valley axes and immediately below lake bunds irrigated paddy and cocoanut palms replace the other crops. This type of irrigation—bunds across the river with artificial tank formation holding up and storing up water during the rainy season for use during the dry season—is characteristic of a large part of Mysore (In this connection I have to notice the peculiarity of these bunds in Mysore state.) The wetter western regions of the maidan concentrate on areca palm, and travelling near Birur we could see large plantations of areca palm and cocoanut palm which has made Birur a very big areca nut centre. The 'ups' are all clothed with lantana which dominate over all other kinds of vegetation up to Birur beyond which the increasing rainfall gives rise to wooded areas.

The malnad also in a general way consists of ups and downs but the gentleness of the profile of the maidan gives place to sharper angles. We have steep slopes and deep valleys taking the place of the gentle ups and downs. The way in which the land is utilised here offers a striking contrast to that of the maidan, an explanation of which is not far to seek, if one understands the climatic conditions. A fertile soil and perennial streams clothe the valleys with verdant cultivation. The rising hill slopes are beautiful with tall waving trees of the tropical monsoon forests which at some place offer light and shade enough for hidden plantations of coffee. Higher up are grassy downs giving the appearance of velvet covered side from a distance. Above all the gigantic mountains

rear up thin heads majestically into fantastic peaks. Human dwellings are few and far between. A cottage here and a cottage there situated picturesquely amidst wooded slopes bordering the fields growing unirrigated paddy, sugarcane or areca palm or plantain represent the homestead of a farmer and his family. Towns there are none and villages are few and far between. "The incessant rain confines the people to their homesteads and farms and hence each householder is tempted to surround himself with all his necessities and succeeds to a large extent in making himself independent of the external world." Such is the malnad and how strikingly it would differ from the maidan one could gather if he visualises the two.

Carrying the analogy of the ups and downs farther we can compare the east and the west coast with the two regions noted above.

The eastern plain (meaning the region to the east of the plateau rim—the Eastern Ghats) consists of the same ups and downs which gradually becomes milder in profile till it is a level plain along the coast. The plain portion and the downs are all clothed with cultivation, the character of the crops varying with the climatic conditions while the higher regions are wooded areas, mostly of the scrub jungle type. The population is more or less evenly distributed but with a tendency to concentration on the plains.

On the west coast also the same features are repeated as in the three preceding regions but the valleys or the downs are drowned, the higher lands remaining as land areas proper of the west coast. The drowned valleys form the backwaters of the Malabar coast, the influence of which on the life of the people is of far-reaching importance.

Thus, in the four regions noticed above, the generality of configuration of the land is the same, the difference being one of degree rather than of kind. This change in degree of the physical configuration coupled with local conditions of climate, etc., have been instrumental in giving rise to different response in the several regions. The thickly (relatively) populated and rich (agriculturally) eastern and western plains are different from the relatively less populated maidan and the thinly populated malnad. In the malnad one longs to see more people while in the west and east coasts, the people resort to seclusion or a quiet life as a variety to relieve the dead monotony of life in a crowded city.

Secondly, what struck us most was the co-ordinated character of the industries and the admirable way in which the natural resources have been profitably utilised. We have already seen only one instance of this co-ordination, namely, the relation of the porcelain factory to the hydro-electric development. The cheapness of electricity has given rise to a large number of industries, cottage industries mostly, but which have been developed on wise lines to ensure co-operation between the cottage industries and the hydro-electric development. This co-ordination has made it possible for the cottage industry to exist side by side with electric development, a feature to which one cannot give credence at first. This is revealed in the Chennapatna toy works, silk factory, etc. Rural development has been facilitated very much by electricity as one sees in the South and South-East Mysore. In fact one can say "Electricity has metamorphosed South and South-East Mysore." This programme of development on electrical lines is to be applied to the North-West corner of Mysore in the near future, if the Mysore State's project is materialised.

We have already seen how the State makes use of its resources in Kaolin, quartz and felspar in the preparation of electric insulators with other porcelain ware as by-products. Another instance of a similar case is the iron industry. The forests are utilised in the manufacture of charcoal for the reduction of iron ores and this process of charcoal making yields a number of by-products included among which are alcohol, acetic acid (cal. acetate), tar, ammonia and creosote. The ammonia is won in the form of am. phosphate which is utilised as a manure. The creosote is used in a novel way. When wood is impregnated with this compound, it protects it from attacks of insects and decay. This property of the creosote is taken advantage of in utilising the forest resources for the development of electricity. The giant trees of the forest are cut and subjected to a process of creosoting (the logs are placed in a chamber into which creosote is let in a vapourous condition) whereby creosote is impregnated into the logs and thus ensures their long life. Such posts are used as posts for carrying the power cables as in the case of the Sivasamudram-Kolar line, the Sivasamudram-Bangalore line, etc. This finds a use for the giant trees of the forests and at the same time reduces the huge capital expenditure which the employment of iron posts would entail. The cheapness of electricity has been well utilised as in the beautification of Mysore. This sense of beauty and a taste for artistic things is well seen in Kannambadi where we have the gardens and the fountains, in Mysore which is even ordinarily artistically

illuminated and more so during the Dusserah period. All these things of the "electrical state" have electrified our imagination and provided us with a new sense of perception and a new angle of vision.

Thirdly, the Mysore authorities are anxious to let people know about their achievements. They do not put any sort of restriction whatsoever in the matter of visiting their works. We could not understand at first how the large number of ordinary people are given permission to visit the power station at Sivasamudram and then again at Bhadravathi. It was at Bhadravathi that we came to know of this. Our host explained that it was their policy to let people know about things popularising their works, a policy which would not be practicable if they were to restrict admission to selected few.

Conclusion. To conclude, I cannot find words to express my joy, my thankfulness and my gratitude sufficiently. The tour was a complete success, thanks to our luck which would never leave us even if we were prepared to leave it. The excursion was in the nature of an experiment, upon the success of which the recurrence of this item in the years to come depended. We have the proud privilege to say "we are the members of the first experimental tour" for the grand success of the item is due to the conjoint influences of all of us and of which one can rightly have his share and be proud of it. Each of us have our own joys but the joy of our sisters should be beyond all bounds for the opportunities offered to them, for such an illuminating excursion are few and far between. The most noticeable feature was the family relationship that existed among us. We were like several members of a single family and did not feel like strangers at all. This is an important attribute to educational tours, that they have a high social value besides the practical and educational values.

Finally, I cannot but conclude this attempt of mine without a word about Mr. Subrahmanyam, our leader. He was not a professor there. He was treating us more like his own sons and daughters than like students. May God give him long life and prosperity!

News and Notes

It is regretted that this and the previous number of the Journal were considerably delayed in their publication, owing to causes beyond the control of the Editor. Steps are taken to see that such delays are not repeated.

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Mr. V. Krishnan, who was appointed to carry on the Regional Survey of Tiruvallur on behalf of and under the guidance of a Committee of the Association, has since been awarded a Research Studentship of the Madras University for continuing and completing the work, thereby relieving the Association financially. During the period of over two months when he worked for the Association, he collected data and prepared maps of land utilisation, crops, etc., of a few typical villages in the Tiruvallur Region. A Report of the Committee will be published in the next number of the Journal.

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The excursion to Mysore, the programme of which was published in the July issue of the Journal, was quite a successful one. A detailed account of it by one of the members of the party, Mr. V. Kalyanasundaram, is included in this number. It is proposed to conduct a similar excursion this year also. The place, time and other details will be notified in due course.

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The two suggestive syllabuses published in the July issue have evoked a general interest in the lower and middle school work in Geography; and there have been several inquiries about them. In this connection we wish to point out to teachers and headmasters that there ought not to be a single stereotyped syllabus for the middle school classes, where the iron hand of uniformity should not be laid as in the high school. In the latter case, there is the excuse of the great need for a common examination. There should therefore be elasticity and local option to try and work out any reasonable syllabus. The real emphasis ought to be on the principles to be kept in view in the choice of topics and on the method of treatment. The Departmental Syllabus is out of date and out of print; and in revising the same, it is hoped that two or three

alternative syllabuses will be issued as suggestive of the kind of work to be done, incorporating the main principles.

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It has been decided not to have a Summer School of Geography during the coming summer holidays as in previous years, but to hold a Refresher Course, preferably for teachers of middle school, later on in the year, either during the Michaelmas or Christmas holidays. The details will be notified after they are settled.

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The Fifth Conference of the Association will be held at Anantapur during Christmas Week, when papers on various aspects of the Geography of Anantapur District will be read by specialists, each in his own line.

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The S.S.L.C. Scheme and Syllabuses are again in the melting pot with scarcely any decent trial given to the existing scheme. The position of Geography in the proposed reorganisation is, of course, theoretically not worse than that of the other long-standing subjects of the school curriculum. But actually its position is bound to get far worse, owing to the fact that no men's college and only one women's college has provided for the teaching of the subject at the Intermediate stage. C Group Geography in the High School has consequently been a blind alley, which few have cared to enter; and when the A Group Geography goes shortly, its reactions on the importance of the subject are bound to be very adverse.

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In this connection we wish to reiterate the great desirability of the Educational Department and some private managements of colleges taking immediate steps to provide for the opening of Geography at least in the Intermediate course, leading eventually to the Degree course in the subject, which at present has only a paper existence in the University Calendar. There is a false fear in some quarters that the equipment for it will be a very costly affair. But we can assure that an institution can start the subject with a minimum equipment within less than a couple of thousand rupees. And as for the staff, we have had for two years the Diploma Course in Geography, which has supplied among others Honours Graduates in Science and Humanities who have taken the Diploma in Geography with distinction, and who are, therefore, competent and

qualified to handle the subject at least in the Intermediate classes. The half a dozen institutions that once started Geography in the Intermediate Course and were forced to close down for want of the qualified teacher can no longer have any excuse for not reopening it now.

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We are glad to find that the modern type of questions, which has long been urged for adoption in the S.S.L.C. Examination, has been definitely accepted by the Board; and model questions have been issued in all the subjects. In Geography more than in the other subjects of the S.S.L.C. Course, the effect is sure to be beneficial, as otherwise it will not be possible to have a valid and comprehensive testing by an hour's question paper on three years' study in the subject.

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Most of the branches of the Association have not been showing signs of life ; and some of them had to be closed down as those of Chittoor, Erode and Nellore. But Vizagapatam and Coimbatore branches have been exhibiting steady activity. The former has contributed a number of important papers, which have been published in some of the back numbers of the Journal. The next issue will contain two papers read before these two branches.

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There are several useful ways in which branches can carry on and contribute to the work of the Association. Studies on their immediate environment from various points of view may be made by members and others and read before the branch, and subsequently published in the Journal. Excursions, lantern lectures, model lessons, discussion of syllabuses, collection of local data regarding weather conditions, economic facts, etc., for publication in the Journal are some of the other important ways in which branches can function usefully.

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The Journal completes its eighth volume with this issue. With increasing the size of each number to more than double what it was at the outset, and as a result of adopting linotype printing and superior get-up as well as on account of the large cost of the numerous maps and diagrams, it has been found very difficult to make both ends meet. We, therefore, appeal to such of the non-journal members as can afford it to go in for the Journal, and to the journal members to secure fresh subscribers, both in the shape of members and of institutions.

Reviews

The Making of Geography. By R. E. Dickinson and O. J. R. Howarth. (Oxford University Press). 264 pages. Price 8sh. 6d.

This book treats of the growth of man's knowledge about the earth and of the progress of geographical science from the first surmises of the Sumerians, Egyptians and Homeric Greeks to the most modern developments of physical and human geography. The journeys of the great explorers and travellers of all ages are mentioned in relation to the advances in geographical theory to which they led. But the book is more concerned with the building up of the geographical science on the results of exploration, rather than as a history of exploration itself.

Of the two collaborators in this work, Dr. Howarth who has done the earlier chapters has gone into the subject of ancient and mediaeval development of geography in a comprehensive manner. But most readers of the book are likely to be more interested in the later chapters by Mr. Dickinson, which deal with the growth of modern geography from the Age of Discoveries with the advance of the physical and natural sciences in modern times. Especially interesting is the elucidation of the work of Humboldt and Ritter as the progenitors of modern geography, and of Lyell and Darwin who contributed to the development of physical geography by establishing the doctrine of *Evolution* in their respective inorganic and organic spheres. In the chapter on the development of human geography the doctrine of *geographic determinism* of Buckle, Ratzel and Semple and its subsequent modification into the '*possibilism*' of Vidal de la Blache, Brunhes and Febvre have been explained very clearly. In the chapter on Regional Concept, the development of the regional idea has been traced to the work of Dr. Herbertson, who approached from the world whole, dividing it into major natural regions, and that of Vidal de la Blache and his disciples, who insisted upon the study of " relations between geographical conditions and social facts viewed at close quarters, in a well-chosen and small field " as an antidote to the danger of large generalisations.

The publication is an interesting and scholarly work; and it is illustrated with a number of diagrams, showing the salient

features of famous maps, and examples of early astronomical and survey instruments.

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Principles and Practice of Geography Teaching. By H .C. Barnard. (London, University Tutorial Press, Ltd.). 234 pages. 4sh. 6d.

This latest book on the teaching of geography falls roughly into two parts. The first part consisting of chapters I to VII deals with a discussion of the scope and content of school geography, teaching aids and equipment, and syllabus and methods. The second deals in detail in chapters VIII to XI with Regional Survey as applied to geography teaching in schools; and this is a special feature of this book. The last chapter (ch. XII) discusses in a broad way the educational and other values of a study of geography in schools; and this is followed up by a short but very useful descriptive list of books on the teaching of geography. The book is simple and clear in treatment, comprehensive in scope, and interesting and serviceable, and can strongly be recommended for use in Training Colleges by graduate students specialising in the teaching of geography.

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Longman's Senior Atlas for India. Edited by George Philip. (Longmans, Green & Co., Ltd., Calcutta). 64 pages. Price Rs. 2.

This is a good Atlas at a moderate price, edited by the well-known cartographer and map publisher, Sir George Philip. It fills a gap between cheap but meagre school atlases like the Taj Mahal and other atlases of the High School standard and the advanced but costly atlases like Philip's New Systematic Atlas and Oxford Advanced Atlas. Having been specially prepared for use by Indian students, it contains a number of special, sectional and historical maps of India as well as systematic maps of each of the continents.

Among its other useful features are a section on Projections and Principles of Relief, Recent Statistical Data with diagrammatic representations of the same, Economic Maps showing world distribution of important crops, minerals, etc., Scale illustrated with reference to maps of a part of India in different scales, astronomical diagrams, world maps showing rainfall, pressure, winds, ocean currents, vegetation, population, communications, etc., and a useful index with pronunciation of the place-names and including a large number of Indian names such as Conjeevaram and Villupuram, not to be found in other atlases.

Altogether it is quite a useful companion to students of geography in High Schools, and even to those in colleges who desire to go in for a cheaper atlas than Philip's New Systematic Atlas or Oxford Advanced Atlas.

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Oxford School Atlas (Tamil and Telugu editions). By John Bartholomew. (Oxford University Press, Madras). Pages viii + 24. Price annas 12.

One of the chief difficulties in the way of using the vernacular medium in the teaching of geography in high schools has been the absence of a good and cheap atlas in the mother-tongue. The Oxford University Press has done a great service for the cause of vernacularisation by bringing out a Tamil and Telugu edition of their School Atlas for India; and in doing so they have carried out several additions and improvements.

Among its useful features may be mentioned a map and picture of land forms for comparison, population statistics of provinces, states and cities as per 1931 census, varieties of map representation, a section on map projections and another containing astronomical diagrams, systematic maps of the World, Eurasia and India, economic data of exports, imports, etc., and length of important rivers and height of chief peaks of the World given diagrammatically.

The lettering on the maps is clear, neat and graphic, and free from overcrowding of names. But the absence of an index has to be noted as a chief drawback. The publication is a marvel of cheapness; and it can be strongly recommended for use not only in middle schools and elementary training schools, but also in those high schools where the vernacular medium has been adopted for the teaching of non-language subjects. We hope that the Publishers will soon follow this up with bringing out Malayalam and Canarese editions of the Atlas, for which we are sure there is an equally insistent demand.

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Map of Madras Presidency (in Tamil) 36 inches by 24 inches. Scale 1 inch = 27 miles approximately. (Christian Literature Society, Madras). Price Re. 1 As. 4.

This wall map of Madras Presidency shows the divisions into districts and the several communication lines—roads, railways and sea-routes, in a clear and graphic way without any over-crowding of the lines and features. Only the essential names are given, and the size of the lettering graduated according to the importance of the place, so that the effect is very pleasing and the map consequently attractive. Mountains and mountainous parts have been shown by simple shading.

An inset map of density of population adds to the usefulness of this cheap and serviceable wall-map, which ought to find a place in every elementary school.

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Geography of the Madras Presidency (Malayalam). By N. Subrahmanyam. (Longmans, Green & Co., Ltd., Madras). 118 pages. Price 6 annas.

This is the Malayalam version of the Tamil book by the same author, reviewed in a back number of this Journal (Vol. VI, Nos. 3-4) and of the Telugu edition reviewed in Vol. VII, No. 2. We quote from the earlier review the following opinion, which applies to this edition also. "Reform in the teaching of geography has hitherto been practically confined to the High School; and books meant for children in the lower school have hitherto been of the old world type. It is, therefore, refreshing to find that an expert in the subject has brought out a Geography of the Madras Presidency on modern lines for use in the fifth standard or class. The language is clear and simple, and the method descriptive. The matter is fuller than in similar publications; and the regional method has been followed in a modified form. The book is well illustrated by a large number of maps and pictures, and the get-up is neat."

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The Atlas Geography of the Tanjore District (Tamil). By G. V. Rama Ayyar (G. V. K. Swami & Co., Kumbakonam). 40 pages. Price annas 5.

This text-book of local geography for Tanjore District differs from the usual lot of them by putting greater emphasis on map

study, which has been made a special feature; and the subject-matter has been presented in a simple and lucid manner. The book is illustrated with a few pictures; and the type is bold and attractive.

But we have to take exception to the logical treatment, as if for adults, in this as in so many other local geography books. We feel strongly that books on geography meant for children should treat the subject in a *regional* and *descriptive* way with the approach from the home and the viewpoint of the child.

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Geography of the Bhimavaram Taluk (Telugu). By S. Peri Sastry. (Venkata Ram & Co., Ellore). 80 pages. Price 3 annas.

This is one of the better books of local geography—chatty and interesting—but written on old lines. Though the author *says* he means it to be used more by the teacher, he addresses it primarily to the pupils; and for pupils' use, the logical treatment as if for adults and the inclusion of lessons on history, astronomy, etc., of the area (however useful otherwise) are features to be deprecated in a modern book on geography meant for the use of children. Though the type is bold and the book contains several useful maps, diagrams and pictures, we wish the treatment were more on present-day approved lines—*descriptive* and *regional*, with the approach to the topics from the child's point of view.

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Nature Study Reader for Second Year Pupils. By Phyllis S. Darling. (Oxford University Press, Madras). 24 pages. Price annas 4.

Nature Study in a lower school, where it is done at all, is often taught in a mechanical second-hand way with sometimes a flower, fruit or leaf being taken into the class room as a concession to modern realistic methods of teaching the subject. Such work is obviously uninteresting and inadequate. The author of this small book, has brought to bear her large Indian experience and has succeeded in producing an eminently useful and suggestive book on what may really be called "general science" on a co-ordinated plan.

Quite a good part of it is taken up with what is often done in the geography lessons in the shape of weather record and the study of physical conditions, relating them to plant and animal life. It is impossible to separate the different branches of science; and the lessons in the books will show how the teacher of biology, and zoology and botany, as well as of physics and chemistry is treading close on the heels of the teacher of geography.

It is hoped that vernacular editions will soon be brought out, of such an eminently useful publication, written from a practical point of view with an insistence from the outset on observation and recording as the true method of science.

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Nature Study Readers : Teachers' Scheme Book (for first and second year pupils). By Phyllis S. Darling. (Oxford University Press). Pages 55. Price annas 8.

Where the foundation has to be well and truly laid for the proper study of science later on and for giving the right scientific training and outlook, the teacher of the lower school on whom this heavy responsibility lies requires detailed and suggestive guidance. Hence, with great forethought the author of the Nature Study Reader (reviewed above) has brought out this companion volume for the teacher. It covers not only the second year's work for which there is the pupils' book, but also the first year's purely observational work coupled with recording in simple outline drawing. The value of this teachers' book will enable him to use the second year pupils' book aright as also to give the first year children a preliminary outlook and training on proper lines. A vernacular edition of this book also is urgently required for general use by the lower school teacher.

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Modern Geography of the World for High School : (In 3 parts). By B. V. Narasinga Rao and N. Subba Rao. (P. N. Chidambara Mudaliar Bros., Madras). Part I-170 pages, Part II-220 pages, and Part III-164 pages. Price 12 annas each part.

This text-book of geography for high schools, prepared in accordance with the syllabus for the S.S.L.C. Course of the Madras Educational Department by two experienced teachers of

geography. The subject matter has been presented in a clear and lucid manner; and the essential facts have been presented in casual correlation. The book has been illustrated with several maps, charts, diagrams and illustrations, and includes statistical tables as well as typical questions at the end of each part.

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A Regional Geography of the World for High Schools (Revised edition). By N. Subrahmanyam. (Indian Publishing House, Ltd., Madras). Pages 455. Price Re. 1 As. 12.

The first edition of this book was reviewed in Vol. VI, No. 2 of this journal, where we stated as follows :—"The author has treated the subject in a simple, lucid and interesting manner, adopting to a large extent the descriptive style and incorporating sound doctrines of modern pedagogy in the presentation. This method has necessarily tended to swell the size of the volume, which is illustrated with a large number of suitable maps and diagrams. The type and get-up are specially attractive."

In this second edition the book has been suitably abridged by the omission of details, which are unnecessary for high school pupils. But all the essential facts and features of the earlier edition have been kept up.