

Hyderabad Geological

Bulletin No.

A BRIEF OUTLINE
OF
THE GEOLOGICAL HISTORY OF HYDERABAD
STATE WITH A REFERENCE TO ITS
MINERAL RESOURCES

BY

KHURSHID MIRZA, B. SC., C. E., M. I., M. E.,
DIRECTOR OF MINES AND GEOLOGICAL SURVEY

HYDERABAD - DECCAN
1937

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P R E F A C E .

It is due to the far-sighted policy and able stewardship of the Rt. Hon'ble Sir Akbar Hydari, Nawab Hydar Nawaz Jung Bahadur, P.C., Kt., LL. D. Finance Member, that the Geological Survey Department has kept on a steady progress for the last fifteen years of its existence and is carrying on a complete systematic survey of the State with special attention to its mineral possibilities.

The Department has been in a position to gather a mass of first-hand information which may be found scattered over its Journals already published and under publication as well as in its unpublished reports.

There are records of information by foreign observers and Geologists to be found locked up in various old publications not easily accessible to the public.

Besides, we have come to know of many mineral occurrences from private sources and are often receiving enquiries from the public regarding information for some mineral or the other.

A need has therefore been felt to publish a pamphlet in a bulletin form incorporating, in brief, an out-line of the geological history of the Hyderabad State with a special reference to its mineral resources, which it is hoped, will meet the present growing requirements of the public

My sincere thanks are due to all the officers of the Geological Survey Department who have co-operated with me in preparing this paper.

I am indebted to the many private Companies for the statements of figures of output and value taken from their reports, to whom my thanks are also due.

K. Mirza,

Hyderabad-Deccan.

2nd January 1937.

Director of Mines &

Geological Survey Department.

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**A BRIEF OUTLINE OF THE GEOLOGICAL HISTORY
OF HYDERABAD STATE WITH A REFERENCE
TO ITS MINERAL RESOURCES. ¹**

SECTION I.

The Hyderabad State of H. E. H. the Nizam lies
INTRODUCTION. between Lat. $15^{\circ} 10'$ and $20^{\circ} 40'$ N.
and Long. $74^{\circ} 40'$ and $81^{\circ} 35'$ E.
with an area of about 83,000 sq. miles and occupy a
polygonal tract almost in the centre of the Deccan
plateau. The average elevation may be taken as 1200
ft. above mean sea level with summits rising to 2,500
ft. to 3,500 ft. The State may be divided into two
large and nearly equal divisions both geologically and
linguistically distinct, separated from each other
by the Manjra and Godavari rivers. The north and
the western portions of the State are occupied by the
Deccan Traps and inhabited by the Mahratta and
Kanarese speaking people, while the other portion
forms mostly the gneissic complex inhabited by the
Telugues.

Before dealing with the general geological history
of the State a brief reference to the previous observers
and the literature available on the subject may be
made.

The mineral possibilities of the Hyderabad State
MINERALS FAMOUS seem to have been realised from
SINCE PROTO-HISTO- proto-historic times. The relics of
RIC TIMES - GOLD ancient gold mines in Raichur Dis-
trict are supposed to date back to
the time of Solomon. There is a theory that the
Phoenecians worked these mines, another suggests
Egyptian influence, and yet another school surmises
that either the Chinese or the Indonesians had ex-
plored these mines as well as those in Rhodesia. In
any case. mining activity in the State dates back to
very ancient times. ²

1. Opening Address : The Indian Science Congress, 1937. Geology Section.

2. Capt. L. Munn. Ancient Indian Gold Mining : Trans. Geol. Min. Inst. Ind. Vol. XXX, 1935.

We have very little connected record of mining activity in historic times, though, **HISTORIC TIMES** it is well known, that along the Kistna basin Diamond Mines were worked and some of the most famous old diamonds in the world such as Koh-i-noor, trace their origin to the so called Golconda Mines. Tavernier ¹ who visited India and parts of Deccan in the seventeenth century refers in detail to the diamond mining activity in the Deccan. The so called Golconda Mines were all situated on the Kistna basin, and Golconda was the mart from where they were distributed.

The steel manufactured from the iron ores of Nirmal and other places in historic times formed an important ware of merchandise between Hyderabad and other countries. The famous Damascus swords used almost exclusively this steel which went by the name of 'Wootz'. All these accounts are practically confined to the description of the mining activities or mineral products and contain little geological information.

From late 18th and early 19th century a number **EARLY GEOLOGISTS** of geologists who were traversing the country on military duty or quasi-military duty have left accounts of their observations which form the earliest geological literature on the Hyderabad State. These are seldom more than mere travel sketches and very often inaccurate.

The earliest observer is Capt. C. Mackenzie ² **C. MACKENZIE-1794** who in 1794 visited parts of the State, Cuddapah and Kurnool Districts and recorded the results of his observations in Asiatic Researches Vol. V. His classification of the formations is erroneous. He refers to iron and diamonds being found in the same hill ranges, which is true to some extent.

¹ For reference see end of Section I.

The next observer is Dr. Benjamin Haynes³ who gave his observations on diamond mines of India. His description of the field Geology of the diamondiferous area is fairly accurate but he does not go into the stratigraphic sequence or age of these beds. His paper on a journey in 1809 from Cuddapah to Hyderabad describes the general character of the rocks of the area of his traverse.

B. HAYNES
1809-1814

Then comes Dr. H. W. Voysey,⁴ Surgeon and Geologist to the great Trigonometrical Survey of India. In several publications he has given an idea of the geology of parts of Hyderabad State. He recognized that granites covered the area in the neighbourhood of Hyderabad, Nalgonda, Medak etc., and describes the individual characteristics of the granitoid gneiss of all these places and discusses the nature and origin of the Bidar plateau laterites (called by him iron-clay), and also makes a reference to the Traps of Tandur and Gulburga. He falls into an error of considering bole beds in the Deccan Traps as being due to the decomposition of granites, and of considering all the dolerite dykes of post-gneissic period as genetically related to the Deccan Traps.

H. W. VOYSEY
1819-1825

In 1825 the same observer published a paper on the diamond mines of South India. Belonging as he did to the Warnerien School of Geology, some of his observations were clouded by the prejudice common to that group. But his descriptions of the actual observations are very accurate. With regards to the source of diamonds, his views are greatly correct. His conclusions were, (a) that the matrix of the diamonds produced in South India is sandstone-conglomerate formation, (b) that those found in the alluvium or soil are derived from the debris of the above rock, (c) that the diamonds found in the beds of the rivers were

washed down by annual rains. The error of his correlating all the quartzite beds to the same horizon need not be detailed here.

In 1833 Col. Sykes ⁵ presented a paper before the Geological Society of London on the geology of parts of the Deccan. He failed to distinguish the low level laterites from the high level ones that form the summits of several tablelands in the Deccan Trap country. He did not recognize the existence of the schist series and considered almost all the formations as being true granites.

The first general account of the Geology of Raichur and Gulbarga Districts was from Dr. Christie, ⁶ who in 1836, gave an account of his observations which reveal his industry and acuteness. He too did not identify the schist series of the area and considered the gneisses as mostly granitic. The variations in the nature of granite gneisses as well as the quartz veins and trap dykes that cut through these rocks, engaged his attention. In his attempt to correlate the geology from meagre data he sometimes falls into serious errors. He also regards the Dykes of the Peninsular complex as contemporaneous with the Deccan Trap.

Next in order of chronological sequence comes Dr. J. G. Molcolmson ⁷ of the Madras Establishment who in a few papers describes the geological features between Hyderabad and Nagpur and of the South Mahratta country. Some of his observations are erroneous and his Geological Map of the area is far from even an approximation.

Capt. Newbold ⁸ between the years 1836 and 1845 wrote a series of papers on the Geology of South India including several tracts in the Hyderabad State and is univer-

sally acknowledged as the best informed and most accurate of all the earlier students of Indian Geology. His descriptions of Bidar laterite and of the country south of Gulburga are correct and precise. In his account of the Geology of Raichur District, he recognizes the schist patches with the associated ferruginous quartzites near Tawargeri. His account of parts of Bijapur District and south-western portions of Gulburga includes description of Bhima series of rocks. It is surprising to know that his estimate of the extent of the Deccan Trap in India is of the correct order of magnitude. He gives the probable extent as 2,50,000 sq. miles, With his characteristic acuteness he could distinguish the basic dykes of post-gneissic period as being geologically much older than the Deccan Traps.

Dr. Carter ⁹ in 1853-54 tried to summarise the geological literature on India upto
 DR. CARTER-1854. the period of the publication of his book. It contains very little original observation.

Col. Meadows Taylor ¹⁰ in 1862-63 gave a description of the Geology of parts of Gulburga District and his observations certainly do credit to an amateur who had no systematic training.

COL. MEADOWS
 TAYLOR.

He is practically the last of the group of early observers on the Geology of Hyderabad State.

We now enter into the second era on the advancement of the geological knowledge of the Hyderabad State. The Geological Survey of India inaugurated in the year 1857 turned its attention almost immediately to Hyderabad State and from time to time the officers of the Geological Survey of India have given the results of their observations in the numerous publications of their Department.

GEOLOGICAL SUR-
 VEY OF INDIA

Leaving aside the short traverse notes on parts of Hyderabad State from the officers of the Geological Survey, reference may be made to some of the major contributions in which some economically important areas in the State have been dealt with in some detail. The earliest of these is the memoir by King,¹¹ published in 1872 on the Cuddapah and Kurnool formations. In this memoir the sedimentary series of the Purana Group fringing the northern bank of Kistna river refer to the Hyderabad State. The memoir attempts at a review of the mining activities for diamond in the area and alludes to the iron that was recovered and smelted from the sedimentary formations.

The next important contribution from the Geological Survey of India is contained in Bruce Foot's¹² memoir on the South Mahratta country. He describes in detail the geology of greater part of Raichur Doab and parts of Gulburga District. A brilliant and conscientious field Geologist, Bruce Foot's contribution is naturally most illuminating and comprehensive, and is an example of what a memoir on such a subject should be. The revision work in the area by the Hyderabad Geological Survey has, however, brought out several discrepancies in the boundary and has also disclosed new formations of Dharwar bands not recognised by him.

The Geology of the eastern coast from Lat. 15° to Masulipatam published in memoir XVIII¹³ in the year 1879 refers to the eastern parts of the State. The next important contribution from the Geological Survey of India is the Report on the Pranhata-Godavari Valley by King¹⁴ who in 1881 demarcated the boundary of the Gondwana formations and indicated the possibility of workable seams of coal.

In recent years Dr. Fox¹⁵ has discussed the correlation of the Gondwana System in his memoir

LVIII in 1931 and about Singareni and Tandur coal fields in memoir LIX published in 1934. Besides these important contributions, several traverse notes have been published by the officers of the Geological Survey of India. It should, however, be recognised that the areas in the Hyderabad State that attracted their attention are mainly regions of economic importance which fringe the British Indian Districts. This constitutes but a very minor part of the total extent of the State. Detailed reference is not made to the contributions of the Geological Survey of India on the Geology of Hyderabad as the publications are easy of reach for any one interested on the subject.

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SECTION II.

From the sketch in the previous section it is clear that the geology of the State did not receive any systematic attention except for a few cursory traverses and notes, besides a few reports by the Geological Survey of India on some local areas which came under their perview in the usual course of their survey.

The State naturally felt a necessity for a systematic survey and first-hand geological information on the mineral resources. So, a Department was inaugurated in 1331 F. with a very limited staff. The activities of this department gradually increased and to meet this enlarged scope some additional hands were subsequently added.

During the first six years of its existence, the survey of the Asifabad, Nizamabad and parts of Nalgunda, Karimnagar and Atraf-i-balda Districts was undertaken. As most of these surveys were done on old Circar sheets and it was found when revision topographical survey was done, that the old sheets fell much short of accuracy with wide departures, it was considered inexpedient to publish the reports based upon the old maps, though the department was in a position to know the geology and the mineral resources of these districts covered by this survey. It is hoped that these reports will be published as soon as the maps are made ready on the revised topo-sheets now available.

With the publication of the revised topo-maps by the Survey of India however, a systematic survey

of the State was planned beginning with south-western corner of the State i. e. Raichur District. The detailed geological survey and the mineral resources of the Raichur Doab together with those of parts of Gulbarga and Mahbubnagar Districts are now completed and these form the basis for the publication of the departmental Journals Vol. I, II, III and others in the press.

The geological map of the State (vide map) is one which has been compiled from the work of the department and from other informations available on the subject and does not claim to be an accurate map of the geology of the State as a whole. Nevertheless, this gives us a fair idea of the geological formations and their distribution.

From the information available it may be computed that about half of the State (*i.e.* GEOLOGICAL FORMATIONS. 35,000 sq. miles) is occupied by the Deccan Trap on the west and north-west, about one fourth of the remaining (about 12,000 sq. miles) is covered by the sedimentary series of Gondwana formations and transition rocks, and the balance of half the area of the State (*i.e.* about 37,000 sq. miles) is covered by the great Archaean Complex with subordinate runs of Dharwar schists distributed in them. About 1,150 sq. miles of Dharwars have so far been mapped.

Broadly speaking, the geology of the State may be summed up in descending order as follows :—

ARYAN GROUP.	{	1. Recent alluvium (Blown sand, Talus at foot of hills, moorum black cotton-soil, low level laterite and other soils.)	}	RECENT.		
		2. Older alluvials of Godavary, Tungabhadra, Kistna and Bhima rivers; high level laterites.		PLEISTOCENE.		
		3. Upper, middle and lower Deccan Traps with intertrappeans and ash beds and infra trappeans (Lametas?)	}	UPPER CRETACEOUS.		
		4. Chikiala, Kota-Maleri beds		Upper Gondwanas. } JURASSIC.		
		5. Kamthi series.	}	Middle Gondwanas.	}	TRIASSIC.
		6. Barakar series. Talchir Boulder beds.	}	Lower Gondwanas.		PERMIAN.
PURANA.	{	Lower Vindhyans.	}	Kurnools, Rhimas Sullavais.	PRE-CAMBRIAN.	
		Cuddapahs.		Pakhals Penganga		

Great Epe-archaeon interval.

VEDIC.	{	1. Peninsular Complex (Newer granites and gneisses).	}	ARCHAEAN.
		<i>Eruptive unconformity</i>		
		2. Older gneisses (C. F. Champion gneisses.)		
		3. Dharwars.	}	
		Trappoid schists. Hornblende schists. Chlorite schists. (Ferruginous Quartzites)	}	

As has been already pointed out, nearly more than half of the State is occupied by the various members of the archaean complex. The study of the archaean complex has particularly engaged the attention of this Department, not only on account of its mineral possibilities but also for academic interest. These series of rocks have been engaging the attention of the Indian Geologists who are trying to establish a correlation so to bring into harmony the various views expressed in different parts of India. The sedimentary rocks in the State have already received some attention from the Geological Survey of India in the course of their usual work and their observations are published in the Geological Survey of India memoirs and records. It is therefore felt expedient to give greater emphasis to the archaean complex of the State.

Very small portion of this complex is however represented by the Dharwars, the oldest **DEHARWARS.** recognisable rocks in the State. As can be seen from the map, the Dharwar schists are found in bands and irregular patches folded with the gneisses in a general north-north-west direction forming practically a northern continuation of the Dharwars of south India, in the Raichur Doab and in Surapur Taluq, Gulburga District. Other occurrences in Mahbubnagar and in Nizamabad Districts have been noted. Areas, as yet unmapped have been reported at Nirmal extending into Nalgonda District, also in Karimnagar and Warangal Districts.

So far as the State is concerned, the type area appears to be the Raichur Doab where the Dharwars have evolved in all their different igneous aspects.

The department has bestowed detailed study on these Dharwars of Raichur and have established the intrusive relationship of the granites and granitic gneisses towards the Dharwar schists. There is a consensus of opinion that all the constituent types of the Dharwars of this area are of igneous origin and that

there is an absence of any facies of sedimentation. The survey has not disclosed any basement rock on which the Dharwars could have, been laid down.

Our study has indicated the igneous origin of the hornblende schists, chlorite schists and the epidiorites. The quartzites are the crushed phases of vein quartz, and the Dharwar conglomerates are of autoclastic nature. Slates, phyllites and quartzites of sedimentary origin and limestones and conglomerates are conspicuous by their absence.

The study of the Peninsular Complex and their relation to the Dharwars and the origin of Dharwars have been the subject matter of controversy for the last decade or two and we have before us the opinion of Dr. Smeeth, Mr. Middlemiss, Dr. L. L. Fermor, Prof. Sampat Iyengar and Dr. Krishnan and recently by Mr. B. Ram Rao of the Mysore Geological Survey from this Presidential chair, and this Department is keenly alive to the line of arguments put forth by the astute archæan geologists.

Our work on the Dharwars of the state strongly falls in with the view expressed by Dr. Smeeth and Prof. Iyengar who have to their credit a life long study of the archæans of Mysore.

Though accepting an igneous origin to the Dharwars of the Raichur Doab, we should not lose sight of some of the other Dharwar formations which have been reported but not studied in detail, where the sedimentary facies of the Dharwars with their ferruginous beds could be recognised. It is thus fortunate that Hyderabad State should form a linking ground where both the facies of Dharwars, viz, the igneous and sedimentary should occur to throw light on the genetic controversy of the Dharwars. The late Prof. Iyengar in 1932 Congress, Bangalore, clearly expressed that in Mysore they were dealing with the igneous facies of the Dharwars, whereas, in the North, Singbhum

and Central Provinces, typical sedimentary facies of Dharwars exist. He thought that there was no reason to give any one specific origin for all the Dharwars in India, neither is it possible. He made a prophetic statement that as they were dealing with the igneous Dharwars on the south in Mysore and the officers of the Geological Survey of India were dealing with the sedimentary facies of the Dharwars in the north, a place may be found where both the facies of Dharwars might occur. It has therefore become a very responsible work for the present and future geologists of Hyderabad to go into this question deeply and bring in facts to harmonise the controversy.

We have recognised during our survey, a series of highly crushed micaceous gneisses, quartz schists, quartz porphyries and other ultra acidic schistose rocks, now and often containing blebs of opalescent quartz, closely associated with the Dharwars, which appear to be lithologically similar to the Champion gneisses of Mysore. It is also significant that our field observations are in accordance with the views expressed by the late Prof. Iyengar¹ who relegated the horizon of the eruptive unconformity between these acidic schists and the later Peninsular gneissic complex and not between the acidic schists and the Dharwars as was originally proposed.² These rocks of the Champion series are so intimately associated with the Dharwars, sharing with them all the tectonic disturbances that it makes it practically impossible to separate one from the other, but nevertheless they show specific intrusive relation to the schists.

Conceding this eruptive unconformity as suggested above, the next set of formation in the archæan evolution in Hyderabad leads us to the most baffling series of rocks termed the Peninsular

1. Acid Rocks of Mysore P. Sampat Iyengar, Bulletin No 9, Mys. Geol. Surv.

2. Dr. Smeeth. Presidential address, Ind. Sc. Con. 1924.

gneissic complex which forms the major portion of the Indian Peninsula.

The work done so far is neither intensive nor extensive, to arrive at a hypothesis for a genetic system of evolution of this great complex.

In this Presidential address in 1924, Dr. Smeeth divided the Peninsular complex broadly into the following three main groups:—

1. Closepet granite complex and other granites.
2. Charnockites.
3. Peninsular gneisses.

Our study of the Peninsular complex in parts of Hyderabad State has revealed similar complexity of the whole gneissic formation which has so far baffled our detailed classification into specific types. Our Survey has however enabled us to regard the archæan gneisses under two main divisions, namely, (1) an older grey and pink division and (2) a younger porphyritic granite and red syenite division. Type charnockites have not been so far recognised in the areas surveyed.

The Peninsular gneisses seem to lend an opportunity for a rough classification from the colour of the feldspars contained in them. They are therefore divided into two main divisions, namely, an older grey series and a younger pink series characterised by the presence of grey or white and pink feldspars. Though one phase gradually shades into the other yet, broadly speaking the pink series are found to show an intrusive relation with the grey series, each series being characterised by its own set of pegmatites and quartz veins. It is significant that the maximum development of the pegmatites is observed along the contact-zone of the Dharwars with the Peninsular Complex.

The porphyritic granites and red syenites occur as intrusive laccolithic masses and dyke-like injections in the grey or the pink series or in both. These appear to be the youngest granitic gneisses of the complex and are therefore comparable with the younger closepet granites and granitic complexes of Mysore.

For a more detailed discussion as to the origin and the inter-relation between the Dharwars and the gneisses, the origin and evolution of the Ferruginous quartzites and the mode of differentiation and regional features of the Peninsular complex as studied so far in the State, reference to our departmental publications may be made.

While mentioning the absence of type charnockites in our area I should like to make a reference to a particular metamorphic facies of the Dharwars represented by the grano-diorites which occasionally occur fringing the main Dharwar basic formations or as isolated bands within Dharwar belt and in its continuity. They occur as a metamorphic facies of the Dharwars, assimilating materials both from the basic schists and the acidic gneisses. They essentially consist of hornblende, mostly shredded, plagioclastic feldspars with some orthoclastic varieties highly sericitised with kaolinised decomposition products with the development of sphene and apatite; quartz also occurs. Types have been recognised from the acidic to the basic varieties depending upon the relative proportion of the assimilated material and the degree of metamorphism to which they were subjected. Garnets are very rarely developed. In the scale of metamorphic classification enunciated by Grubermann this grano-dioritic phase appears to answer to the middle or the meso-stage. It is interesting to note that Vredenburg, suggested that the charnockites are an acute phase of metamorphism of the Dharwars.

It would therefore be pertinent to enquire if these granodioritic forms may be considered as only a stage in the ultimate metamorphism of the Dharwars into charnockites. For a discussion on this subject reference may be made to Journal, Hyderabad Geological Survey Vol. III pt. i.

A little diversion here may not be out of place.

Dr. Fermor in a recent publication¹ on the correlation of the ancient schistose formations of Peninsular India has divided the country into two main-regions viz. the non-charnockitic and the charnockitic. Except for a little portion in the east in the Warangal District the whole of the complex of Hyderabad State come under the non-charnockitic region. But only a detailed survey by the Department can show the alignment of the dividing line accurately, as it appears that rocks similar to charnockites occur also in portions of Karimnagar District. However that may be, broadly speaking, a major portion of the State may be considered, so far as our present knowledge goes, to be non-charnockitic. Thus we are missing one of the important group of rocks in the archaean evolution.

Next we pass on to the youngest members of the crystalline complex which are represented by a series of later porphyritic granites and coarse red syenitic rocks and other binaries of the acidic intrusives comparable to the closepet granite complex series of Mysore.

It has been found that porphyritic granites and red syenitic rocks have had their maximum development both in the Krishna and the Tungabhadra basins fringing a central mass composed of older Peninsular gneisses. Such a distribution should naturally indicate some zones of weakness through which these rocks could have found outlet.

1. L. L. Fermor Mem. G. S. I. Vol. LXX. Part 1, 1936.

The suggestion given by Dr. Fermor in his recent publication referred to above, that the relative elevation of the charnockitic region may be due to a relative vertical uplift along the belt of weakness—a fault zone along the junction between the charnockitic and non-charnockitic regions, is supported by the seismic data which show that the charnockitic terrane is less stable than the non-charnockitic region.

It is therefore suggestive that such seismic regional disturbances must have had their counterparts in the non-charnockitic region in inducing prominent zones of weakness and fault lines through which later granitic intrusives could have found their way.

The courses of the prominent rivers like the Kistna and Tungabhadra seem to have been determined by the zones of weakness through which they must have carved their course aided by differential denudation. This is exactly what we find in the regions fringing the Raichur Doab. If such tectonic disturbances were of a widespread character resulting in the formation of zones of weakness in the continental floor, the occurrence of these younger series of granites and their widespread distribution can perhaps be easily accounted for. This relation therefore may be considered contemporaneous or rather later to the seismic disturbances connected with the charnockitic evolution.

We thus see that the evolution of the porphyritic granites and their associates are decidedly subsequent or younger to the charnockitic series and compares in harmony with a similar evolution established by the Mysore Geologists as represented by the closepet granites.

Both in India and South Africa, it is a common experience of the geologists to find salt and saline springs associated with pegmatites at the junction zone between the Dharwars and the gneisses. Examples of such phenomenon in Raichur Doab and Surapur taluq are common where saline efflorescence and weak brine occur extensively in localised centres and indigenous salt industry has been carried on from time immemorial. Bruce Foot¹ considers that such saliferous activity is of deep-seated origin. Our examination of the area fully confirms this view and reveals that the saliferous activity so closely associated with the pegmatitic zones, especially in the later pink members is due to progressive fractionation of the acidic members of the Peninsular gneissic complex with which the ingredients were genetically associated in their deep-seated condition. Their association particularly with the auriferous areas of the Dharwars is more than an accident. This specific distribution of salinity is very clearly brought out in the Doab. The contact zone of the auriferous Muski-Wandalli band of Dharwars is highly saliferous but in the Kushtagi-Hungund Band which is non-auriferous, salinity is poorly developed. Similar relation is borne out in the Surapur area to the north of the Kistna where the Mangalur Band of Dharwars constitutes the northern extension of the auriferous Muski Dharwars of the Raichur Doab. The present distribution is however controlled not only by the pegmatitic centres but also by the meteoric circulation shifting from place to place in their neighbourhood in isolated hydrographic basins. The question of salinity has been studied in detail in the Raichur Doab and parts of Gulburga District, and the result of this enquiry are published in the Departmental Journals.

Whether the conditions so far observed are of any uniform or widespread character remains to be seen

1. 'Mem. G. S. I. - Vol. XII,

when the other parts of the State where Dharwars are reported to occur but still unmapped, are taken up.

The close of the igneous activity marked by the evolution of the porphyritic granites, red syenites and associated pegmatites, **EPARCHÆAN INTERVAL** brings us to a period of quiescence ushered in by the beginning of the great Eparcbæan interval. This interval so far studied in Hyderabad separates the Archæans from the Puranas. This interval of time is unrivalled in the geological history of India and must have witnessed the culmination of the folding and crumpling of the archæan rocks into high ridges only to be worn down through countless ages to their base level of erosion before they finally got submerged below the waters of the Purana seas. During this period, huge tectonic disturbances leading to the transgression of the purana sea resulted in an isostatic regional variation of the ocean level. A more quiet period representing denudation and deposition must have marked the closing of this great Eparcbæan interval.

Other than the above considerations supported by the enormous denudation of the archæan rocks which must have been of enormous magnitude in this country, we have very little positive evidence from the field to mark this huge interval of time except perhaps to attribute some of the fragmentation of the pegmatitic and quartz spreads below the Dharwars to some stages in the huge break.

LYKES

The dyke rocks of Hyderabad may conveniently be divided into two main heads:—

- (1) The contemporaneous trap dykes and hornblende dykes of Dharwar age.
- (2) The Cuddapani lava flows and sills; dykes of Dolerite character.

The former group is distinguished by the complete amphibolisation of the pyroxenes, while the latter is characterised by little or no amphibolisation of the augites. The Dharwar dykes are recognisable as hornblende dykes, amphibole dykes, amphibole peridotites, green stones and epidiorites. The association of steatite or talc with altered amphibolite and also of tremolitic asbestose is an occasional feature with some of these Dharwar dykes.

The second group of dykes which appears to be of lower Cuddapah age is mostly doleritic in character passing at times to epidiorites due to partial alteration of the augites into hornblende. That these dykes belong to the latter group can be definitely established as they are always found intrusive into the gneissic complex and also to some of the members of the Cuddapahs.

One peculiar structural feature in the distribution of dykes may here be mentioned. At or near the Dharwar margin especially along the concavity of the gneissic bays these later doleritic dykes seem to have developed in parallel runs along lines of weaknesses produced by the impact of the gneissic invasion against the lands of pre-existing Dharwars. The strike of these dykes generally follow the main structural foliations of the gneisses and sometimes at right angles to them, along their main fissures.

We may now pass on to the next group of rocks, namely, the Puranas (Pre-Cambrian), PURNA GROUP Dr. Fermor in his publication referred to above, uses the term archæan, as applicable to all formations below the eparchæan unconformity, separating the Cuddapahs and the other unfossiliferous formations lying above the unconformity, termed Purana by Dr. Holland.

The Purana group of rocks are scattered in isolated basins within the State and a glance at the map will show their distribution. These formations

are unfossiliferous, though very puzzling concretionary and weathered fragments in the beds often simulate some fossil forms. These beds usually occur with low angles of dip over considerable areas and only appear highly tilted along a few zones of special disturbance. These formations being unfossiliferous, correlation is based mainly on lithological grounds and each separate group has been named after the type-area in which it has been noticed. The main belts of Cuddapah formations occur along the north bank of the Kistna river in Amrabad Taluq south of Nalgunda, underlying the Kurnool beds and along the Kistna river after its confluence with the Tungabhadra. They mostly consist of slates, quartzites and limestones. In addition to the above beds classed under Cudjapah we have within the State some groups of sedimentary rocks known as Pakhals, Pengangas, Sullavai beds and Bhimas.

These have been studied in their type areas from which they derive their name and are regarded as of Cuddapah and lower Vindhyan age, respectively.

The next higher series of beds are represented by the Kurnool series of rocks which are however not much developed within the State. Near Alampur and along the left bank of the Kistna river both diamondiferous quartzites and conglomerates occur and have remained unworked. These areas have not yet been studied in detail by the Department and it is proposed to take them up in the near future. Closely related to the Kurnools and resembling them in lithological characters are the Bhima series of rocks so called from the river in whose basin these formations occur. On their north western border these beds are covered by the Deccan Trap flows and on the north east border for a long distance they rest on the archaean gneisses. The Upper Bhima is chiefly a limestone formation, though beds of shales occur occasionally and sandstones and shales constitute lower members

of the series. The limestones are fine-grained and possess a texture approaching lithographic stone. The grey colour prevails; pink black, yellow and other tints are not un-common. The rock occurs as flagstones and are largely used for building, especially for flooring. The limestones of this series yield good material for cement manufacture and is extensively used in the Sahabad Cement Works. The black varieties take nice polish and can be used for decorative purposes as a cheaper substitute for marble. The association of iron pyrites with these limestones, sometimes seggregated in layers, has been noted in Surapur, Andola and Gulbarga taluks.

We have now to pass over a big hiatus in the geological history of Hyderabad before we come to the Gondwana formations, the earliest fossiliferous strata in the State. Rocks of Carboniferous to Cambrian (Dravidian group) are un-represented within the State limits.

The Gondwana formations are the next group of **GONDWANA SYSTEM** rocks met with in the State. Without digressing into the details of these formations, the reports of which are available in the Records¹ and Memoirs² of the Geological Survey of India, it may be pointed out that these formations occur in the eastern and N. E. border of the State fringing the Pranhita, Warda and Godavari basins.

These areas have attracted the attention of geologists due to their economic possibilities and the Singareni Collieries have long been in existence tapping coal in these beds.

Our Departmental survey in portions of Asifabad District and the activities of other prospecting Companies have brought into light the continuation of coal bearing beds along the belt. About 25 square miles of

1. G.S.I. Rec. Vol XI.
2. " Mem. Vol. XVIII and MEM. Vol. XIII

coal bearing Barkar rocks have been proved to exist to the south of the Godavari in the Jangaon area, Sultanabad Taluq, Karimnagar District of which 800 acres have been fully proved by bore-holes where good second class coal is available at economic depth to an estimated quantity of about 38 million tons*. The activity of the coal Companies are being sufficiently encouraged for a wider scope of operation.

In addition to the coal mining at Singareni, other operations are also being conducted both at Tandur and at Sasti areas in the N. Godavary Valley.

The fossils found in the Gondwana rocks and specially the saurian reptalian remains from the Kota-Malari group in Asifabad District have received world wide attention.

Workable iron-ore is found concentrated in the upper beds of the Gondwana series and extensive deposits are noted in portions of Asifabad and in Warangal Districts. Fire-clay and pyritiferous nodules have been noted in association with the coal seams.

Next in order of succession we have the Deccan Trap DECCAN TRAPS rocks occupying nearly one half of the State. The Hyderabad Traps are regarded as belonging to the middle series with some Inter-trappeans. These formations are engaging the special attention of this Department from their water bearing point of view. As it is well known that the flows consist of hard basaltic trap, intercalated with softer vesicular layers which are susceptible to greater decomposition and consequent storage of water, it has been found by careful study of natural sections and well logs that there are specific layers in certain horizons which are aquiferous and wells driven to these depths have proved of successful perennial supply. By a careful study of these physical features it has been made

*Unpublished report by Mr. A. B. Hughes

possible to reduce the element of chance to its minimum and save lot of money for the public which would have been otherwise wasted. Though it has been found that any correlation in a particular area may not be so uniform or widespread as to make it of universal application, yet the knowledge gained in this study has proved of immense value within the area limited by such co-ordination.

The Deccan Traps are sometimes capped by laterites. The laterites vary from highly ferruginous to practically alluminous boles and have yielded iron ore for local smelting. These high level laterites form the great Bidar plateau and are found scattered at Vikarabad, Ananthagiri, parts of Nizamabad District and elsewhere. At places where it is very thick it offers at its base basins for storage of water and wells in such areas yield drinkable water with characteristic iron-taste and tonic properties. Vikarabad is growing into a sanitorium not only due to its comparative height but also to the presence of such mineral water.

Intertrappeans are rarely met in the Deccan Traps of the State. A few fossiliferous **INTERTARPEANS** areas, however, consisting of lamelli branches and gastropods have been noted in parts of Nizamabad, Parbani and Gulburga in course of the Survey.

Some stray patches of lameta beds or infra-**LAMETAS** trappeans have also been recently located in Surapur Taluq with interesting vertebrate remains. These areas are engaging our attention.

A few remarks here may be added regarding the recent formations of the alluvials and the soil groups of the State and artifacts of apparently human manufacture reported from some of these recent formations. These afford good examples of the trace of man in the **PLIESTOCENE & RECENT** Pliestocene gravel beds. Silicified wood and mama-

lian bones are also met with in the Godavari alluvials. The Kistna gravels are similar to those of Godavari and the deposits of importance in this connection are the diamondiferous gravels which consist of sandy shingle composed chiefly of quartzites. The gravels occur at considerable elevations above the river and are covered by the black cotton-soil. The diamond mining in the State is now at a stand still yet there remains, specially around Partial and Nandikonda, large areas whose diamondiferous gravels must be lying untouched.

S O I L

The soils of the State may be broadly classified under two main divisions.

1. Black cotton-soil generally covering the Deccan Trap and the Dharwar schist areas and shifting much beyond their boundaries by the normal methods of migration.
2. Loamy gneissic soil occupying a great portion of the archæan country with its sub-soil or moorum. Lignitic and peaty soil even now occur in swampy areas in the neighbourhood of Barakar series of the Gondwana formations in Chinur Taluq, Asifabad Dist.

The question of soil erosion and shifting has become a serious problem for the agricultural geologists and some portions of the State are heavily exposed to impending dangers of complete soil erosion and eventual barrenness if no precautions are immediately taken. Semi-arid areas like Raichur and portions of Deccan Trap Districts are constantly exposed to this menace of shifting soil and the local methods of field bunding is rather a poor check against the rapid and extensive soil erosion. A comprehensive scheme of re-forestation and organised methods of field bunding appear to be the effective measures for the prevention of this erosion which is already engaging the attention of the Government.

SECTION III.

As the literature on the mineral resources of the State is diffused in several publications and in unpublished Departmental Reports and many known occurrences have not been given sufficient publicity, the available information on the mineral resources of the State may here be outlined. Minerals which have been noticed so far by the Departmental Survey or by other previous observers may be mentioned as follows:—

1. Gold.
2. Coal.
3. Diamond.
4. Iron.
5. Copper.
6. Manganese.
7. Mica.
8. Garnet.
9. Graphite.
10. Galena.
11. Kaolin.
12. Salt deposits, Salt peter, Dhobies earth etc.
13. Ochres.
14. Feldspars and Material for Ceramic Industry.
15. Glass Industry.
16. Ilmenite.
17. Kyenite.
18. Semi-precious stones like amethyst, agate, Jaspur, Plasma, Bloodstone Opal etc.
19. Zeolites.
20. Pyrites.
21. Corundum.
22. Antimony.
23. Talc and Soapstones.
24. Laterite and aluminous bole.
25. Clays, Brick Earth, Fire Clay etc.
26. Materials for Cement Industry.
27. Springs and Mineral Waters.

- 28. Water falls.
- 29. Building Stones.

1. GOLD

This precious metal has been worked in Raichur Doab from pre-historic times as evidenced by a number of old-workings found scattered in the auriferous areas, which attracted Europeans enterprises.

The history of their exploitation marks a romantic rise and a short-lived development in modern mining.

The Hyderabad Deccan Company started a subsidiary Company under the name of Hutti (Nizam's) Gold Mines Ltd., in 1901 to work the Hutti Gold fields situated on the Muski Band of Dharwars. The average yield from 1914—1918 was 16,539 oz. valued at £ 63,463/-. The mines were worked upto early 1920 when the operations ceased.

Another Company, The Topaldoddi Nizam's Gold Mines Ltd., was formed in 1905 to work the Topaldoddi-Wandalli area but as the ore proved to be of a low grade the mine was closed down. Other small subsidiary companies also sprang up working the southern parts of the Maski band but their activity was short-lived due to the poor quality of the ore which could not be worked.

Gold is reported at Chitral, Nalgonda District and was worked for sometimes but due to a very small yield the mining was closed down.

In the course of the Departmental activity these auriferous tracts of the Doab engaged special attention. Some promising fields could be located which gave encouragement for a revival of gold industry in the Doab with the present high value of gold. To the north of the Kistna in Surapur area, the

survey of the northern continuation of the Maski Dharwar band has given encouraging indications for a big scale prospecting. With these potential fields still unworked, it is hoped that ere long some enterprising private companies, with a full knowledge of working of such fields, will take up a detailed prospecting and mining of these areas.

The following statement will show the quinquennial output of fine gold from 1910-1924.

	1910-14.	1915-19	1920-24.
Gold output.	Ozs. 63,228	72,144	12,390
Value.	Rs. 33,40,300/-	41,63,170/-	5,88,695/-

2. COAL.

The Gondwana series occur towards the eastern portion of the State as a continuous strip from the Warda Valley through the State into the Madras Presidency and occupy about 3,800 sq. miles, mostly covered by Kamthi rocks which need not all be underlaid by coal beds. Actual outcrops of Barakars and Talchirs in which the coal has been located are few and far between.

The proved areas may be classified as under:—

1. Sasti-Rajuar Area.
2. Antergaon-Aksapur area.
3. Tandur area.
4. Chinnur-Sandrapali area.
5. Karalapalli outlier
6. Bandala outcrop.
7. Maddapuram-Allapalli area.
8. Opposite Lingala.
9. Yellandlapad (Singarini coal-field).
10. Kothagudem.
11. Kamnigiri.
12. Damarcherla.

Though borings proved coal near Kothagudem and pits sunk and rail connections established, yet this had to be abandoned in preference to the Tandur area due to the advantages derived by the opening of the Kazipet-Balharshah Railway. Details of these coal beds may be obtained from the coal memoirs of Geological Survey of India, Vol. LIX, by C. S. Fox.

Active mining operation is now been conducted at Singareni, Tandur and Sasti areas.

The Singareni fields where the first coal mining operations were started by the Hyderabad Deccan Co., in 1893, have since yielded about 20 million tons of coal.

During the last 25 years the Singareni and Tandur Collieries yielded about 15,941,606 tons or on an average of 6,37,664 tons of coal per year. The average daily outturn at Singareni is about 2,000 tons and that at Tandur 1,500 tons. The following statement will show the average quinquennial output and value of coal from Singareni, Kavala and Tandur, Sasti and Oaoni Collieries (from 1910-35).

		1910-14	1915-19	1920-24	1925-29	1930-34
Coal	Output Tons	26,01,329	32,04,061	23,27,888	35,65,535	38,77,341
	Value Rs.	156,07,974	163,28,341	218,89,359	216,17,971	187,60,576

The quality of average Singareni coal may be given as hereunder:—

Sp. Gravity	...	...	1.39
Fixed carbon	...	...	55.85%
Volatile matter	....	...	24.12%
Ash	....	...	14.17%
Moisture	...	...	5.86%
			<u>100.99</u>

Calories	...	...	6,433
B. Th. U.	...	...	11,580

Besides the above zones, another important field was proved by prospecting conducted by Sir Fazulbhoy Currimbhoy in the south of Godavari forming the Jangaon coal field in which about 38 million tons of coal has been estimated. Continuing across the river in the Chinur and Asifabad Taluqs, surface indications of in-situ coal has been reported during the geological survey of the District.

3. DIAMOND.

Tavernier in his 'Travels' refers in detail to the working of the diamond mines in the Deccan. His route passes right across the State beginning from Daulatabad, via. Golconda and Hyderabad, to Masulipatam. He has given an exhaustive description of the diamond mining then existing in this part of the country. Golconda which has become famous in history for its diamonds, has been from earliest Hindu times and subsequently under the Kutubsahi dynasty the mart for the diamonds. As generally believed Golconda was never a place for diamond mining; the area on which it stands is wholly composed of archæan gneisses

The famous Partial group of diamond mines all lie on the north bank of the Kistna within the State. In fact, from Alumpur along the left bank of the Kistna river both diamondiferous quartzites and the conglomerates have remained unworked. Some of the best Indian diamonds have come from the Kistna basin, a good part of it lying within the limits of the State. At Nandikonda and in the left bank of the Kistna diamond is reported to have been found and even now picked up. The diamondiferous quartzites as well as the Kistna alluvials require a careful examination with modern machinery and suction

dredge capable of handling huge quantity of material per day. It may be noted here that most of these tracts to the north of Kistna along with other areas still lie unexplored and are now engaging the attention of this Department.

4. IRON.

Iron ore is extensively found in various parts of the State in almost all the formations from Dharwars upwards upto Deccan Trap laterites, not to speak of iron sands brought down by the rivers and streams.

Iron smelting has been known from time immemorial since the neolithic times as evidenced by the neolithic implements with iron slags. The old workings for iron on the Kushtagi band of ferruginous quartzites, at Tintini and elsewhere seem to have been worked from ancient times.

The unrustable iron chains and plates on the Mudgal fort gate testify to the high quality of iron that was produced by the local smelters and the high standard of workmanship at that time. It appears that the local iron industry in Raichur Doab did not assume the importance of that of Nirmal and Nizamabad Districts. The iron stones found in Armour are of high grade and the blades made from Konasamudram steel was once famous for their strength, and Damascus sword. The place at the time of Voysey was still visited by Persian traders for the steel as this Indian "Wooze" was known throughout the world.

Local smelting of iron is still straggling in many parts of the State; the local ores can hardly stand the competition but from Bihar and Orissa where hills of high grade iron ore are obtained with very little labour and cost.

Iron ore occurs extensively in the following localities:—

1. The ferruginous quartzite bands in the

Dharwar schists belt in the Raichur Doab constitute an important source of iron ore where hæmatite and magnetite occur in large quantities. The Kushtagi-Taugeri band of ferruginous quartzites may be regarded as an important source for development.

2. Ferruginous quartzites in Armour, Nizamabad District and Nirmal, Kinwat and Laxetipet taluqs Asifabad District, are also extensively noted.

3. There are innumerable localities of iron ore in the area occupied by the gneissic complex, but the quantity available is meagre. Specific occurrences of spicular iron are known in association with quartz veins and dykes, but the quantity in any one area does not warrant any economic exploitation though due to its high quality it may be useful as subsidiary feed for central iron works.

4. Iron ore is also found distributed among the Purana group of sedimentaries as iron-pyrites and ferruginous sandstones, fringing the north bank of Kistna. These ferruginous sandstones have often yielded materials for the ancient smelters. Iron-pyrites and siderite in the limestone formations in disseminated layers have been noted. When the survey of the Purana formations are completed a suitable area of concentration may prove of economic interest not only for iron but also as a source for sulphuric acid manufacture.

The Gondwana formations are associated with iron-ores both in the lower and the upper beds of the series. The lower beds consist of iron-stone clay nodules occurring between the Barakar and the Kamthis. The important beds are those in the Chikiala formations where hæmatitic nodules occur in extensive quantity. Broad stretches of the Chikiala beds in the Sirpur taluq constitute an extensive source of iron-ore. Local smelting of iron is still carried on in the villages in the neighbourhood of the Chikiala iron hills.

A very extensive outcrop of magnetite iron ore has been noted near the southern boundary of the Singareni coal fields covering a distance of about 3 miles long forming a ridge varying between 150 to 350 ft. in height. The ore is reported to be of a very rich quality.

5. The next formation which is an important source of iron is the Deccan Trap laterite. Huge areas constituting highly ferruginous varieties occur in many parts of the Mahrattwara Districts of the State. The following localities require special mention.

There are extensive lateritic caps at Bidar and Kalyan, Vikarabad and in parts of Nizamabad. Bidar lateritic cap is about 28 miles long and 22 miles broad and that of Kalayan is more extensive. Smelting is said to have been carried on at Kollur and Ananthagiri lateritic region near Warangal, and in Nizamabad District, and at Marbi and Boghiri in Bidar District.

As regards the quality of the various types of ore available, average bulk samples of Tawargeri zone of ferruginous quartzites assay about 40% of iron. The rich ore near one of the old workings yielded 48% of iron. The lateritic ores in parts of Nizamabad District yield as follows:—

Sungium hills (Galdhari Taluq) about 48% of iron.

Lingampet (Yallareddi Taluq) 44% of iron.

Kondapur (Kamareddi Taluq) 43% of iron.

In Karimnagar District Thimmapur laterite yields 47% of Fe_2O_3 .

Parkal iron ore 93% of Fe_2O_3 .

The Chikiala hæmatite nodules near Sankaram, Chinnur Taluq, give about 97% of Fe_2O_3 and bulk sample from Armour taluq from 45% to 83% of Fe_2O_3 .

The absence of coking coal is a handicap to the development of these iron-stones, but with the advent of Hydro-electric schemes under contemplation these ores are likely to attain economic importance. The economic possibilities of iron-stone areas are engaging the attention of the Government with a view to develop an iron-smelting industry on modern lines without prejudice to the coal and forest reserves of the State.

5. COPPER.

Traces of copper are reported from the gneisses in Nalgonda and in Yelgurrupin Warangal District. At Chintrala in Nalgonda it is reported that malachite occurs between layers of argillaceous slates. A number of old-workings are found scattered over this area, apparently for copper. Copper as carbonate is noted in parts of Raichur District. Some old workings with copper-stained debris are often met with within Gadwal Samasthan. Old workings are noted in Machnur and Chincholi in Raichur, and Tintini in Surapur Taluqs. At the junction of aplites and diabases, copper staining is noted south of Jagarkal Mallapur and between Timapur and Gabur in Raichur Taluq. Copper slags are found lying scattered in their vicinity. Along the eastern margin of the Manglur patch of Dharwars in Surapur taluq, copper staining is also noted in the pegmatitic veins. Quartz veins with copper staining are observed in Maktal taluq. A quartz reef fringed by diabasic schist, outcrops between north of Siddapur and south of Benkanhalli in the porphyritic greissic country in Surapur taluq. This quartz shows an extensive staining of copper all along its run. Chalcopyrite and pyrites, malachite and cuprite are associated; and covellites are observed scattered in the quartz veins. Near the Parmanand hill, Surapur taluq, extensive spread of copper slag may be noted.

6 MANGANESE.

Manganese has not been widely reported in the State. The existence of Manganese in the Bidar

laterite near Halbarga about 16 miles north of Bipar is reported by Newbold. The laterite is said to have been traversed by a net work of veins of manganese ore about an inch thick consisting mostly of black manganese oxide with iron.

Occurrence of manganese¹ is noted near Rajampet and Kondapur in Kamareddi taluq, Nizamabad District. The ore occurs in association with calcareous nodules about 18 inches thick resting upon hard kukkar limestone and overlain by lithomarge and laterite soil. This area deserves special investigation. In the limestone area of the Surpur taluq² some manganeseiferous encrustations are frequently met with coating the limestone formations in the nullah cuttings where extensive soil erosion has taken place. In pyriteferous limestones north of Mudnur manganeseiferous coating is also frequently observed with ferruginous matter.

7. MICA

In parts of Armur taluq,³ Nizamabad District muscovite mica has been noted in pegmatites in association with tourmaline in the zone of contact of argillaceous sediments with pegmatites.

Mica occurs in flakes and books about 1½ to 2" sq. indicating economic possibilities in depth.

Micas of commercial sizes have been reported from near Khammamet in Warangal District.

In parts of Raichur Doab muscovite mica has been noted in the following localities. Near Yabballu in Gangawati taluq there are old workings for mica in pegmatite. The size of the mica is about an inch square and may perhaps improve in depth. The trial pits by some previous prospectors to the north of the village contain the rock debris where mica even 4" sq. was obtained in pegmatitic gneisses in Sindhur-Marli track.

1, 2, 3. Unpublished reports, Hyd. Geo. Surv.

4. Jour. Hyd. Geol. Surv. Vol. II pt. I pp 96-97.

About $\frac{1}{2}$ a mile south of Tawargeri-Kushtagi road mica bearing pegmatites associated with quartz veins occur. The average size of some of the surface specimens is about $1\frac{1}{2}$ inches. Payable mica in depth appears to be a possibility.

Along the eastern margin of the Surapur band of Dharwars white quartz reefs and coarse pegmatites occur along a strip of country about 7 to 8 miles long. Books of muscovite mica are noted in the quartz fragments strewn along the run of the band.

Small size mica and flakes are now in demand for making micanite and for dry lubrication along with graphite.

8 GARNET.

High pressure metamorphic minerals like garnets are rarely met with in the State. Only at some places small crystals of about $\frac{1}{2}$ " diameter of iron garnets are noted in association with mica in the Tawargeri area as well as in gneisses too small for marketing. Garnets for economic exploitation has been reported from Paloncha and Garibpet in Warangal District. It is interesting to note here that this part of Warangal District is a zone of hypo stage of metamorphism where garnetiferous gneisses and kyanite schists are reported to occur. Precious garnets are also reported in the water courses draining the hills composed of garnetiferous rocks from which they are derived as detrital products. Formerly large quantities of garnets are said to have been sent to Madras to be cut into semi-precious stones. The mining has since been in abeyance.

The following table shows the quinquennial output of garnets mined from 1910-29.

	lbs.	Rs.
1910 - 1914	13,630	7,798/-
1915 - 1919	2,32,612	1,02,580/-
1920 - 1924	62,517	47,218/-
1925 - 1929	28,443	8,232/-

9. GRAPHITE.

Graphite is reported from Paloncha in Warangal District in schistose garnetiferous gneiss in beds varying from a few inches upto 2 ft. in width. The graphite is much impregnated with earthy material. Good quality graphite has also been reported from the area and an improvement both in quality and quantity in depth is indicated. A small deposit of graphite is reported from near Hasanabad, Karimnagar District.

10. GALENA.

Galena is reported from Devarkonda taluq Nalgonda District at the contact of a greenstone dyke and coarse binary gneiss impregnated with quartz stringers. No in-situ occurrence has been noted.

A sample of galena from this locality assayed a high percentage of silver.

Samples of galena have also been reported from Warangal District.

Near Maski, Lingsugur taluq, some minor occurrence of galena has been noted in the schist dump near the old gold working. At Hunkuni, Deodrug taluq, galena is noted in the siliceous hornblendic schist as disseminated grains in the mineralised zone of the schist.

Good samples of galena was sent to this Department from Hyderabad from the pegmatites near Nawab Fakrul Mulk's Mansion and further beyond in Banjara Hills.

11. KAOLIN.

Abundant pegmatites and highly felspathic binary gneisses occur widely distributed throughout the Peninsular Complex in the State. The decomposition of the felspar according to the grade and stage

have yielded materials ranging from unaltered fels-pathic grits to decomposed calcareous products with very little kaolin and fine kaolinised clay. In areas under semi-arid conditions there is more of disintegration than decomposition and kaolin is rarely formed. Huge deposits of white calcareous earth are found particularly in the saline areas where the quantity of calcium carbonate practically forms the whole of the decomposed material with little or no kaolin.

An important deposit of kaolin is reported from Chintrala-in Nalgunda District where the material occurs in beds of considerable thickness in the area of highly decomposed pegmatites. This material is reported to be of high grade for ceramic purposes comparable with other high grade foreign kaolin. A sample from this locality gave the following assay:-

Silica	69.3%
Al ₂ O ₃	26.1%
Ca O	0.8%
Mg O	0.5%

Iron was detected in very small traces and the sample is practically free from carbonates of Ca and Mg.

12. SALT DEPOSITS.

The occurrence of common salt and brine is a very frequent feature in the neighbourhood of Dharwar rocks at or near their junction with the gneisses, particularly in the zone of pink pegmatites. This feature is commonly noted in the Raichur Doab, parts of Gulbarga, and Mahbubnagar Districts and also in areas where arid conditions prevail in other western districts of the State. Local salt industry has been carried on in such areas from a very long time and even now this exists in a straggling condition. Mainly two varieties of salts are produced viz. edible salt and "tanning" salt. The most important centres

of salt manufacture along saline nullahs are located in (1) Sarjapur Guddihal zone. (2) Sindhnur zone and (3) Lingsugur and Raichur taluq areas in the Raichur Doab. A sporadic distribution is also met with in other parts of the District specially in Mauvi fringing the Dharwarian belt where numerous salt works may be noted.

Another important centre of salt production is located in the Baichhal area, Surapur taluq, Gulbarga District. By far the greatest quantity of edible salt is produced in this area to meet the local demand. The Agni nullah is particularly saline and is a promising centre for an improved cottage Industry. Sahapur, Yadgir and Makthal also contribute a small percentage to the output. For purposes of local consumption edible salt is manufactured to a greater extent than the tannery salts. With a view to place this dying cottage industry on a sound economic basis an extensive survey of the saline areas of these districts has been conducted and investigations as regards the quality and quantity of brine in the test area in Sarjapur have been carried on and experiments on quicker methods by stack evaporation completed. The production as the figures show, if properly developed, will no doubt increase the total output considerably and meet the demand of the districts in which the salt occurs. Typical edible and tanning salts give the following analysis:—

	NaCl	Na ₂ SO ₄	MgSO ₄	MgCl ₂	H ₂ O	CaCO ₃	CaSO
Edible salt.		96.45%	1.23	-	.72	1.6	- -
Tanning salt.		37.9	42.11	11.45	-	-	7.6 .8

It must be borne in mind that even with the best effort, an increased output can only supply a fraction of the State. The possibilities of increasing the output of tanning salt is much wider, as it appears that

most of the weak brine which lie unused may in future be utilised under improved methods of production. The tanning salt is much in demand for curing raw hides in Raichur Warangal, Aurangabad and other places. An increased output will always find a ready market.

The average annual quantity of the edible and tanning salts produced in different centres at the time of visit is summarised as follows:—*

	Edible salt in bags of 2½ mds.	Tanning salt in bags.
Shorapur.	5,200	1,500
Shabpur.	454	...
Yadgir.	457	...
Makhtal.	403	65
Raichur.	2,550	560
Deodurg.	800	60
Gurgunta.	3,000	2,000
Lingsugur.	1,220	1,350
Kushtagi.	20	...
Gangawati.	284	...
Sindhnur.	2,894	1,560
Manvi.	1,116	312
Alampur.	...	...
	<u>18,400</u>	<u>7,407</u>

Exhaustive reports on salt indicating the possibilities of its future development have been published in the Departmental publications and in the publication of the Commerce and Industries Department. Other reports are in the press. Associated with the common salt, as the above chemical analyses reveal, there are sodium sulphate, magnesium chloride, magnesium sulphate, calcium sulphate, calcium carbonate etc, which occur in the brine or as saline efflorescence. It is needless to point out the commercial value of most of these salts. When the local salt industry is placed on an economic footing

* Dept. of Com. & Ind. Hyd. Bulletin No. 11. 1934

with an increased output, these salts, separated by fractional crystallisation, will undoubtedly find a ready market with a more increased return than what ordinary crude tanning salt would yield.

In parts of Yadgir and Makhtal taluqs the saline efflorescences in the nullah basins yield a very good percentage of sodium sulphate and carbonate locally known as "Soudu". These, on treatment, have yielded soda for the manufacture of local glass industry which is being carried on from very ancient times.

With the improved methods of separation and manufacture of soda and with facilities for glass industry on modern lines, these ancient glass and bangle making industry should naturally find a great impetus.

SALT PETER.

In the arid parts of the State, where humidity combined with a low diurnal range of temperature favours the growth of nitrifying micro-organism. Salt peter is mostly manufactured from the earth under the refuge heaps of big villages where such accumulations have continued for ages.

The manufacture of nitre¹ is even now carried on at Maski, Mudgal Sindhur, Koratgi, Manvi, Watgal, Gabur, Hirebodur, Santikellur, Kotankal and other areas in the Raichar Doab and at number of localities in Surapur taluq particularly at Kembhavi, Yelgi, Kudligi and in Makhtal. The crystallised salt is mostly utilised within the State for making fireworks and gunpowder.

DHOBIES EARTH.

In low swampy areas along nullah basins where date and toddy palms flourish luxuriantly and in the

bed and banks, of drying tanks, a kind of white earthy encrustation is scarped by the local dhobies for washing purposes. This efflorescent earth mostly consists of carbonate of soda with subordinate quantity of sodium chloride and magnesium chloride. This encrustation is extensively formed after the rains. The soda earth is also used in making soda ash for glass bangle industry.

13. OCHRE.

Ochre of various colour and ochreous lithomarge and bole suitable for pigments occur in various parts of the State. The chief deposits are found in association with the Dharwar magnetite haematite schists and quartzites, in Deccan Trap laterite areas and also in areas where ferruginous materials are found concentrated undergoing decomposition. The Kushtagi band of ferruginous quartzites is noted for extensive ochreous deposits'. Both reddish chocolate, purple and yellow limonitic varieties are commonly met with in the zone. They are very fine in texture and do not require much sifting and are mostly now being used for painting the mud walls and the wood structure of village houses.

Very fine ochre is found in association with the laterites and is available in various shades of scarlet, purple, chocolate, yellow etc. Ochres of fine quality and colour are reported from Vikarabad lateritic area. There is a good supply of this raw material for a silicate paint industry, and some of it is being employed in the Hyderabad Paint Factory (The Deccan Paint Works.)

14. FELSPARS AND MATERIAL FOR CEREMIC INDUSTRY

Felspars occur in great quantity widely distributed throughout the Peninsular Gneissic Complex area particularly associated with pegmatites. These pegmatites are also noted extensively fringing the Dharwar bands sometimes as tabular masses and sheets in the Raichur Doab.

A few localities may be noted below whence felspars of good quality and appreciable quantity are obtainable.

1. The neighbourhood of Matmari, Partipalli and Turkandoddi, Raichur taluq. ¹ (Matmari is a Ry. Station south of Raichur M. S. M. Ry.).
2. Between Basanapalli and Mamnnapur (Makhtal taluq), Mahbubnagar District ².
3. Near Kotakunda, ³ Makhtal taluq, Mahbubnagar District.
4. Between Bhirapur and Siddapur ⁴ in Surapur taluq, Gulbarga District.
5. Extensive quantity of felspar ⁵ has been noted in the pegmatite veins at Dantur, Allagutta, Onagepet and Drugpalli and at the foot of Godkol ranges, between Sankotah and Morthad and in other places in Armour taluq, Nizamabad District.
6. At Yadullah Hosseni Pahad ⁶ in Kamareddi taluq, Nizamabad District.

With the abundant occurrence of potash felspars and a noted deposit of kaolin at Chitralla, the possibilities of a ceramic industry are encouraging and it is interesting to note that there are enquiries and attempts for private enterprises for ceramic and enamel industry in the State.

1. Jour. Hyd. Geol. Surv. Vol. III pt. 1, in the press.

2. Jour. Hyd. Geol. Surv. Vol. IV pt. 1, under preparation.

3. do do do do do do do do

4. do do do do do do do do do

5. Unpublished reports of the Department.

6. do do do

15. GLASS INDUSTRY.

The raw materials for the manufacture of glass are silica in form of powdered quartz or sand and alkali as sodium carbonate (soda ash) or sodium sulphate. If lime is added a less fusible and harder glass results. Alumina is to be added for specially hard and heat resisting glass ware. Borax is often used when clear optical glass is desired. Colouring agents are added for the colour desired.

Requisite raw materials are available in large quantity in the State to encourage glass industry provided the products can stand competition in the market. Quartz occurs abundantly in form of veins and purer form of quartzites in the Peninsular Complex, Dharwar areas, as well as in the Sedimentaries. Huge dumps of fine powdered quartz are available in the abandoned mining areas of Hutti and Wandalli which may be profitably used for a glass industry. The brine and saline efflorescences, particularly in parts of Yadgir and Makhtal taluqs, yield requisite quantities of sodium carbonate and sulphates which may be easily separated from other impurities.

Glass and bangle-making industry has long been in existence in the State and evidences of indigenous glass works are found near Gazulpet and Manikonda¹ etc, testifying to a flourishing condition of this industry in times past. This crude method of manufacture without modern equipment has received a set back due to the influx of cheap foreign material which has swamped the market and given a death blow to this ancient cottage industry. It is encouraging to note that a glass factory has been started near Hyderabad whose development is watched with interest. With the abundance of raw material and the encouraging progress shown by the existing factory, it is hoped that ere long, new enterprises in the line will be forthcoming.

¹ Jour. Hyd. Geol. Surv, Vol: IV pt I under preparation.

16. ILMENITE.

This is a mineral commonly found associated with the basic rocks. It is often noted as a colloidal coating on rock boulders in streams and rivers and as sifted black sand deposited along streams or river banks. Methods of magnetic separation and extraction might afford a commercial possibility for this mineral. A fairly scattered deposit of this ilmenitic sand has been noted along the Kistna river near Jaldrug fort.

17. KYANITE.

Voysey¹ reports the occurrence of kyanite in abundance in association with garnet at Garibpet, Warangal District.

18. SEMI PRECIOUS STONES.

Opal, chalcedony, jasper, bloodstone, plasma, agate etc. occur in amygdules in the amygdaloidal layers of the Deccan Traps in a widely scattered manner. Amethystine quartz is often found in some of the quartz veins in the gneisses.

19. ZEOLITES.

Stilbite and natrolite occur abundantly in the zeolitic amygdaloidal layers of the Deccan Traps. They may be commercially exploited for softening and purifying water for town water supply schemes.

20. PYRITES.

Pyrites occur associated with the auriferous quartz reefs of the Dharwars and as disseminated grains in hornblende schists. They are met with in the limestones of the Ehima series. Nodules of pyrites occur with coal beds of the Barakar series in the Singareni and Sasti coal mining areas. Pyrite was also reported from Mudnur, Sarapur taluq but a survey could not locate any extensive deposit.

21. CORUNDUM.

Fragments of corundum are reported: from the water courses draining the Kannigiri hills, also from the fields near the villages of Gobuguru, Bunjur, Golguda in Warangal District. Emery-like stone is reported from Amrabad², Mahbubnagar District.

22. ANTIMONY.

Stibnite is reported to have been found in a well at a depth of 34 feet from Yenchapali in Karimnagar District.

23. TALC AND SOAPSTONE.

Talc schists are often found in the talc-chlorite series of the Dharwars in Kushtagi band of schists and in the Parampur schist belt of the Raichur Doab. Fine bands of talc occur fringing the ferruginous quartzitic bands near 20th milestone on the Lingsugur-Tawargeri road.³

Varieties of soapstone and potstones occur commonly as alteration product of the amphibolites and peridotites. Potstones are reported from Maitpalli in Karimnagar District and Damenapalli in Warangal Districts. Potstone locally known as Bulpham occurs as alteration product of amphibolitic rocks at Chootpali,⁴ Armour taluq.

Impure varieties of soapstone are also observed near Abhangapatam⁵ in Makhtal taluq and at Arewatla and Lamur⁶ in Atraf-i-Balda.

1. Walker A. M. Mad. Jour. Lit & Sc. XVI 1850.

2. Imp. Gazettier of India, Hyderabad State 1903 p. 145.

3. Jour. Hyd. Geol. Surv. Vol. I & Vol. II pt. 1.

4. Unpublished report of Hyd. Geol. Surv.

5. Jour. Hyd. Geol. Surv. Vol. IV pt 1 under preparation.

6. Unpublished report of Hyd. Geol' Surv.

Soapstones occur in the Dharwar schist patch near Malkapali,¹ Seram taluq. Gulbarga District, where a small ridge is wholly composed of this material.

24. LATERITE AND ALUMINOUS BOLES.

Both high and low-level laterites are met with within the State. Laterite occurs extensively covering wide areas in the upper layers of the Deccan Trap. This is also met with in gneissic areas developed under semi-arid and tropical conditions. Extensive formations of laterite in Bidar, Vickarabad, parts of Nizamabad, at Rajungutta hill of Godkol and at Basiralagutta of Rawatla, Armour taluq² and Asifabad³ have already been noted for their utility as an economic source of iron. The ratio between the iron-oxide and alumina varies considerably, so that the laterites approximate on one hand to high grade iron ores, and on the other, to almost pure bauxite. The percentage of iron-oxide in the Nizamabad laterites⁴ varies from 13.9 to 60.98 while that of alumina from 55 to 36%. Samples of aluminous bole from Goorgakuntla, Kamareddi taluq and Kyrtlaquilly in Yellareddi taluq assay 25.5 and 36.3% of Al_2O_3 , respectively.⁵ These boles are invariably whitish to purplish blue to lighter shades and consist of fine aluminous materials from which most of the iron oxide has been eliminated.

At Godkol and Basiralagutta of Rawatla in Armour taluq, bluish aluminous clay galls occur associated with lithomarge from lateritoid accumulations.

25. CLAYS.

Clays of various qualities are found widely distributed in the State and they may be generally classified according to their utility.

1. Jour. Hyd. Geol Surv Vol. IV pt. I under preparation

2. Unpublished reports of Hyd Geol Surv.

3, 4, 5. do do do do do

Potter's clay.
 Brick earth clay.
 Fire clay.
 Lithomarge, maris etc.

The true clays are all plastic and refractory to a great or less degree and on this property their value for industrial purposes depend. The ordinary clay and silt found in vicinity of villages are largely utilised by the potters and brickmakers for their specific purposes. Good quality deposits of clay silt¹ for the potter has been noted at Upal Mailawaram, Kotalapuram, Amjapur Balapur etc in Atraf-i-Balda and near Bhongir which is noted for its potteries. In the neighbourhood of Mallur and Tirth in Surapur Taluq, Bhima shales are extensively used for pottery which are highly prized.

BRICK EARTH.

Poor quality brick earth is widely distributed. The bricks made therefrom fail in the main essentials—strength, durability and regularity in shape, Good quality bricks are however obtained from Sarunagar and Golkonda which partly meet the demand from Hyderabad. Bricks are also made near Bhongir.

FIRE CLAY.

Heat resisting clays suitable for making fireproof materials are obtained in association with the coal beds of the Barakar series. Reddish fire clay² is found as a bedded deposit overlying the coal in the hills south of Antargaon in the nullah sections below the red clays of the Kamthis, near the border of Sirpur and Rajura taluqs. Fire clays³ has been reported by Voysey, from Konasamudram, Nizamabad District. This clay was used for furnaces and making

1. Unpublished reports

2. do do

3. Jour. A. S. B. I. 1832.

erucibles for the steel manufacture by the old iron smelters. The clay is reported to be highly refractory. Extensive deposits of red lithomarge clay are often met with under the lateritic cappings and in between the Deccan Trap flows as decomposed materials.

Near Wadagaon ¹ in Osmanabad Taluq, Shiral in Paranda Taluq and in southern parts of Asti Taluq, Bhir District as well as in Gurumatkal plateau in Yiadgir Taluq extensive deposits of red lithomargic clay occur below the laterite capping. Lithomargic clay is also widely met with near Kondapur in Kamareddy Taluq, Nizamabad District. Ocherous lithomarge in the Jajadgudda hills, Kushtagi taluq, Raichur District is widely noted along the margin of the ferruginous quartzitic band.

26. MATERIAL FOR CEMENT MANUFACTURE.

The Purana sedimentaries of the Bhima and the north Kistna basins afford materials for cement manufacture. The limestones and shales near Sahabad yield excellent materials and a cement Factory is working very successfully at Sahabad controlling major portion of the South Indian Market. The Matur Project drew its cement supply only from this Factory. The following statement gives the quinquennial output and value of cement manufactured in the Sahabad Cement Work between 1925 - 34,

		1925—29.	1929—34.
Cement	Output. Tons.	1,94,170	5,49,734
	Value. Rs.	70,09,793/-	1,83,72,201/-

Limestones assaying on an average 87% Ca CO₃ with negligible traces of magnesia and iron are obtained at Wazirabad in Nalgonda District. Shales

of required quality are also found extensively. The Bhima limestones¹ on the west of Surapur Taluq are suitable for cement manufacture and a specimen from Yedihalli-Hebbal plateau assayed as follows:—

Ca CO ₃.	....	92%
Mg CO ₃.	...	1.2%
Insoluble (Mostly silica)		6.8%
Fe.	...	in traces.

As there is no dearth of iron-free limestones and shales suitable for cement manufacture in the Bhima and the Kistna basins a wide field and opportunity for extensive development of this Industry is afforded.

27. SPRINGS AND MINERAL WATERS.

Along the margin of the Chikiala range in Sirpur Taluq, Asifabad District, many natural springs are noted at the junction of sandstones and clay beds, the notable among them being near Bijur and Hutpali.²

At the contact of the shales and limestones of the Bhima series in Surapur Taluq natural springs occur which occasionally feed some perennial streams.³

At Wajal and Mudanoor perennial warm mineral water springs with copious discharge have been noted. Water is insipid to taste. At Buga in Warangal District, a hot spring, with a temperature 110°F. forms a pool 40' x 30' and about 5' deep, but the discharge is small. Hot springs are also noted at Unkeshwar, Kinwat Taluq, Asifabad District. These springs are well known for their medicinal properties.

At the junction of the Dharwar Schists and gneisses perennial springs are common. Such springs are seen at Pamankallur, Hira, Chikbergi, Todgi, etc., in Raichur Doab.

1. Jour. H. G. S. Vol. IV under preparation.

2. Unpublished reports of Hyderabad Geological Survey.

3. Jour. H. G. S. - Vol. IV. - Pt. 1 under preparation.

28. WATER FALLS.

With big rivers like the Godavari, Kistna, Tungabhadra, Manjra, flowing through the state, the economic possibilities of hydro-electric schemes may not be lost sight of. The Jaldrug falls has been made famous by Col. Medows Taylor. This has a total fall of about 140 ft. distributed over a distance of about a mile and a half with a number of small cascades, the biggest of which has a vertical fall of about 60 ft. The Gollapalli falls in Gurgunta Samasthan discends in two stages down a vertical height of 97 ft.

Southada falls in Bir District in a tributary of the Sena River has a considerable catchment within the State limits which descends vertically down to about 230 ft., at the scarp of the Deccan Trap plateau, sheltered under a V shaped valley. After the fall, the river flows for about a mile in this State before it enters Jamkhed Taluq in Abamadnagar District. Except for about 2 months in the dry season, the stream is said to have a surface flow. With a dam raised to about 50 ft. near the scarpment, the continuity of the flow of the stream at a uniform rate may be maintained throughout the year. The conditions are, ideal for an hydro-electric scheme and the excess of power generated may be easily sold to the mills in the British Indian Districts.

A perennial stream rising in the Deccan Trap Table land, gives rise to a fall of about 80 ft. in the gneissic country about a mile to the south-east of Gurumatkal. This water may well be regulated for a suitable hydro-electric installation to provide power to the taluqs and particularly to Narayanpet which is a growing commercial centre about 10 miles from the site of the falls.

A vertical fall of about 15 ft., is noted at Chennur, on the Hunsgi nullah, which is perennial.

In Yelgurap Taluq, Asifabad District a vertical drop of about 120 ft. in Kadam river seems to command an ideal site for hydro-electric scheme to supply the District.

A minor fall has been noted at Wajia in Kinwat Taluq with a drop of 25 ft.

Picturesque water falls lend charm to the wilds of Aurangabad trappean plateaus, particularly near Ajanta.

29. BUILDING STONES.

The many historic edifices, forts, temples, mosques and mosoleums etc., are the standing monuments of the quality, durability, beauty and variety of the building stones with which the State abounds. The Lingampalli granite¹ near Hyderabad proved superior to Abardeen granite and was exclusively used for Bombay Harbour construction. The granites of Munirabad and at Raichur are of exceptionally quality for heavy construction. The world famous caves and rock cut temples of Ellora and Ajanta have been chiselled out from solid trap rocks and have stood the ravages of time. The variegated colour of granites and gneisses, the decorative value of porphyritic granites, red syenites, banded gneisses, the coloured sandstones and limestones of the Purana and the Gondwana formations, the red and black trap rocks and the laterites, supply unlimited resources for building materials which have been extensively used.

The slaty Dharwar trappoids make good flooring and roofing material in the Raichur Doab.

1. Hyd. Geol. Sur. Bull. No. 1:- The granite quarries in Hyderabad and its neighbourhood have received special attention by K.A.K. Hallows of the Geological Survey of India who has studied and tabulated the various physical properties and crushing tests of the building stones available.

The rocks of the Peninsular complex yield building material of varied types both for massive construction and decorative purposes. Huge slabs and pillars even 30 ft. to 40 ft. long are not uncommon in the temples of Deccan.

Granite slabs are quarried at Rampur and Raichur. In Mauvi between Bayalmerchaid and Nirmanvi, some quarries yield long pillars. Satpahar hills in Gangawati, Mudgal, Masarkal-Gabur in Deodrug Taluq are few of the instances where extensive quarrying is being carried on even to-day. The Baragaz pahar about 2 miles from Mudgal is said to have yielded the material for Mudgal Fort in which pillars of about 30 to 40 ft. high has been used. One of the old quarries exposes a face 40 ft., in length 15 ft. breadth and about 15 ft. in depth from which pillars were cut. Partially worked stones are still seen lying in the vicinity. Lingampally and various other centres near Hyderabad have long been known to yield excellent building material.

The Purana series of rocks yield unlimited supply of limestones both as massive varieties and as flags well suited for constructional purposes. The different shades of colour like black grey and lilac yield decorative materials. The grey variety of limestone is by far the most extensive in occurrence and has been mainly used for flooring and ceiling. Extensive quarrying for flagstones is carried on in Sahabad, Wadi, Chitapur, Tandur, Seram and other places in Gulbarga District. These quarries are leased out and are in the hands of private Companies and individuals paying fixed royalty which adds considerably to the revenue under Mines.

The limestones fringing the Gondwana formations in the Adilabad, Karimnagar and Warangal Districts offer attractive material for lithographic stones.

Black limestones of Surapur Taluq near Kolihal, and of the hills north of Luxetipet in Asifabad District occur extensively but are not worked on any commercial scale for want of transport facilities. From South of Farukabad in Mabbubnagar District bright brick-red varieties of laminated limestone is reported. Near Wazirabad, Mirialguda Taluq, Nalgonda District variegated and multicoloured limestones are extensively met with. On the British side of the Kistna River similar limestones are quarried and many articles of novelty like paper weights, tablets, table-tops etc., are being made and marketed. Yellow limestone is found near Nalwar, Gulburga District.

The output of quarried limestone has steadily been increasing. The following table will show the quinquennial output and value of the quarried flagstones.

	1915-19	1920-24	1925-29	1929-34
Flagstones: Output	87,32,092	1,90,20,623	1,95,24,539	1,56,55,051
Sft.				
Value Rs.	2,61,963	5,70,618	5,85,736	4,69,652

In the Sangora bank of the Warda river in Rajura Taluq highly crystalline limestones approaching marble have been noted.

Extensive occurrences of marble has been reported from Warangal District, near Yellandu Tasthapalli. The marble near the former village is being quarried by a private Company. After cutting out blocks from the quarries for making flooring tiles, table tops, and other decorative articles, the waste chips are used for making marble lime which are claimed to have better properties of setting, strength and finish than the ordinary lime prepared from kunkar.

Pink, grey and buff coloured sandstones of varying grades of texture are extensively developed both in the Purana rocks as well as in the Gondwanas. The sandstone quarries of Hanamsagar, Raichur Dist. yield material for building purposes and also for making millstones. The iron-free Barakar and Kamthi sandstones are used in Rajura, Chinur and other Taluqs in Asifabad District.

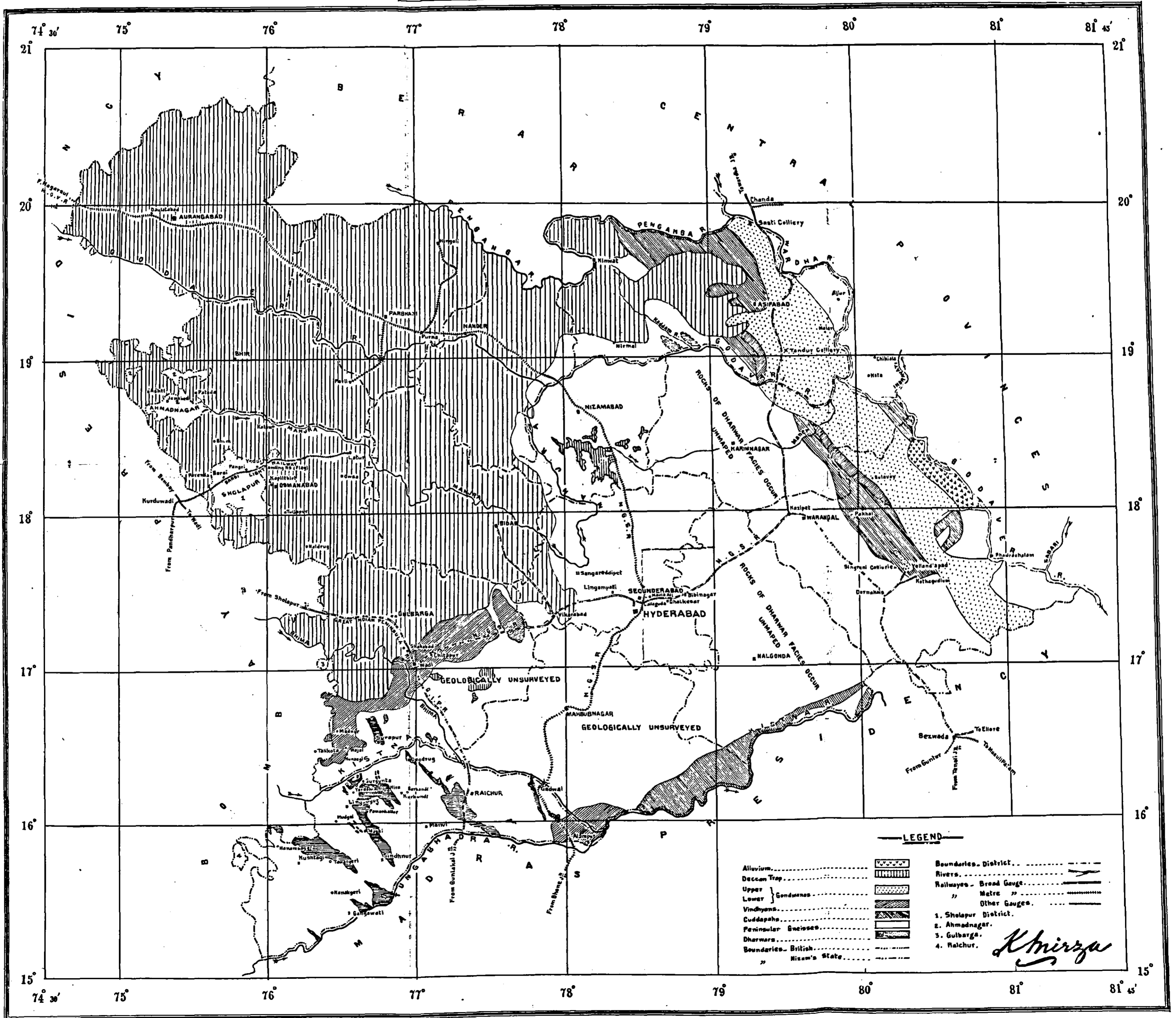
Good building materials are easily obtained from Deccan Trap areas where layers of hard fine andesitic varieties are particularly suitable. Basaltic and porphyritic layers yield decorative varieties. The red andesitic varieties form excellent decorative stones. The black and red varieties are used for floral designs in the Mosuleum Bibi-ka-Makbara, Aurangabad.

Lateritic blocks of suitable size and shape are cut out of the lateritic layers in Bidar and other places and extensively used for minor constructions. The Bidar lateritic blocks find market outside the State.

The numerous quartz veins and reefs, dolerite and epidiorite and trap dykes yield unlimited material for road construction.

GEOLOGICAL MAP OF H. E. H. THE NIZAM'S STATE

Scale 32 Miles = 1 inch



LEGEND			
Alluvium.....		Boundaries - District.....	
Deccan Trap.....		Rivers.....	
Upper Gondwana.....		Railways - Broad Gauge.....	
Lower Gondwana.....		" Metre ".....	
Vindhya.....		Other Gauges.....	
Cuddapa.....		1. Sholapur District.....	
Peninsular Gneiss.....		2. Ahmadnagar.....	
Dharwad.....		3. Gulbarga.....	
Boundaries - British.....		4. Raichur.....	
" Nizam's State.....			

K. Mirza

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