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Part 1.—Annual report for 1887. Geology of Upper Godavari basin, between river Wardha and Godavari, near Sironcha. Geology of Kashmir, Kishtwar, and Pangi. Siwalik mammals. Palæontological relations of Gondwana system. ' Erratics in Punjab.'

Part 2.—Geology of Sind (second notice). Origin of Kumaun lakes. Trip over Milam Pass, Kumaun. Mud volcanoes of Ramri and Cheduba. Mineral resources of Ramri, Cheduba and adjacent islands.

MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA

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VOLUME XLIII, PART 1.

INDIAN GEOLOGICAL TERMINOLOGY. BY SIR THOMAS H. HOLLAND, K.C.I.E., F.R.S., *Professor of Geology, Victoria University of Manchester, and* G. H. TIPPER, M.A., F.G.S., *Geological Survey of India.*

Published by order of the Government of India

CALCUTTA:
SOLD AT THE OFFICE OF THE GEOLOGICAL SURVEY OF INDIA,
27, CHOWRINGHEE ROAD

LONDON: MESSRS. KEGAN PAUL, TRENCH, TRUBNER & CO.
BERLIN: MESSRS. FRIEDLÄNDER UND SOHN.

1913.

PREFACE.

THIS glossary of the terms which have been used by geologists in India has grown out of rough notes made from time to time for my own private use when, as Director of the Geological Survey, it was one of my duties to edit the departmental publications. Some of the terms naturally came into more frequent use than others and for these the definitions were often reviewed and repaired. As the definition in this way gradually became fixed, the notes in turn proved to be of practical assistance in editing the reports and memoirs prepared by junior officers, and thus arose the idea of completing the glossary and of publishing it for the general use of those within and without India who have now to handle a literature that is becoming inconveniently extensive.

In a few instances also the meanings of terms grew and sometimes became modified by personal discussion among the officers of the Department, without formal publication of the circumstances. In other cases terms were used at first in a tentative way when there was insufficient ground for giving them a formal definition; these sometimes became fixed and recognised and at other times became discarded, neglected or superseded. A beginner in Indian geology would thus naturally find it difficult to trace the terms to their origins, and might be puzzled by apparent inconsistencies between the old and the modern literature.

It was only after leaving the service that I found time sufficient to undertake the necessary mechanical work of piecing together the notes, summarising the extracts from literature, of checking the co-ordinates of the localities quoted, and of reducing the entries to some approach to that uniformity which is necessary to make a work of reference of practical value.

I have taken advantage whenever possible of the advice and help of many friends who have intimate knowledge of special sections of Indian Geology; to these, as they well know, I am ever grateful. But I ought specially to mention the great assistance that I have received from my colleague, Mr. G. H. Tipper, whose unusually wide knowledge of the literature has enabled him

to add a large fraction of entries, to extend many of my own notes and to modify the definitions given.

With an active body of geologists at work our knowledge of India is growing daily, and thus, like a dictionary in dealing with a language, such a glossary as this must be out of date before it is issued. Still, the notes have now reached a stage when they might be of use to young students and, in spite of their shortcomings as well as their errors, they ought to be of more value published than if kept any longer for mere private use. Publication is the only way to obtain the practical criticism of a large body of workers, each of whom in his own sphere will be able quickly to supersede each special entry. The critical remarks of such workers will be welcomed and will be turned to account in preparing future editions.

T. H. H.

Alderley Edge,
June 3rd, 1913.

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INTRODUCTION.

Previous to the formation of an official Geological Survey Department in 1856 various isolated observations regarding the geological features of India had been collected and published by independent workers, some of whom were enthusiastic amateurs devoting their leisure time to the work, while others were employed by the East India Company for special enquiries. The earliest investigations were undertaken through the agency of the Topographical Survey Department, Mr. Laidlaw being attached to Captain Webb's party in Kumaun in 1817 and Dr. H. W. Voysey being appointed to accompany Colonel Lambton in 1818. Among those who followed these pioneers may be mentioned :—

J. Adam (1821-42), J. Prinsep (1825-38), J. D. Herbert (1825-44), J. Franklin (1826-35), G. G. Spilsbury (1827-44), P. T. Cautley (1828-60), J. Calder (1829-33), J. Hardie (1829-34), J. G. Malcolmson (1831-46), H. Piddington (1831-57), H. Falconer (1831-65), R. Everest (1831-42), J. F. Royle (1832-57), T. J. Newbold (1833-48), W. E. Baker (1834-57), R. B. Smith (1834-45), M. Vicary (1835-53), P. M. Benza (1835-37), G. Fulljames (1836-61), J. McClelland (1837-55), S. F. Hannay (1838-56), J. Campbell (1839-46), C. T. Kaye (1839-46), G. Buist (1843-60), W. S. Sherwill (1845-58), R. Strachey (1847-56), E. O'Riley (1847-64),

A. Fleming (1848-54), H. J. Carter (1848-61), A. Hunter (1850-71), and S. Hislop (1855-64).[1]

The majority of these authors described mineral occurrences and features of physical geology without introducing or discussing questions of terminology of a kind dealt with in this paper. Attempts were made, however, to classify the Indian formations, and to form some idea regarding their position in the European stratigraphical scale. The earliest general account of the country was due to J. Calder,[2] who in 1829 published his summary as a preface to a series of papers by Franklin, Voysey, Hardie, Jones and Coulthard.

Calder's summary touched very lightly on the sedimentary formations, about which there was at the time very little information available. He gave an account of the nature and general distribution of the fundamental crystalline rocks, of the overlying sheets of basaltic lava (now generally known as the Deccan Trap), and of the coal-measures (now Gondwanas) in the Damuda valley. No special questions of nomenclature were introduced other than those that require translation in accordance with the general changes which have taken place in the use of geological terms, although Calder accepted Franklin's erroneous conclusion that the Vindhyan sandstones and limestones represented the English New Red Sandstone and Lias.

Between 1833 and 1850 Captain T. J. Newbold published various papers, his numerous observations being summarised in a series of papers published by the Royal Asiatic Society.[3] As a contribution to detailed local knowledge of the rocks and of the economic mineral products, Newbold's summary was a remarkable piece of work. He naturally used terms that were then current in geological literature and was evidently familiar with the most recent developments of geological science in Europe at the time. He gives the following table of formations in Southern India :—

Supra-cretaceous or Tertiary Strata.

1. Sandstone of Coromandel, imbedding existing shells.
2. Coromandel black clay and Regur (Pliocene).

[1] The figures in parentheses refer to the years in which the authors mentioned published papers on Indian geological subjects. This list includes the more important contributors. A much fuller one will be found in R. D. Oldham's Bibliography of Indian Geology, Calcutta, 1888.

[2] General Observations on the Geology of India. *Asiatick Researches*, XVIII, part 1, pp. 1—22, 1829.

[3] Vol. VIII, pp. 138, 213, 315; 1844. Vol. IX, pp. 1, 20. Vol. XII, p. 78.

3. Ancient Kankar and Gravel, imbedding remains of Mastodon (Pliocene).
4. Silicified wood deposits of Pondicherry and older Laterite.
5. Fresh-water limestone of Nirmul, Hyderabad and Rajahmundry (Eocene).

Secondary Strata.

6. Limestone beds of Trichinopoly, Verdachellum and Pondicherry (Neocomian or Lower Chalk).
7, 8 & 9. Diamond Sandstone Group (Carboniferous or Devonian).

Hypogene Series.

Volcanic and plutonic rocks.

Among the plutonic rocks, regarded by Newbold as intrusive into the gneisses and schists, were included the gneissose granites which form conspicuous tors of jointed blocks in the Bellary district and other parts of South India. By the earlier workers on the Geological Survey these rocks were grouped together under the general name of Bundelkhand gneiss, and were regarded as constituents of the gneissic complex more thoroughly metamorphosed than the conspicuously banded forms; they were consequently regarded as probably the oldest parts of the complex. Similar ideas prevailed elsewhere, in Canada, for instance, where the corresponding massive crystalline rocks were known as the Laurentian division of the basement gneisses. Recently, however, there has been a tendency to revert to the ideas which governed Newbold, and to regard these gneissose granites and many other sections of the crystalline complex as igneous instrusions, sometimes older and sometimes younger than the associated gneisses and schists, being batholiths of granite, syenite, diorite and gabbro rendered gneissose in structure by earth pressures, either during or subsequent to their irruption. (*Cf.* T. H. Holland, *Memoirs, Geological Survey of India*, Vol. XXVIII, 1900, 119, 242; Imperial Gazetteer of India, New Ed., Vol. 1, 1907, 59.)

Dr. H. J. Carter's[1] summary, which appeared first in 1854 and was afterwards reprinted in 1857, was a very much more ambitious attempt to classify the formations then known in India. Subse-

[1] Summary of the Geology of India, between the Ganges, the Indus and Cape Comorin. *Journal, Bombay Branch, Royal Asiatic Society*, Vol. V, p. 179, 1854.
Reprinted with footnotes in "Geological Papers on Western India," p. 628, 1857.

quent observations, however, have shown that the attempt was very largely premature; for Dr. Carter grouped together the Gondwanas with the much older Transition and Vindhyan systems, increasing the prominence of the error by correlating all these sediments with the "Oolitic" series of Europe. He regarded the trap sheets of the Bombay Presidency as intrusive, whereas subsequent observers agree in considering these to be normal effusive lava-flows. Although marked by errors of classification and correlation, Dr. Carter accumulated a large quantity of valuable detail, both palæontological and stratigraphical. His classification of the Indian formations is shown in the following table:—

Provisional Table of the Igneous and Sedimentary Rocks of India.

(H. J. Carter, 1854.)

	XIII. Recent	Deposits now taking place.	
Post-Tertiary	XII. Post-Pliocene	Sands Shells, and Conglomerates. Upper Blue Clay. Kankar (Travertin). Regur. Kankar	X. Trappean Effusions, 2nd Series.
Tertiary	XI. Pliocene	Semi-consolidated or loose calcareous or siliceous Sands, Grits, Shells, and Conglomerates. River Conglomerates. Old Kankar.	
	Miocene	Solid, coarse, shelly Limestone. Oyster-beds. Calcareous, argillaceous, quartzose or sandy Conglomerates. Lower Blue Clay. Ossiferous Conglomerate.	
		IX. Intertrappean Lacustrine Formation	VIII. Trappean Effusions, 1st Series.
	VII. Eocene	Nummulitic Beds and White Marl.	

Provisional Table of the Igneous and Sedimentary rocks of India—contd.

(H. J. Carter, 1854.)

Secondary	VI. Cretaceous	White Limestone, Arabia and Sinde ? (1,400 feet ?).		
		Upper Greensand and Gault (Albien, D'Orbigny), Trichinopoly, and Verdachellum.		
		Lower Greensand (Neocomien, D'Orbigny), Pondicherry.		
		Diamond Conglomerate ?		(Trappean Effusions ?)
		Punna Sandstone		Eruption of Felspathic and Hornblendic Rocks.
			Shales. Limestone. Coal.	
	V. Oolitic	Kattra Shales	Cutch. Pondicherry.	
		Tara Sandstone. (Old Red ? McClelland.)		III.
Primary	IV. Cambrian and Silurian. (McClelland.)	Transition Gneiss, with micaceous and hornblende Schistose beds.		
		Newer Clay Slate, with quartzose and steatitic Sandstone beds		Eruption of Felspathic Rocks.
	II. Metamorphic Strata.	Gneiss. Mica Schiste. Hornblende Schiste. Clay-slate. Granular Limestone		I. Primitive Plutonic Rocks.

In his explanation of a general geological map of India, G. B. Greenough (*Report, Brit. Assoc.*, 24th Meeting, Liverpool, 1854) referred to the "prodigious quantity of plutonic rock, which occupies both the northern and southern portions of India" as the product of many epochs. He consequently did not separate an older fundamental complex of crystalline rocks as distinct from the sedimentary systems. The latter he classified as follows :—

Post-Tertiary, including *regur*, or black cotton soil; *kankar*, or concretionary calcareous material; laterite and beds of black clay

and lignite of the Travancore coast, presumably the Warkalli beds of King.

Pliocene and Miocene.—The beds mentioned include the Siwaliks of the Salt Range and the Sub-Himalaya, as well as the ossiferous deposits of Perim Island.

Eocene.—The beds so classified included the formations now known as the Yenangyaung series in Upper Burma, the Intertrappean beds of the Deccan, and from an erroneous conclusion of Colebrook, some shales in the Karharbari coalfield.

Nummulitic beds are mentioned as occurring around the Persian Gulf, near Cabul, Western Himalaya, Suleiman Hills, Sind and Assam.

Cretaceous.—Said to occur near the head of the Persian Gulf, Pondicherry (on the authority of Forbes regarded as Neocomian), Verdachellum and Trichinopoly, regarded as equivalent to the Upper Greensand and Gault. D'Orbigny's opinion that the South Indian beds are Senonian in age is quoted.

Jurassic and Oolitic.—The beds now known as the Umia series of Cutch were regarded as Callovian.

Oolitic Coal.—The Peninsular coal was described as equivalent to the Brora coal in Scotland.

Oxford Clay.—The well-known Spiti shales were evidently referred to under this head. The Jurassic limestones of Rajputana were also recognised, but were confused with the Makrana marble of much older age. Evidently due to the mistake of Carter, the "diamond sandstone of Golconda," other beds of the Kurnools and Cuddapahs, as well as the Gondwanas of the Central Provinces were regarded as Oolitic in age.

Burdwan Coal.—Reference is made to the fact that some of the fossil plant genera in the coal of the Burdwan district occur also in the English Coal-Measures; but the Gondwanas of the Central Provinces with *Glossopteris*, *Vertebraria*, etc., under the Deccan trap are referred to as Jurassic.

Trias.—The red sandstones of the Vindhyan system are referred to as similar to the salt-bearing New Red Sandstone of England. The occurrence of marine Triassic limestones in the Central Himalaya was known at the time from the work of Sir R. Strachey.

Carboniferous Limestone.—The only formation referred to under this head was that now known as the Productus Limestone of the Salt Range.

Devonian ?.—The salt marl of the Salt Range was considered to be probably Devonian on account of the observation of Dr. Fleming that it occurred under the Carboniferous (Productus) Limestone.

Silurian.—A brief reference is made to the occurrence of Silurian trilobites and other fossils in the Central Himalaya.

It will be noticed that, while Greenough's notes, by including the discoveries of Strachey and Fleming, showed a material advance on previous summaries, the classification of Indian formations was still in a primitive state, marked by great deficiencies and striking errors in correlation.

A more serious attempt to unravel the problems of Indian geology was made with the employment in 1851 of the distinguished geologist, Dr. T. Oldham. For the first few years of his service Dr. Oldham was occupied on areas supposed to contain valuable deposits of coal and iron; but, in spite of the fact that his work was intended to be more directly economic, he was able in 1856 to reduce his observations to order, and in that year the regular Geologial Survey was organised, the first part of the now well-known *Memoirs* was issued, and Dr. Oldham was able to lay the foundation of a stratigraphical classification. With the year 1856, therefore, a new era in the history of Indian geological research was commenced.

It was at the May meeting of the Asiatic Society of Bengal[1] in 1856 that Dr. Oldham made his first contribution to the classification and nomenclature of Indian geological formations. He there proposed to adopt the name Vindhyan for the great group of unfossiliferous strata stretching across the northern part of the Peninsula, sub-dividing the group into :—

3. Bundair.
2. Rewah.
1. Kymore.

He recognised the fact that the Vindhyan formations were older than the great coal-bearing group of sandstones and shales, which for the time being he regarded as Jurassic in age and distinguished by the name *Damoodah.* The sandstone formations of the Pachmarhi hills he regarded as younger than the Damoodahs

[1] *Journal Asiatic Society of Bengal,* Vol. XXV, pp. 249—254, 1856.

and distinguished them as *Mahadewas* of unknown geological age, but older than the trap-flows of the Deccan. The rocks referred to as Damoodahs and Mahadewas are now united in the Gondwana System.

The next distinct step towards the development of a stratigraphical classification was due to the work of W. T. and H. F. Blanford and W. Theobald in the Orissa division. They discovered under the Damoodahs a formation of peculiar lithological characters which they proposed to distinguish by the name *Talcheer*. At the same time these authors argued[1] from imperfect evidence that the Damoodahs and Talcheers could not be younger than the European Permian, thus correcting the previously-held impression regarding the Mesozoic age of the strata.

Successive volumes of the Geological Survey Memoirs gradually extended the Indian stratigraphical scale until, in 1879, it was found possible to issue a general account of the Geology in the form of a Manual which showed the remarkable progress made during the previous twenty-three years in correlating Indian formations with those of the standard stratigraphical scale of Europe. On account of their general differences in geological history, the Peninsular and Extra-Peninsular areas were treated separately, and the following tables show briefly the sub-divisions and ages of the formations then recognised :—

Classified List of Formations in Peninsular India.

(H. B. Medlicott and W. T. Blanford, 1879.)

			Approximate maximum thickness.
Cænozoic .	Recent and Post-Tertiary.	Blown sand. Soils, including black soil or regur. Modern alluvial deposits of rivers, estuaries, and the sea coast. Khadar of Indo-Gangetic plain, etc. Raised shell beds of coast. Low-level laterite. Older alluvial deposits of Ganges, Narbada, Godavari, etc. Cave deposits.	Unknown; 700 feet deepest boring.

[1] *Mem., Geol. Surv. of Ind.*, Vol. 1, p. 46.

Classified List of Formations in Peninsular India—contd.

(H. B. MEDLICOTT AND W. T. BLANFORD, 1879)—*contd.*

				Approximate maximum thickness.
Cænozoic	Tertiary		Miliolite of Kattywar. Pliocene, miocene, and eocene (nummulitic) beds of Cutch and Guzerat. Sandstones, clays, and lignites of the west coast, Travancore and Ratnagiri. Cuddalore sandstones. High-level laterite.	2,700
Mesozoic	Deccan Trap Series.		Upper traps and intertrappeans of Bombay. Middle traps. Lower traps and intertrappeans of Central India, Rajamahendri, etc. Lameta or infratrappean group. Infratrappeans of Rajamahendri.	6,000
	Marine Cretaceous Rocks.		Arialur, Trichinopoly, and Utatur groups. Bagh beds. Neocomian of Cutch.	3,000
	Marine Jurassic Rocks.		Umia, Katrol, Chari, and Pachham groups of Cutch. Jesalmir limestones. Tripetty and Ragavapuram beds of east coast.	6,000
Palæozoic	Gondwana System.	Upper.	Cutch and Jabalpur. Rajmahal and Mahadeva.	11,000
		Lower.	Panchet. Damuda :—Raniganj or Kamthi, ironstone shales, and Barakar. Karharbari and Talchir.	13,000
Azoic.	Vindhyan Series.	Upper.	Bhanrer (Bundair). Rewah. Kaimur (Kymore).	12,000
		Lower.	Karnul. Bhima. Son. Semri.	2,000 ?
	Transition or Sub-Metamorphic Rocks.	Upper.	Gwalior, Kadapah, and Kaladgi series.	20,000
		Lower.	Bijawars. Champanir beds. Arvali. Malani beds. Transition rocks of Behar and Shillong (the last extra-peninsular).	?
	Metamorphic or Gneissic.		Gneiss granitoid and schistose rocks, etc.	?

Classified List of Formations in Extra-Peninsular Territories belonging to India.

(H. B. MEDLICOTT AND W. T. BLANFORD, 1879.)

Recent and Tertiary.	Post-	Alluvial and lake deposits. Sub-Himalayan high-level gravels.
Pliocene		Upper Manchhars of Sind. Upper and middle Siwaliks of Sub-Himalayas, Punjab, etc. Mammaliferous deposits of Western Tibet. Dehing group of Assam. Fossil-wood deposits of Pegu.
Miocene		Lower Manchhars and Gaj of Sind. Murree beds (in part). Nahan. Tipam group of Assam ? Pegu group of Burma.
Eocene	Upper	Nari group of Sind. Kasauli and Dagshai groups of Sub-Himalayas.
	Middle	Nummulitic limestone of Sind, Punjab, Assam, Burma, etc. Khirthar of Sind, Subathu of Sub-Himalayas. Indus or Shingo beds of Western Tibet. Coal-measures of Assam ?
	Lower	Ranikot beds of Sind. Lower nummulitics of Salt Range.
Cretaceous	Upper	Deccan trap. *Cardita beaumonti* beds and cretaceous sandstones of Sind. Olive group of Punjab Salt Range. Disang group of Assam ? Upper cretaceous of Khasi Hills. Negrais beds of Burma? (*N.B.*—It is not certain that some of these formations may not be, in part at least, eocene).
	Middle	Hippuritic limestone of Sind. Cretaceous beds of Mount Sirban in Hazara and of Kohat. Chikkim beds of North-Western Himalayas. Cretaceous beds of Assam in part. Mai-i group of Burma.
	Lower or Neocomian.	Beds in Chichali Pass, Salt Range.
Jurassic	Upper	Salt Range. Gieumal and Spiti beds of Northern Punjab and North-Western Himalayas.
	Middle	Variegated group of Salt Range. Part of Spiti shales in North-Western Himalayas ?
	Lower or Lias	Upper Tagling limestone of North-Western Himalayas. Sylhet trap ?
Trias	Upper including Rhaetic.	Lower Tagling limestone of North-Western Himalayas. *Nerinæa* beds of Mount Sirban, Hazara. Para limestone of North-Western Himalayas. Beds with *Megalodon* and *Dicerocardium* at Mount Sirban, Hazara.
	Middle	Salt Range ? Lilang series of North-Western Himalayas and Kashmir. Axial group of Burma.
	Lower	Ceratite beds of Salt Range. Infra-triassic of Hazara, in part ?

Classified List of Formations in Extra-Peninsular Territories belonging to India.—contd.

(H. B. MEDLICOTT AND W. T. BLANFORD, 1879)—*contd.*

Permian and Carboniferous.	Salt Range Carboniferous limestone. Damudas of Sikkim and Bhutan ? Infra-triassic of Hazara ? Kiol limestone of Pir Panjal ? Krol limestone and Infra-Krol of Western Himalayas ? Kuling series of North-Western Himalayas and Kashmir. Maulmain group of Burma.
Silurian [1] . .	*Obolus* beds of Salt Range. Attock slates of Upper Punjab ? Slates and traps of Pir Panjal and Kashmir ? Muth and Bhabeh series of North-Western Himalayas. Blaini and Infra-Blaini of Simla area ?
Infra-Silurian .	Salt marl of Salt Range ? Gneiss of Pir Panjal and Ladak. Upper gneiss of Zanskar range. Shillong series of Assam hills ? Mergui group ?
	Lower or central gneiss of Himalayas. Gneiss of Assam and Burma.

Those formations about which at the time there appeared to be reasonable doubt as to their positions in the list are marked with a note of interrogation.

[1] Silurian is here used in its old sense as including the Ordovician and Cambrian.

The second edition of the official Manual, prepared by Mr. R. D. Oldham and issued in 1893, showed the progress which had been made during the next fourteen years in extending the survey over new ground, and in adding precision to the correlation of the isolated outcrops of Indian formations with one another and with the European scale. In consequence of this progress in knowledge it was found possible to make a much more complete grouping of isolated formations in chronological order instead of maintaining the geographical divisions, although possibly some of the groupings were undertaken prematurely.

The new edition of the Manual introduced greater precision in the treatment of nearly every division of the rocks, the progress of knowledge and removal of difficulties being shown by the reduction in the bulk of the work. The small number of changes made in classification, however, showed that the work of the Survey as organised by Dr. T. Oldham had proceeded on sound scientific lines. Among the "Metamorphic and Crystalline rocks" the old division into the granitoid gneisses of Bundelkhand and the schistose and banded forms of Bengal was maintained by R. D. Oldham and extended to other parts of India. At the time the igneous nature of the granitoid types was only just beginning to be appreciated. The old division into Lower and Upper Transitions was abandoned in favour of regarding the foliated and semi-foliated schistose forms to be "Transitions," such

as the Dharwars, Aravallis and Champaners, while the unfossiliferous non-foliated sediments, such as the Cuddapahs, Kurnools and Vindhyans, were regarded as "Older Paleozoic." With the Transitions, however, the undisturbed Gwaliors were grouped, although they more nearly resemble the lower part of the Cuddapahs.

Among the unfossiliferous systems of the Outer Himalaya a distinction was made by regarding the Jaunsars, Deobans and Baxas as older Paleozoic, while the Simla slates, Blaini glacial boulder beds and Krol beds were placed with the Carbo-Trias system on account largely of the supposed equivalence of the glacial beds near Simla with those at the base of the Gondwana system. Attention was drawn to the fact that in the Salt Range and in the Central Himalaya there was an apparently conformable succession of beds between the Permian and the Trias, with a similar gradual passage in Western India between the Cretaceous and Tertiary.

In 1906 T. H. Holland[1] proposed some changes in the classification of the Transitions and the unfossiliferous formations of the Peninsula and Himalaya. It was pointed out that the great "break" between the foliated schists and gneisses and the overlying unfossiliferous strata, such as the Cuddapahs and Vindhyans, indicated a great difference in age between those below and those above, which corresponded roughly with the great Eparchæan interval in America. The foliated Dharwars were thus closely related in time to the gneisses and schists, being actually older than some gneissose granites. These foliated rocks were thus put into one group, the *Archæan*. The unfossiliferous systems of the Peninsula were likened to the Algonkians (Animikies or Upper Huronian and Keweenawans) of America, and their unfossiliferous character was thought to be due to the same cause which made the great pre-Cambrian strata of America unfossiliferous. These rocks were thus put into another group, the *Purana*, and, with those of the peninsula, were associated the unfossiliferous systems of the Outer Himalaya, the glacial boulder bed of the Simla region being regarded as not necessarily Carboniferous, since similar glacial beds were known among other much older systems in the Southern Hemisphere. Within the Purana there are several unconformities with thicknesses of strata sufficient to constitute fair-sized "groups." Similarly, among the immeasurably older Dharwars "breaks" of unknown value occurred, and it is possible that between the oldest and youngest

[1] Presidential Address: *Trans. Min. and Geol. Inst., Ind. I, 17.*

of the Dharwars preserved the time interval is greater than that covered by any younger "group." Some of the gneissose granites are younger, others are older than some Dharwars. The important point to notice is that while among the Dharwars, gneisses and schists, only divisions of local value can be made out according to time and order of succession, there is a widespread and great unconformity between these foliated rocks as a whole and the non-foliated Purana systems—Cuddapahs, Kaladgis, Bhimas, Kurnools and Vindhyans. This great unconformity thus forms a natural group limit in India as in Canada and South Africa, and all three areas having escaped later folding movements show still clearly preserved the distinction between the groups, Archæan and Purana.[1]

The next great division line selected by Holland was taken to be about equivalent to the Middle or Upper Carboniferous of Europe—the basement beds of the Gondwana system, those below the Productus Limestones of the Salt Range and the unconformity of similar age in the Himalaya. The rocks below this break formed the proposed *Dravidian group*, while those above were linked together to form the *Aryan group*.

In 1907 Mr. E. W. Vredenburg published "A Summary of the Geology of India," in which he introduced certain modifications of previous classifications. He separated the Dharwars from the Archæan gneisses and schists, not on mere lithological grounds, as in the case of Holland's classification, but on account of their supposed younger age. The reasons for linking the Dharwars with the gneisses and schists in one group have, however, been indicated above and are more fully discussed below under the headings Archæan, Dharwar and Purana. The Vindhyans are by Vredenburg distributed through the Cambrian system, apparently on the ground of a rough lithological correspondence between them and the fossiliferous Cambrian beds of the Salt Range. A much greater degree of precision in correlating isolated occurrences of the Cretaceous and Tertiary stages is attempted in consequence of recent palæontological work. In the "Summary," as in the papers cited, it is insisted[2] that the gradual transition of Cretaceous

[1] Dr. L. L. Fermor (*Rec., Geol. Surv., Ind.*, Vol. XLI, 292, 1912) in recording the discussion at the Stockholm (1910) meeting of the International Geological Congress confirms Holland's classification and proposes to extend it to other similar areas.

[2] Fuller discussions of these results will be found in separate papers published in *Rec., Geol. Surv., Ind.*, Vol. XXXIV, parts 2, 3, and 4; Vol. XXXV, parts 1 and 2; Vol. XXXVI, parts 2, 3, and 4; Vol. XXXVIII, parts 2, 3, and 4. Vredenburg's results are not always in agreement with those of Pilgrim, who has mainly studied the fresh-water fossiferous deposits (*cf. Rec., Geol. Surv., Ind.*, Vol. XL, part 3).

into Tertiary recognised by Blanford, Griesbach and Oldham in Western India and Baluchistan is only apparent, and that the "break" recognised in Europe occurs also in this country and is of equal value. The same idea is applied to the boundary between the Palæozoic and Mesozoic in the Salt Range and the Himalaya against the evidence of geologists such as Wynne, Waagen, Noetling, Krafft, Diener, Griesbach, and Koken, who have studied the rocks closely in the field and have also worked out the palæontology in detail.

It must be evident from a perusal of this short historical account of the classification of Indian geological formations that local names—many of them derived from places of greater or less importance—have played a conspicuous part in the terminology. Although the necessity for many of the older names has disappeared in the course of the geological survey, some of them still remain of great importance and are in continual use in the publications of the Department. In the following pages an attempt has been made to collect all the various names which have from time to time been proposed for the sub-divisions of Indian geological formations of whatever value; to record the date of their first introduction; to give the shortest possible outline of their lithological characters, fossil contents, their correlation amongst themselves and on broad lines with the European scale and the vicissitudes through which the terminology may have passed.

In all except well-known localities the latitude and longitude are given in brackets. The latitudes are of course all north and the longitudes all east. As the highest figure for latitude is lower than the lowest figure for longitude in the Indian Empire, no confusion can occur between the two. Where co-ordinates are given for rivers or mountain ranges, they refer to the geological points concerned in the text, and are sufficient to enable one to identify the places on the ordinary Indian Atlas sheets.

The spelling adopted is in general agreement with that of the new edition of the Imperial Gazetteer, and all villages and towns with post offices are given according to the spelling adopted in the Quarterly Post Office Guide, which forms also a useful indication of the districts in which the places occur. Whenever the old spelling of names would result in any serious change in the alphabetical order, cross references are given.

Abur beds.—Named by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 159, 1886) from a village (27° 5′; 70° 37′) north-west of Jaisalmer. They are the highest of the Jurassic rocks in Jaisalmer, and include the bed referred to by W. T. Blanford (*Rec., Geol. Surv., Ind.*, X, 16, 1877) as "the ammonite-bed of Kuchri."

Ajabgarh series.—One of the five sub-divisions of the Aravalli system recognised by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 85, 1877) in Alwar State. Later work by Hacket inclined him to regard the Ajabgarh and associated Mandan series to be really equivalent to the Raialo series, which he had placed at the base of the Aravallis (*Rec., Geol. Surv., Ind.*, XIV, 281, 1881). Recent work by A. M. Heron (Director's General Report, *Rec., Geol. Surv., Ind.*, XL, 114, 1910, and XLI, 80, 1911) tends to confirm Hacket's original conclusion regarding the position of the Ajabgarh series in the Aravalli succession.

Akauktaung stage.—Name given by M. Stuart (Director's General Report, *Rec., Geol. Surv., Ind.*, XLI, 79, 1911, and XLI, 243, 244) to the lower marine beds included by him in the Irrawaddy system and lying between an unconformity in Lower Burma above the Kama clays and the "red bed" of Upper Burma, thus including beds regarded by F. Noetling as part of the Pegu system. The beds are regarded as about Burdigalian (Lower Hinglaj) in age. Name from the Akauktaung hills in Henzada district. In previous publications these beds are referred to as "Marine beds of the Irrawaddy series."—(See *Rec., Geol. Surv., Ind.*, XXXVIII, 266, 274, etc., 1910.)

Albaka beds.—The upper division of the Pakhal series in the Godavari valley, the Pakhals being regarded as an extension northwards of the Cuddapahs. Named by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 211, 1881) from the town of Albaka (18° 13′; 80° 44′) on the left bank of the Godavari river. In the typical area the Albaka series consists of two well-marked members, a lower slaty stage, with some arenaceous and limestone beds, and an upper, more arenaceous, series of beds. They correspond approximately to the Nallamalli series in the Cuddapah system.

Allagiri stage.—R. B. Foote (*Mem. Geol. Surv., Ind.*, XX, 11, 1883) divided the crystalline rocks of the Madura district into six divisions ("groups") as follows :—

6. The upper granular quartz rock—Allagiri group.
5. The upper granitoid gneiss—Melur group.
4. The middle granular quartz rock—Nagamalai group.
3. The middle granitoid gneiss—Sikandarmalai group.
2. The lower granular quartz rock—Kokulam group.
1. The lower granitoid gneiss—Tirumangalam group.

Almod beds.—Not defined as a series by H. B. Medlicott in *Mem., Geol. Surv., Ind.*, X, part 2, 27, though referred to in the Manual, 1st Ed., 134, 1879. They are the uppermost beds of the Lower Gondwanas in the Satpura range, consisting of sandstones with a few carbonaceous shales. They possibly represent the Pánchets of Bengal. Almod (22° 23′; 78° 26′) is a village at the south base of the Pachmarhi escarpment.

Alveolina limestone.—C. L. Griesbach (*Mem., Geol. Surv., Ind.*, XVIII, 9, 22, 1881) used this term for the lowest of his three sub-divisions of the Eocene strata in Baluchistan, the beds regarded as next higher being correlated by mistake with the Ranikot series of Sind. The corresponding Alveolina limestone which was noticed by W. T. Blanford in 1867 (*Mem., Geol. Surv., Ind.*, VI, 6) was afterwards grouped by the same author (*Rec., Geol. Surv., Ind.*, IX, 13, 1876) with his Kirthar series, but F. Noetling (*Centr. fur Min.*, 1903, 521) separated this and associated beds under the name of Laki, placing the series between the Ranikot and Kirthar, with an age approximately corresponding to the Lower Lutetian of Europe (E. Vredenburg, *Rec., Geol. Surv., Ind.*, XXXIV, 86, 182, 1906).

Alwar group.—Proposed first as a division of the Aravalli series by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 85, 1877) from the town (27° 34′; 76° 39′) and state of that name in Rajputana. Afterwards, Hacket (*Rec., Geol. Surv., Ind.*, XIV, 281, 1881) separated the *Alwar quartzites* from the Aravalli system and included them in the (new) Delhi system.

The Alwar quartzites in the Biana hills include—

5. Wer quartzites and black slaty shales.
4. Damdama quartzites and conglomerate.
3. Biana white quartzite and conglomerate.

2. Badalgarh quartzite and shale.
1. Nithahar quartzites and bedded traps. (Hacket, *Rec., Geol. Surv., Ind.*, X, 86, 1877.)

Amb beds.—Name given by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) to the Lower Productus Limestone of the Punjab Salt Range. The village of Amb (32° 31′; 71° 59′) is about 6 miles N.N.W. of Warcha in the western part of the range. For correlation, see *Productus limestone*.

Amir shingle beds.—Named by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 160, 1886) after the village of Amir in the Jaisalmer State. Sub-recent shingle beds and possibly marine littoral deposits.

Ammonite bed of Kuchri (W. T. Blanford) afterwards included in the Abur beds by R. D. Oldham.

Anaram beds.—Plant-bearing shales. Casually mentioned by W. King (*Rec., Geol. Surv. Ind.*, X, 61, 1877) and supposed by him to be equivalent to the Sironcha sandstones; eventually in a later paper (*Rec., Geol. Surv., Ind.*, XIII, 15, 16, 1880) considered to be locally bottom beds resting on the Kamthis and lower in the Kota-Maleri group than the Kota zone of limestones. Anaram (18° 54′; 80° 0′) is a village in the Central Provinces.

Anisoceras beds.—Name used by F. Kossmat (*Rec., Geol. Surv., Ind.*, XXX, 54, 1897) as equivalent to Valudayur (*q.v.*).

Anthracolithic sub-group.—W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) suggested the use of the term Anthracolithic to include the Carboniferous and Permian systems. C. Diener has also used the term frequently in describing Indian fossil collections, on account of the intimate stratigraphical and faunistic connection between these two systems in the Indian region (*Pal. Ind.*, Ser. XV, Vol. I, Part 2, 1, 1899, and numerous memoirs issued subsequently).

Arakan system.—F. Noetling (*Rec., Geol. Surv., Ind.*, XXVIII, 62, 1895; *Pal. Ind.*, New Ser. I, 5, 1899-1900) used this term to include the Pegu, Nummulitic (Bassein) and Axial (Chin) formations in Burma. Having concluded that the Chin series is probably not older than Cretaceous, the name Arakan covered the period from Cretaceous to Upper Miocene (*loc. cit.*, p. 14). The Chin series (Axial group of W. Theobald) has since been found to include Triassic and Upper Cretaceous fossils, and is thus composite in character.

Aravalli system.—Named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 84, 1877) from the Aravalli hill-ranges in Rajputana. Originally the system included the Mandan, Ajabgarh and Alwar series, but some of these were excluded afterwards and included in the Delhi system (R. D. Oldham, Manual, 2nd Ed., 1893, 67, 68). The system so limited includes quartzites, calciphyres, hornblendic and mica schists, with andalusite, staurolite and garnet, felspathic schists and gneisses. The schists are traversed in places by granite-veins. The relations to the Delhi system have not been satisfactorily established.

Archæan group.—In India, as in its own home, America, and in Europe the name Archæan suggested by J. D. Dana in 1872 (*Amer. Journ. Sci.*, 3rd series, Vol. III, 179, 250) to cover all rocks below the known Cambrian base has been given various meanings. The fundamental crystalline complex, which is such a conspicuous feature in Peninsular India especially, was referred to occasionally during the eighties as Archæan, especially after the International Geological Congress of 1885, when it was agreed to use the word Archæan as a group name to include the various pre-Cambrian systems. Probably the first precise application of the term to Indian rock groups was by R. B. Foote (*Mem., Geol. Surv., Ind.*, XXV, 26, 1895), who limited its meaning to the gneissose and granitoid members of the crystalline complex, excluding the rocks of the Dharwar system, which he regarded as distinctly younger than the gneisses and gneissose granites. This use of the term coincides with that which developed in the United States (after the invention of the term Algonkian to cover the systems of unfossiliferous pre-Cambrian strata) as expressed by C. R. Van Hise in 1892 (*Bull. U. S. Geol. Surv.*, No. 86, 13); that is, applying the name Archæan to "granitic gneissic and schistic rocks, among which are never found beds of quartzite, limestone, or any other indubitable clastics." In 1906 T. H. Holland (*Trans. Min. and Geol. Inst., Ind.*, I, 47) grouped the Dharwars with the fundamental crystalline rocks as Archæan, drawing attention (Imper. Gazetteer of India, New Ed., 1907, 57) to the great "break" which separates the gneisses, schists and Dharwars from the much younger, unaltered Cuddapahs and other unfossiliferous rocks of the Peninsula, while some of the gneissose rocks were regarded as eruptives probably younger

than some of the Dharwars. This view is adopted by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 236, 1909), and is substantially similar to that finally adopted by J. D. Dana himself in the 4th Edition of his Text-Book published in 1875, where he includes gneisses of all kinds and infolded metamorphosed clastics. Van Hise also afterwards adopted this meaning for the Archæan, including, with the gneissose granites and schists, the iron-bearing formations of Vermilion, Marquette, etc. (21st Ann. Rept., U. S. Geol. Surv., Part III, 1901, 305—434). E. Vredenburg (Summary of the Geol. of India, Calcutta, 1907, p. 4) restricts the term in a novel way to rocks "underlying the oldest undoubted sediments" among which are gneisses representing "in part, at least, the original crust of the globe, when the surface of the originally molten mass first began to solidify." He thus excludes the Dharwars, but includes the Khondalites of Walker, which are altered sediments, with the Hosur gneissose granite which is young enough to have picked up fragments of the Dharwars.

Archipelago series.—Name applied by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XVIII, 138, 1885) to rocks occurring in the Ritchie Archipelago and mainland of the Andamans. Shown by G. H. Tipper (*Mem., Geol. Surv., Ind.*, XXXV, 5, 7, 1910) to be composite in character.

Ariyalur stage.—A stage in the Cretaceous deposits of the Trichinopoly, Viruddhachalam, and Pondicherry areas distinguished by H. F. Blanford (*Mem., Geol. Surv., Ind.*, IV, 23, 125, 1862). Age, about Upper Senonian; divided in the Pondicherry area into a lower horizon known as the Anisoceras, or Valudayur, beds, and an upper, distinguished as the Trigonoarca beds (F. Kossmat, *Rec., Geol. Surv., Ind.*, XXX, 58, 67, 81 and 82, 1897). The Ninniyur beds of Danian age were formerly regarded as part of the Ariyalur stage and form part of a continuous series of beds. Ariyalur, from a village in the Trichinopoly district (11° 8′; 79° 8′). E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 195, 211, 1908) correlates the Ariyalur with the Hemipneustes beds of Baluchistan, which he regards as Campanian in the lower part (Valudayur beds) and Maestrichtian above (Trigonoarca beds).

Aryan group and era.—Name proposed by T. H. Holland (*Trans, Min. Geol. Inst., Ind.*, I, 49, 1906; Imperial Gazetteer of India,

New Ed., I, 56, 68, 1907) for the whole range of strata in Peninsular India above the base of the Gondwana system and the corresponding upper Carboniferous horizon in extra-Peninsular areas. The division into two great groups, Aryan above and Dravidian below, *thus recognises in India an important and widespread "break"* of about Upper Carboniferous age. This is marked by the Talchir boulder-bed forming the base of the Gondwanas on the Peninsula, by the glacial boulder-bed at the base of the Permo-Carboniferous in the Salt Range, and by a prominent conglomerate in the Central Himalayas. The Aryan group thus includes beds equivalent to a part of the Upper Palæozoic of Europe, added to the whole of the Mesozoic and Cainozoic systems.

Atgar (Athgarh) or Cuttack stage.—The rocks so named occur between Cuttack and Atgar (20° 31′; 85° 41′). They consist of grits, sandstones and conglomerates with white or pinkish clay-beds (W. T. Blanford, *Mem., Geol. Surv., Ind.*, I, 68, 1859; *Rec., Geol. Surv., Ind.*, V, 59, 1872; V. Ball, *Rec., Geol. Surv., Ind.*, X, 63, 1877). Determined from fossil plants by O. Feistmantel to be of Rajmahal age (*Rec., Geol. Surv., Ind.*, X, 68—70; *Pal. Ind.*, Ser. XII, I, 187, 1879).

Attock slates.—Named by A. B. Wynne (*Mem., Geol. Surv., Ind.*, IX, 333, 1872) from the town on the Indus (33° 53′; 72° 17′). Unfossiliferous dark or black slates with limestones and sandstones of an olive, sometimes liver-colour; also with intrusive and interbedded trap. They lie below the infra-Trias (? Devonian) rocks with marked unconformity and are now regarded as probably part of the Purana group.

Awk.—See **Owk shales.**

Axial series.—Named by W. Theobald (*Rec., Geol. Surv., Ind.*, IV, 33, 1871), and described as the group of altered rocks constituting the main Arakan Yoma. Afterwards divided into two, the name *Axial* being restricted to the older division thought to be Triassic, and the name *Negrais* being applied to the younger or possibly Cretaceous division (*Mem., Geol. Surv., Ind.*, X, 315, 1873). Although Triassic fossils occur in the Axials (*Rec., Geol. Surv., Ind.*, IV, 39, and XXXIV, 134, 1906) the group of rocks is composite; for, among the fossils collected by Theobald and labelled "Triassic," G. H. Tipper (*Rec., Geol. Surv., Ind.*, XXXV, 119, 1907) found specimens of *Cardita*

(*Venericardia*) *Beaumonti* d'Arch., a form characteristic of beds in Sind and Baluchistan which E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIV, 86, 1906; XXXVI, 192, 1908) regards as Mæstrichtian, reaching perhaps to Lower Danian. F. Noetling (*Pal. Ind.*, New Ser., I, 5, 1899-1901) refers to these rocks as the Chin series. Similar rocks have been recognised by R. D. Oldham (*Mem., Geol. Surv., Ind.*, XIX, 223, 1882) in Manipur and the Naga hills.

Babeh series.—Named by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 17, 135, 1865) from the Babeh (Bhabeh) pass (31° 43′; 78° 4′) in the Central Himalaya of Spiti. Described as consisting of sandstones, slates and quartzites of probably Lower Silurian age, by which was intended Lower Silurian in its then wider sense to include the Ordovician and much of the Cambrian. The Babeh series was afterwards included by C. L. Griesbach (*Mem., Geol. Surv., Ind.*, XXIII, 53, 1891) in his Haimanta system, and was shown by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXVI, 19, 1904) to be Cambrian.

Badalgarh quartzite and shale.—A local sub-division of the Alwar quartzite group, named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 86, 1877) from a hill and fort (26° 53′; 77° 18′) in the Bharatpur State, Rajputana.

Bagh beds.—Named from the town of Bagh (22° 21′; 74° 57′) in the Gwalior State for certain marine limestones and sandstones of Cretaceous age exposed at various places in the Narbada valley between Chota Udaipur and Baroda. Regarded by W. T. Blanford as of the same age as the freshwater Lametas, and younger than the Mahadeva sandstones (*Mem., Geol. Surv., Ind.*, VI, 218, 1869). Fossils described by P. Martin Duncan (*Quart. Journ., Geol. Soc.*, XXI, 357, 1865; *Rec., Geol. Surv., Ind.*, XX, 81, 1887), P. N. Bose (*Mem. Geol. Surv., Ind.*, XXI, 35, 1884) and E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 109, 1907) indicate a cenomanian age, corresponding to the Utatur stage in the Coromandel Cretaceous beds. P. N. Bose avoided the use of the term "Bagh beds," because of its previous use with various meanings (*Mem., Geol. Surv., Ind.*, XXI, 36, f.n.). He divided the marine Cretaceous of this area into three stages—

(3) Coralline limestone.

(2) Deola and Chirakhan marl.
(1) Nodular limestone.

These were assumed to be roughly equivalent to the (1) Utatur, (2) Trichinopoly and (3) Ariyalur stages in South India; but E. Vredenburg (*loc. cit.*, 110) regards the three divisions as successive facies of a single palæontological stage.

Baghanwala stage.—The name (spelt as Bhaganwala) was suggested by F. Noetling (*Rec., Geol. Surv., Ind.*, XXVII, 74, 80, 1894) for the uppermost division of the Cambrian beds in the Punjab Salt Range, previously and generally known by the descriptive term Salt Pseudomorph beds, or as originally described by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 69, 98, 1877), as the Pseudomorphic Salt Crystal Zone, which he referred to as possibly Triassic in age on account of its lithological nature, and in the absence of fossils. The formation is best developed in the neighbourhood of Baghanwala (32° 42′; 73° 17′) in the Jhelum District.

Bagra stage.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, X, 150, 1873) from an old fort (22° 38′; 78° 3′) built upon the beds at the mouth of the Tawa gorge in the Satpura range. The name was applied to the uppermost of three sub-divisions of the Mahadeva series in the Satpura-Gondwana basin.

Bahrain series.—Name used by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 20, 21, 1908) for the facies of Nummulitic rocks typically exposed in the Bahrain island (26° 0′; 50° 33′), consisting for the most part of white limestone or white marl with associated saliferous and gypsum beds. The fossils suggest a correlation with the Mokattam stage of the Cairo beds, corresponding to the Priabonian.

Bairenkonda quartzites.—The lower part of the Nallamalai series of the Cuddapah system, so named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 212, 1872) from the Bairenkonda hill (15° 38′; 79° 3′), the summit of which is formed of these rocks.

Bakhtiyari series.—Name proposed by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 52, 1908) for a series of detrital deposits, consisting of unfossiliferous conglomerates and sandstones corresponding to the upper part of Loftus' gypsiferous series (*q.v.*). The gypsum is supposed to have been derived from the underlying Fars beds. The series from its position is considered to be Pliocene and to correspond to some portion of the Siwaliks. It is named from the Bakhtiyari mountains in Northern Persia.

Balaghat gneiss.—Term proposed by W. King (*Mem., Geol. Surv., Ind.*, XVI, 125, 1880) for the gneissose granites, generally reddish in colour, typically developed in the western parts of North Arcot, in the Cuddapah sub-division, in the eastern part of Bellary, in Kurnool and over the eastern portion of the Hyderabad territory up to the higher reaches of the Godavari. Similar rocks have been referred to as the Bellary gneiss and Hosur gneiss, and the rocks appear to be approximately similar to the so-called Bundelkhand gneiss of Central India.

Balmir sandstones.—See **Barmer sandstones.**

Banganapalli stage.—Named by W. King (*Rec., Geol. Surv., Ind.*, II, 8, 1869; *Mem., Geol. Surv., Ind.*, VIII, 40, 1872) from the town of Banganapalli (15° 19′; 78° 17′), the headquarters of a state in the Kurnool district. It is the lowest stage of the Kurnool series, and is distinguished by the occurrence in it of diamonds for which numerous old workings are known.

Bap beds.—Boulder beds found by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 123, 1886), near Bap (27° 22′; 72° 23′) in Jaisalmer State were regarded as similar and equivalent to the Pokaran beds (*q.v.*).

Barakar stage.—Name suggested by T. Oldham (*Mem., Geol. Surv., Ind.*, III, pt. 1, 212, 1861) for the lowest stage of the Damudas previously known as the Lower Damudas. Named from the Barakar river, which runs over the Barakar and other stages of the Raniganj coalfield to join the Damuda.

Barmer (Balmir) sandstones.—Distinguished by W. T. Blanford (*Rec., Geol. Surv., Ind.*, X, 17, 18, 1877) as one of the divisions of the Jurassic rocks in Jaisalmer, and named from the town of Barmer or Balmir (25° 45′; 71° 25′) in Marwar. Similar beds east and south-east of Jaisalmer were distinguished as the *Lathi beds* by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 158, 1886). T. H. D. La Touche suggested (*Mem., Geol. Surv., Ind.*, XXXV, 33, 34, 1902) that these beds are not older than Cretaceous, as they include remains of dicotyledonous angiosperms and underlie beds that resemble the Nummulitic "Multani mitti."

Bassein series.—Name proposed by F. Noetling (*Pal. Ind.*, New Ser., I, 5, 1899-1901) for the Nummulitic rocks of Burma, which were described by W. Theobald (*Mem., Geol. Surv., Ind.*, X, 278, 1873) under the latter name. Besides the Nummulites, the

occurrence of *Velates schmideliana* Chemn. indicates an Eocene age for these rocks.

Bawar series.—Name given to a series of quartzites in north-east Jaunsar by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XVI, 197, 1883). Considered at the time to be of Tertiary age, but afterwards (*Rec., Geol. Surv., Ind.*, XXI, 137, 1888) grouped with the Mandhalis in the " Carbonaceous " system.

Bawdwin volcanic stage.—Originally called the Bawdwin grits and rhyolites by T. H. D. La Touche (*Rec., Geol. Surv., Ind.*, Vol. XXXVII, map, pl. 23, 1909) but changed to the above in his Memoir on the Geology of the Northern Shan States (*Mem., Geol. Surv., Ind.*, Vol. XXXIX, 55, *et seq.*). The series consists of rhyolitic flows and tuffs, and has been extensively mineralised in the neighbourhood of Bawdwin (23° 6′ ; 97° 20′), the locality from which the name is derived. The beds are undoubtedly pre-Ordovician, and are considered to form part of the Tawng-peng system.

Baxa series.—Named by F. R. Mallet (*Mem., Geol. Surv., Ind.*, XI, 12, 33, 1875) from the hill fort of Baxa (26° 45′ ; 89° 38′) in the Western Duars. The rocks consist of unfossiliferous quartzites, slates and dolomites which were noticed to resemble the Krol rocks of the Punjab Himalayas, but their age with reference to the Damuda beds in the Darjeeling area was not satisfactorily established. They are now regarded as representatives of the Purana group.

Bedesar beds.—A division of the Jurassic rocks of Jaisalmer recognised by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 158, 1886). Named from the village of Bedesar (27° 3′ ; 70° 49′) north-north-west of Jaisalmer. The beds are of purplish or reddish sandstone with bands of calcareous sandstone and thin layers of black, vitreous, ferruginous sandstone ; they contain a few fossils similar to forms from the Katrol group of Cutch.

Behar transitions.—See **Bihar transitions**.

Beldongrite.—Mineral named by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 115, 1909) from Beldongri (21° 20′ ; 79° 21′), Nagpur district, Central Provinces, where the mineral was found in the manganese-ore deposits. Composition, $6\ Mn_3\ O_5 . Fe_2\ O_3 . 8\ H_2O$. It is a variety of psilomelane, and the name is regarded as of provisional value only.

Belemnite beds.—A self-explanatory term used by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXV, 19, 1892) to distinguish a

Cretaceous formation in Baluchistan. It was shown by F. Noetling (*Pal. Ind.*, ser. XVI, 1, part 2) to be of Neocomian age. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVII, 200, 1910) divides it into :—

3. Lituola beds	.	Flaggy porcellanic limestones.
2. Parh limestones	.	Unfossiliferous siliceous limestones.
19. Belemnite shales	.	Variegated in colour but usually black and crowded with belemnites.

Bellary gneiss.—Synonym suggested by W. King (*Mem., Geol. Surv., Ind.*, XVI, 125, f.n., 1880) for the Balaghat gneiss (*q.v.*). King suggested that the gneiss might also be called Mysore gneiss. R. B. Foote (*Mem., Geol. Surv., Ind.*, XXV, 28, 29, 1895) points out the resemblance between the Bellary gneiss and that of Bundelkhand, and he correlates with them the granitoid gneisses of Mysore, the central and western taluqs of North Arcot, the Baramahal division (Hosur gneiss) of Salem, the centre of Kistna, south-west of Nellore, south-east of North Arcot, centre of South Arcot, south of Trichinopoly, Pudukkottai State, part of Madura north of the Vaigé river, and south-western Tinnevelly.

Bengal gneiss.—In describing the geology of the Khasi hills T. Oldham (*Mem., Geol. Surv., Ind.*, I, 116, 1859) distinguished two types of metamorphic rocks—" the older and more altered group . . . represented by . . . alternating beds of gneiss, quartzose schists, and quartz, greatly contorted, and traversed in every direction by veins of finely crystalline granite. With these are also associated occasional beds of hornblendic rocks." The upper group is " essentially slaty, consisting of blue and grey flaky schists, with some micaceous and quartzose layers." The former group was distinguished as the gneiss of " Bengal Proper," while the slaty group was distinguished as " that of the Sikkim-Himalaya (Darjeeling)." The term Bengal gneiss was afterwards used generally for the well foliated and banded areas of gneiss on the Peninsula (*cf.* Man. Geol. Ind., 1st Ed., 1879, xviii and 17).

Betwa series.—Term proposed by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIII, 259, 1906) in a new classification of the Vindhyan

system for the sandstones named Upper Bhander. Name taken from that of the river which traverses the formation in Bhopal State.

Bezvada gneiss.—Named by W. King and R. B. Foote (Foote, *Mem., Geol. Surv., Ind.*, XVI, 25—27, 1879, and King, *Mem., Geol. Surv., Ind.*, XVI, 206, 1880) from the town of Bezvada (Bezwada) (16° 31′; 80° 40′) in the Kistna district where it was first noticed. Various garnetiferous gneisses and schists are included in the group, occurring along the eastern faces of the hills from the Kistna north-north-eastwards into the Vizagapatam district. A prominent lithological type is garnetiferous and contains murchisonite (King, *Rec., Geol. Surv., Ind.*, XIX, 150, 1886).

Bhabar.—Vernacular term in use for the fringe of gravels along the foot of the Himalaya. It is in this gravel that so many of the rivers lose themselves on issuing from the hills to re-appear in the lower and moister *Terai*.

Bhabeh.—See **Babeh**.

Bhaganwala stage.—See **Baghanwala stage.**

Bhander series.—Named from a hill-range north of the Narbada valley by T. Oldham (*Journ. As. Soc., Beng.*, XXV, 251, 253, 1856). The uppermost series in the Vindhyan system. Divided by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIII, 259, 1906) into—

(*b*) Betwa	. . .	Sandstones.
(*a*) Haveli	. .	Shales and limestones with subordinate sandstones.

Bhangar.—Vernacular term in use to denote the small plateaux of older alluvium of a river system which are too elevated to be flooded.

Bhiaura quartzites.—Named by F. R. Mallet (*Rec., Geol. Surv., Ind.*, VII, 39, 1874) from the Bhiaura range in Northern Hazaribagh. A local stage in the "Sub-Metamorphics" below a series of mica-schists which lie under the Mahabar quartzites (*q.v.*). The quartzites sometimes break with a sub-vitreous fracture, and occur in beds two or three feet thick in which no schistose character is developed; in other cases they are coarser in

grain with micaceous flaggy beds, and are sometimes interbedded with hornblende-rock and mica-schists (*loc. cit.*, 37, 38).

Bhima series.—Named by W. King and described by R. B. Foote (*Mem., Geol. Surv., Ind.*, XII, 139, 1876) from the Bhima river, which traverses the series and joins the Kistna in the Nizam's Dominions. Considered to be equivalent to the Kurnools and Lower Vindhyans (Foote, *Mem., Geol. Surv., Ind.*, XII, 164, 1876). Divided by Foote as follows :—

Upper Bhima series.

(*g*) Red shales.

(*f*) Flaggy limestones.

(*e*) Buff shales.

(*d*) Quartzites.

(*c*) Limestones, Talikot.

Lower Bhima series.

(*b*) Red, purple and green shales and shaly sandstone.

(*a*) Quartzites, grits and sandstones.

Biana white quartzite and conglomerate.—A local sub-division of the Alwar quartzite group, named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 86, 1877) from the Biana hills (26° 54′ ; 77° 21′) in the Bharatpur State, Rajputana.

Bihar transitions.—Name used without stratigraphical precision for the schists, slates, quartzites, etc., in Eastern Bihar, where the more resistent rocks stand up as prominent hills in the peneplain, such as the Maher, Rajagriha (Rajgir), Shaikpura, Kharkpur and Gidhaur hills. Details of the rocks are given by H. B. Medlicott (*Rec., Geol. Surv., Ind.*, II, 40, 1869), and F. R. Mallet (*Rec., Geol. Surv., Ind.*, VII, 36, 1874). Similar rocks occur on the Shillong plateau (Medlicott, *Mem., Geol. Surv., Ind.*, VII, 197, 201, 1869) and in the Aravalli region.

Bijaigarh shales.—One of the stages, according to F. R. Mallet's classification (*Mem., Geol. Surv., Ind.* VII, 27, 28, 1869), of the Kaimur series of the Upper Vindhyan system. Named from the hill fort of Bijaigarh.

Bijawar system.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 35, 1860) from the State of Bijawar in the Bundelkhand Agency, Central India. It consists of quartzites, sometimes conglomeratic, hornstone breccia, cherty limestone, ferruginous sandstone, hematite-beds and contemporaneous trap-flows. The rocks rest unconformably on the gneiss and are generally not greatly disturbed; they resemble the Gwalior series. Rocks lithologically somewhat similar to typical Bijawars have been described as such in the neighbourhood of Bagh and Jobat (*Mem., Geol. Surv., Ind.*, VI, 199, 1869), but they are foliated with the gneisses and are probably equivalent to the Dharwars of South India. C. A. Hacket (MS. Report, 1871, unpublished) describes rocks of somewhat similar lithological characters, but closely folded, in the Jubbulpore district. He divides the rocks in this area into—

4. Chanderdip group
3. Lora group.
2. Bhitri group.
1. Majhauli group.

P. N. Bose (*Rec., Geol. Surv., Ind.*, XXII, 216, 1889) regroups these into—

2. Lora group.
1. Majhauli—Bhitri group.

Bijori stage.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, X, 159, 1872) from the village of Bijori (22° 22′; 78° 30′) in the Chhindwara district, Central Provinces. The Bijori stage or horizon, as it was originally named, is the upper part of the Damudas in the Satpura region, in which the remains of *Gondwanosaurus bijoriensis*, Lyd., were found. The general facies of the flora in the Bijori beds agrees with that of the Raniganj stage in Bengal, whilst the overlying Almod beds, not distinctly defined, may represent the Panchets.

Bivalve limestones.—One of W. Waagen's sub-divisions of the *Ceratite beds* (*q. v.*) of the Punjab Salt Range.

Blaini (Blini) beds.—Boulder-beds and limestone occurring under the Infra-Krol stage in the so-called "Carbonaceous" system in the Simla Himalaya. The boulder-beds have been considered to be of glacial origin, and have often been correlated with the Talchir boulder-bed and that of the Salt Range; but

somewhat similar boulder-beds have been found in the Purana group elsewhere, and these rocks are now regarded as much older than the Talchirs. Named from the Blaini river (30° 55′; 77° 8′) by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, pt. 2, 17, 30, 1864). See also T. H. Holland (*Rec., Geol. Surv., Ind.*, XXXVII, 129, 1908).

Blanfordite.—Named after W. T. Blanford by L. L. Fermor (*Trans. Min. and Geol. Inst. of India*, I, 78, 1906). A highly pleochroic, manganiferous pyroxene, found in the manganese-ore deposits of the Central Provinces, Central India and Bombay (*cf. Mem., Geol. Surv., Ind.*, XXXVII, 125, 1909).

Boileauganj quartzites.—Distinguished by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, pt. 2, 34, 1864) as the probable equivalent at Boileauganj (31° 6′; 77° 10′) near Simla of the Krol sandstones. They occur apparently above the carbonaceous shales (R. D. Oldham, *Rec., Geol. Surv., Ind.*, XX, 147, 1887), and are included by R. D. Oldham in the Infra-Krol series (*Rec., Geol. Surv., Ind.*, XXI, 135, 1888).

Bombite.—Name given by De Bournon (Observations sur quelques-uns des Mineraux, etc., 30, 1823) to material found near Bombay and brought to Europe by M. Leschenault de la Tour. It occurs in amorphous or rounded masses and has no fixed chemical composition. Probably an occurrence of tachylyte.

Budavada stage.—The lowest of three divisions of the Upper Gondwanas south of the Kistna river, named by R. B. Foote (*Mem., Geol. Surv., Ind.*, XVI, 4, 70, 1880) from the village of Budavada (15° 51′; 80° 12′). This stage corresponds with the Golapilli stage of the Ellore area, and includes numerous marine shells which do not appear to have been determined.

Bundair.—See **Bhander series.**

Bundelkhand gneiss.—Name instituted by F. R. Mallet (unpublished report) from the state of that name and adopted in the Manual of Indian Geology (1st Ed., 1879, 10) for a gneiss possessing the characters of coarse pink granite of constant composition and almost free from accessory minerals. Foliation is never well developed. Pegmatite veins, and quartz reefs are common. It has, in fact, all the characters of an intrusive granite, but covers an extremely wide area. Originally it was looked upon as the oldest gneiss in India. This view is no longer

held and the intrusive character fully recognised. See Fermor (*Mem., Geol. Surv., Ind.*, XXXVIII, 238, 1909), and *cf. Balaghat* and *Bellary* gneiss.

Burmite.—Name suggested by Dr. O. Helm and used first by F. Noetling (*Rec., Geol. Surv., Ind.*, XXVI, 31, 1893) for the amber-like resin found in Upper Burma. It differs in chemical composition and physical characters from amber. (Helm, *Rec., Geol. Surv., Ind.*, XXV, 180; XXVI, 61).

Byana.—See **Biana.**

Byrenconda.—See **Bairenkonda quartzites.**

Calderite.—Name given by H. Piddington (*Journ. As. Soc., Beng.*, XIX, 145, 1850; XX, 207, 1852) after James Calder to a massive lime-garnet rock from the Hazaribagh district. See F. R. Mallet (*Rec., Geol. Surv., Ind.*, VII, 34, 1873; Man. Geol. India, pt. IV, Mineralogy, 89, 1887).

Carbonaceous system.—Name applied by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXI, 133, 1889) to the unfossiliferous rocks of the Outer Himalaya consisting of the Simla slates, the Blaini beds, the Infra-Krol series and the Krol series. So called on account of the black, carbonaceous shales which occur in the Krol and Infra-Krol series as well as in the supposed equivalents of these beds in other areas. The Carbonaceous system is practically the same as Medlicott's "Himalayan series" (*Mem., Geol. Surv., Ind.*, III, 17, 21, 1864); it was once considered to be about Permo-Carboniferous in age on account mainly of the included Blaini boulder-bed; but these unfossiliferous Himalayan rocks are now grouped with the Purana systems of Peninsular India.

Cardita Beaumonti beds.—Olive shales and sandstones in the Laki range of Sind have been known generally by the abundance of *Cardita* (*Venericardia*) *Beaumonti* d'Arch. which they contain. This and the associated fossils show a distinctly Cretaceous character, but have nevertheless strong Tertiary affinities (W. T. Blanford, *Mem., Geol. Surv., Ind.*, XVII, 34—36, 1880). Blanford (*Mem., Geol. Surv., Ind.*, XX, 108, 1883) thought the preponderance of evidence was in favour of regarding these beds as Eocene or possibly as passage beds between the Cretaceous and Tertiary. Similar beds have been found in the Salt Range of the Punjab, where, on account of their colour they were referred to as the "Clive group" by

A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 104, 1877). *Cardita Beaumonti* has also been found in parts of Baluchistan, for instance, at Mazar Drik (29° 50′; 68° 41′) and in the Pab sandstones, which are regarded as Mæstrichtian to Lower Danian by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 177, 192, 1908). *Cardita Beaumonti* has also been recognised by G. H. Tipper (*Rec., Geol. Surv., Ind.*, XXXV, 119, 1907) among fossils collected by W. Theobald from the "Axial group" of Burma. A closely related form identified with *Cardita Jaquinoti* d'Orb. occurs in the Ninniyur beds on the Coromandel coast, and on account of this and other palæontological correspondences, E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 195, 1908) correlates this well known formation in Western India with the Ninniyur beds of Trichinopoly and the Nerinæa beds of the Pondicherry Cretaceous.

Carnatic gneiss.—Term proposed by W. King (*Mem., Geol. Surv., Ind.*, XVI, 125, 1880) for the schistose gneisses of South India, including rocks like micaceous, talcose, hornblendic and quartzose schists, such as those of the Nellore mica-bearing area.

Central gneiss of the Himalaya.—Applied by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 15, 1866) to "the principal geological axis of the North-Western Himalaya," and corresponding in its relationship to the stratified rock with the central gneiss of the Alps. The granitic constituent of the central gneiss was proved by C. A. McMahon (see literature indexed, *Rec., Geol. Surv., Ind.*, XX, 206, 1887) to be intrusive; and at one of Stoliczka's type localities, Changrizang (32° 2′; 78° 41′) on the Para river in Spiti it was found to be intrusive into Permian strata (Hayden, *Mem., Geol. Surv., Ind.*, XXXVI, 8, 1904).

Ceratite beds of the Salt Range.—A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 69, 96, 1878) described these as resting conformably (p. 66) on the "Carboniferous" (Productus) limestones. W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. II, 3, 1895) recognised the Triassic age of the beds and divided them into—

Dolomite series	Topmost limestones. Dolomitic beds.
Bivalve limestones	Bivalve beds. Upper Ceratite limestone.
Ceratite beds proper	Ceratite sandstone. Ceratite marl. Lower Ceratite sandstone.

F. Noetling (*Neues Jahrb. f. Min.*, XIV, 1901, 448) distinguishes the series by the name *Scythian* and divides the beds as follows:—

Scythian Series (Noetling).

Upper division.	Olive-coloured limestones.	Hedenstrœmia beds.	5. Zone of *Stephanites superbus.*
	Sandy, light grey limestones and sandstones.		4. Zone of *Flemingites Flemingianus.*
Middle division	Dark grey shales .	Meekoceras beds	3. Zone of *Koninckites volutus.*
			2. Zone of *Prionolobus rotundatus.*
Lower division .	Grey limestone .		1. Zone of *Celtites* sp.

The whole series is regarded as equivalent to the Bunter (p. 464) of the European Trias.

Chakrata series.—The name provisionally given by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XVI, 193, 1883) to some unfossiliferous quartzites, slates and limestones in Jaunsar. Afterwards replaced by the same author (*Rec., Geol. Surv., Ind.*, XXI, 131, 1888) by the term Jaunsar (Jaonsar) system. Chakrata (30° 43′; 77° 54′) is the name of a cantonment near Mussoorie in the Dehra Dun district.

Champaner beds.—Named by W. T. Blanford (*Mem., Geol. Surv., Ind.*, VI, 202, 1869) from the old town of Champaner (22° 29′; 73° 32′) in the Panch Mahals, formerly the capital of the Mahommedan kingdom of Gujarat. The rocks grouped under this name appear to be a south-westward extension of the Aravalli system; they include a prominent quartzite with conglomerates, slates, limestones and occasional ferruginous bands, and they appear to pass gradually into gneisses from which a distinct boundary

cannot be marked. The area originally described is about 30 miles east-north-east of Baroda.

Chappar shales.—Name, derived from the Chappar Rift near Harnai in Baluchistan, used by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXIII, 93, 1890) for beds afterwards considered to be equivalent to the upper part of the Belemnite beds (*Rec., Geol. Surv., Ind.*, XXV, 19, 1892).

Chari group.—Name used by F. Stoliczka (unpublished report) for one of the divisions of the Jurassic of Cutch (Kachh). Chari (23° 34′ ; 69° 19′) is the name of a village 32 miles north-west of Bhuj, from which fossils were first obtained by Captain Grant (*Geol. Trans.*, 2nd series, V, 1840). The group has been divided into four sub-divisions characterised by lithological differences and fossil contents. W. Waagen (*Pal. Ind.*, Ser. IX, Vol. I, 1873) gives the ammonite zones.

4. Oolites (Dhosa oolites) with *Stephanoceras polyphemus, Perisphinctes indogermanus, Aspidoceras perarmatus*, etc.	Zone of *Amaltheus cordatus.* Zone of *Amaltheus lamberti.*	Lower Oxfordian.
3. White limestone with *Peltoceras athleta, Oppelia bicostatus*, etc.	Zone of *Peltoceras athleta.*	Callovian.
2. Shales and ferruginous nodules with *Perisphinctes anceps, P. obtusicosta, Harpoceras lunula*, etc.	Zone of *Perisphinctes anceps.*	
1. Shales with calcareous bands and locally golden oolite with *Stephanoceras macrocephalus, tumidus*, etc.	Zone of *Stephanoceras macrocephalus.*	

Charnockite.—Named by T. H. Holland (*Journ. As. Soc., Beng.*, LXII, 162, 1893) after Job Charnock, the founder of Calcutta, whose tombstone (1695) was the first specimen of the rock described. It is essentially a hypersthene-granite of sp. gr. 2·67, composed of hypersthene, microline, quartz and iron-ores, with about 75 per cent. SiO_2 ; 11—13 per cent. Al_2O_3 ; 5 per cent. FeO and Fe_2O_3 ; 0·65 per cent. MgO ; 0·75 per cent. CaO ; 6 per cent. K_2O and 1·5 per cent. Na_2O.

Charnockite series.—Name proposed by T. H. Holland (*Mem., Geol. Surv., Ind.*, XXVIII, 120, 242, 1900) for the rocks resembling the pyroxene-granulites and pyroxene-gneisses of Europe and America. They include pyroxene-bearing forms varying in composition from hypersthene-granite (charnockite) to pyroxenite, and are regarded as part of the Archæan complex of India. Previously named "Nilgiri or mountain gneiss" by W. King (*Mem., Geol. Surv., Ind.*, XVI, 125, f.n., 1880).

Chaungmagyi series.—Name proposed by T. H. D. La Touche (*Rec., Geol. Surv., Ind.*, XXXVII, 53, 1909; *Mem., Geol. Surv., Ind.*, XXXIX, 47, 1913) from a river of that name in the Northern Shan States, for a series of unfossiliferous red, purple and grey quartzites, slaty shales and felspathic grits, generally showing signs of alteration. Its age is considered to be doubtfully Cambrian, as the rocks had suffered deformation and denudation before the deposition upon them of true Ordovician strata. They are compared to the Shillong series on the one hand and to the Hu-t'o system of Northern Shan-si in China and also to the "Untersinische Schichten" in Shantung on the other hand.

Cherra sandstone.—The sandstones underlying the Nummulitic limestone near Cherrapoonjee (25° 17′; 91° 47′) in the Khasi hills of Assam were regarded by T. Oldham (*Quart. Journ. Geol. Soc.*, XIX, 526, 1863) as Upper Cretaceous in age. The fossils collected by H. B. Medlicott were identified by F. Stoliczka (*Mem., Geol. Surv., Ind.*, VII, 181, 1869) and regarded as having a facies similar to that of the Utatur stage on the Coromandel coast. The Cretaceous beds of Tharia Ghat (25° 11′; 91° 48′) contain also many Ariyalur fossils (*loc. cit.*, p. 183).

Cheyyeru (Cheyair) series.—The thickest of the series forming the Cuddapah system, so named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 127, 1872) from the river Cheyyeru which traverses the series in the Cuddapah district. Composed of—

(*b*) Pullampet slates
(*a*) Nagari quartzites
} About 10,500 feet.

Chidamu beds.—One of the sub-divisions of the middle Spiti shales including fossils of Kimmeridgian and Lower Tithonian age. The name was introduced by C. Diener (*Denk. k. Akad. Wiss.* Wien., Math.-naturw. Classe, Bd. LXII, 587, 1895). The

ammonite fauna is described by V. Uhlig (*Pal. Ind.*, Ser. XV, Vol. IV, fasc. 1, 2 and 3).

Chidru beds.—Name given by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) to the topmost beds of the Upper Productus limestones of the Punjab Salt Range. Named from the village of Chidru (32° 33′; 71° 50′) in the western part of the range. Regarded by Waagen as about equivalent to the Otoceras beds of the Central Himalayas and near the passage between the Permian and Triassic systems.

Chikiala stage.—Named by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 290, 1881) from the village of Chikiala (19° 3′; 79° 59′), situated near the boundary of the stage, but actually on the underlying Kota sandstone. Considered to be resting unconformably on the Kotas and doubtfully grouped with the Upper Gondwanas, being unfossiliferous and lithologically similar to the Tripetty sandstones.

Chikkim limestones and shales.—Named by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 116, 1866) from the Chikkim hill (32° 21′; 78° 3′) in Spiti. Fossils found only in the limestone which lies below the shale; but the two together were regarded as Cretaceous in age (see also Hayden, *Mem., Geol. Surv., Ind.*, XXXVI, 86, 1904).

Chilpi beds.—Named by W. King (*Rec., Geol. Surv., Ind.*, XVIII, 187, 1885) from the Chilpighat (22° 10′; 81° 7′) on the road from the Bilaspur plains to the Mandla plateau. Quartzites, dark-green and buff-coloured slates, shales, conglomerates and numerous beds of trap. Generally much disturbed, but sometimes gently inclined. Stratigraphical position left in doubt, but probably equivalent to the Bihar transitions, Dharwarian. L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVIII, 282-283, 1909) correlates them with the latter.

Chin series.—Name proposed by F. Noetling (*Rec., Geol. Surv., Ind.*, XXVIII, 62, 1895; *Pal. Ind.*, New Ser., I, 5, 1899-1901) for the formations known to W. Theobald as the Axial group (*q. v.*) in the Arakan Yoma. Noetling considers these rocks to be Cretaceous or Eocene in age, and, though in doubt about this, asserts that they are certainly not Triassic. So named from the wild Chins who live in the Arakan hills.

Chintalpudi sandstones.—Name introduced by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877) for a lower sub-division of the Kamthi beds in the Godavari district, less coarse in character than the overlying Dummapett sandstones, corresponding possibly to the Tarcherla sandstones of Hyderabad and the Central Provinces. In a later paper (*Mem., Geol. Surv., Ind.*, XVI, 205, 1880) the name is applied to the whole of the Kamthis in this district and the Dummapett sub-division is dropped. Chintalpudi (17° 3′; 81° 3′) is the name of a village in the district.

Chirakhan.—See **Deola.**

Chitor gneiss.—C. A. Hacket (*Rec., Geol. Surv., Ind.*, XIV, 299, 1881). Name applied to a great spread of granitic gneiss exposed near Chitor (24° 52′; 74° 41′) in Udaipur State, Rajputana. The stratigraphical relationships of the formation are not defined, but it is probably part of the intrusive gneissose granites of the Aravallis.

Conularia bed.—Term applied to the upper part of a boulder bed in the Salt Range considered by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 69, 1878) as belonging to his Olive group and therefore of Cretaceous age. The discovery of Conulariæ in concretions in this bed by H. Warth (1884) enabled W. Waagen (*Rec., Geol. Surv., Ind.*, XIX, 22, 1885) to point out the Palæozoic age of this deposit. R. D. Oldham (*ibid.* 127) considered the concretions as derived and not contemporaneous, a conclusion with which H. B. Medlicott did not entirely agree (*ibid.* 131). Further discoveries of fossils in the overlying calcareous sandstones described by Waagen (*Pal. Ind.*, Ser. XIII, Vol. 4, 143 *et seq.*) definitely proved the age and the close relationship of the fossils to those of marine sediments intercalated with the Upper Palæozoic glacial formation of Australia. Warth (*Rec., Geol. Surv., Ind.*, XX, 118, 1887) insists on the identity of the boulder bed wherever found in the Salt Range, and consequently that of the speckled sandstones in the west, with the Olive group in the east. With this view subsequent writers are all in agreement.

Coralline limestone.—Highest of three divisions of the marine Cretaceous rocks of Bagh (*q. v.*), previously recognised by early workers but formally marked off as a stratigraphical

unit by P. N. Bose (*Mem., Geol. Surv., Ind.*, XXI, 2, 35, 42, 1885) following the name used by H. J. Carter (*Journ., Bomb. Br. Roy. As. Soc.*, V, 237, 1857). Bose correlates this stage with the Ariyalur of South India (*loc. cit.* 44).

Corundum.—Name given by C. Greville (*Phil. Trans.*, Vol. 88, 403, 1798) from the Hindustani name کرند (korund), by which the mineral has been known and used in India for many generations. The recognition of the ruby and sapphire as varieties of corundum is due to Count de Bournon (*Phil. Trans.*, Vol. 92, 233, 1802), who worked on material probably from Sittampundi in the Salem District, where the corundum occurs in a matrix of anorthite (indianite).

Cuddalore sandstones.—Named by H. F. Blanford (*Mem., Geol. Surv., Ind.*, IV, 27, 165, 1862) from the town of Cuddalore, the headquarters of the South Arcot district, Madras Presidency, (11° 43′; 79° 49′). Various occurrences of beds referred to this series have been found near the east coast of India as far north as Midnapur, and W. King (*Rec., Geol. Surv., Ind.*, XV, 93, 1882) refers the Warkalli beds of the Travancore coast to the same series. The beds unconformably cover the Cretaceous deposits, and are practically undisturbed; they have been consequently referred to as "young." R. B. Foote (*Mem., Geol. Surv., Ind.*, XX, 41, 1883) reports the association of grits, similar to those of the Cuddalore series, with sub-recent marine beds on the Travancore coast. A few occurrences of marine formations of Miocene age have been reported at different places around the coast, as at Quilon, Karikal and in Mourbhanj (see E. Vredenburg, *Rec., Geol. Surv., Ind.*, XXXVI, 321, 1908). It seems possible therefore that beds of different ages have been concealed by laterite and other recent formations around the Indian coasts.

Cuddapah beds.—The representatives of the system known to T. J. Newbold (*Journ., Roy. As. Soc.*, VIII, 159, 1844) as the "Diamond Sandstone, and Limestone" in Southern India. They evidently include King's Cuddapah and Kurnool systems (*q.v.*); for they are described as occupying an area of 9,000 square miles between the 13th and 17th parallels, stretching north as far as the left bank of the Kistna, near Waripilly and covering the eastern and central portions of the Eastern Ghats to Naggery, the adjacent table-lands of

Cuddapah, Kurnool, Tripetty and part of North Arcot to the north frontier of Mysore. (See *Cuddapah system.*)

Cuddapah system.—Name given by W. King (*Rec., Geol. Surv., Ind.*, II, 5, 1869; *Mem., Geol. Surv., Ind.*, VIII, 1, 1872) from one of the districts in the Madras Presidency in which this system of unfossiliferous, ancient strata is largely developed. The system is now included in the Purana group and regarded, like the Gwaliors, Bijawars, etc., as probably pre-Cambrian in age. King sub-divided the system as follows:—

Kistna series, 2,000 feet .	Srishalam quartzites. Kolamnala slates. Irlakonda quartzites.
Nallamalai series, 3,400 feet	Cumbum slates. Bairenkonda quartzites.
Cheyair series 10,500 feet .	Pullampet slates. Nagari quartzites.
Papghni series, 4,500 feet.	Vempalli slates. Gulcheru quartzites.

To the Cuddapahs King relegated such occurrences as the Pakhals and Penganga rocks.

Cumbum slates.—The upper part of the Nallamallai series in the Cuddapah system. Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 227, 1872) from the village of Cumbum (15° 34′; 79° 9′) in the Kurnool District.

Dag beds.—Name used by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XXV, 106, 1892) for beds exposed near Dag, which were originally supposed by W. Waagen [Salt Range Fossils, Geol. Results, *Pal. Ind.* (IX), Vol. IV, 13] to be Attock slates. Griesbach considers them as more probably a flysch facies of the Upper Murree beds.

Dagshai stage.—A sub-division of the Lower Sub-Himalayan system, afterwards the Sirmur series (*q. v.*) distinguished by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, Vol. III, pt. 2, 17, 1864) and named from the hill station (30° 53′; 77° 6′) in the Simla district. The rocks are grey or purple sandstone with purple or bright-red clays, without recognisable fossils, and were supposed to afford a conformable passage from the Eocene Subathu to the Lower Miocene Kasauli beds. R. D. Oldham (unpublished note) thinks it possible that the Kasauli and Dagshai beds are local variations of the same stage or series, whilst G. E. Pilgrim

(*Rec., Geol. Surv., Ind.* XLI, 83, 1911-12) regards the two series as of perfectly distinct ages, the Dagshai however being markedly unconformable to the Subathu, and probably representing the lower portion of the Murrees (*q. v.*).

Dalchipur sandstone.—Stage recognised by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 1860) in his Semri (afterwards Lower Vindhyan) series in Bundelkhand. From the town of Dalchipur (24° 10′; 79° 5′).

Daling series.—A series of schists and gneisses covering a large part of the Darjeeling district and the Duars. Named by F. R. Mallet (*Mem., Geol. Surv., Ind.*, XI, 12, 1875) from Dalinkot (27° 1′; 88° 46′). The beds appear to underlie and pass gradually into the Darjeeling (Sikkim) gneissose granite; they also appear to overlie the Damuda and the Buxa series, but the apparent position may be due to inversion.

Damdama quartzites and conglomerate.—A sub-division of the Alwar quartzite group, named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 86, 1877) from the village of Damdama (26° 54′; 77° 19′) in the Bharatpur State, Rajputana.

Damuda series.—Named by T. Oldham (*Journ., As. Soc. Beng.*, XXV, 253, 1856) from the river which runs through or near the great Bengal coalfields in which the Damuda series is well developed and includes the chief coal seams. See also W. T. and H. F. Blanford, *Mem., Geol. Surv., Ind.*, I, 46, 56 and 84 (1859), who regarded these beds with the underlying Talchirs (*loc. cit.*, p. 82) as not more recent than Permian, though they had previously been regarded as probably Jurassic. The term Lower Damuda was used first by W. T. Blanford (*Mem., Geol. Surv., Ind.*, III, 29, 1861) for the stage subsequently named Barakar, but the term "Upper Damuda" had been previously used in the Narbada area for beds regarded as younger than the upper division of the Damudas in Bengal.

Dangot sandstones.—Name used by A. B. Wynne (*Rec., Geol. Surv., Ind.*, Vol. X, 120, 1877) for Siwalik rocks near Kalabagh, considered equivalent to the Upper Siwaliks. W. Waagen (Geol. Results: Salt Range, *Pal. Ind.*, Ser. XIII, Vol. IV, 17) considers them to be Middle Siwaliks. The name is from Dangot hill, (32° 59′; 71° 40′) near the Indus river, east-north-east of Kalabagh in the Mianwali district.

Daonella beds.—Term first used by C. L. Griesbach (*Mem., Geol., Surv., Ind.*, XXIII, 66, 1891) for the lower part of the Upper Trias of the Himalaya (*cf.* Diener, *Denk. k. Akad. Wiss.*, Wien, 587, 1895). It was also used in the same way by Hayden and von Krafft (Director's General Rep., 1899-1900, 193, 228, and 229). Later it was divided into—

Daonella limestone
Daonella shales.

(Diener, *Mem., Geol. Surv., Ind.*, XXXVI, Part 3, 13, 73, 1912.)

Deccan trap.—The commonest form of rock among the great Deccan trap-flows is a dark-green basalt without olivine in which a basic plagioclase and augite are the chief constituents (C. A. McMahon, *Rec., Geol. Surv., Ind.*, XVI, 42-50, 1883; XX, 111, 1887). These traps frequently contain vitreous material and sometimes palagonites (C. S. Middlemiss, *Rec., Geol. Surv., Ind.*, XXII, 226, 1889). The name is derived from *dakshin*=south, the Deccan corresponding to that part of the Peninsula south of the Vindhyan range.

Delhi series.—Named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, XIV, 281, 1881) because the quartzites which form such a prominent constituent of the series continue from Rajputana to the famous ridge near the city of Delhi (28° 39′; 77° 17′). Consists of a lower stage composed of slates and limestones and an upper stage mainly of quartzites (Alwar quartzites). Considered by R. D. Oldham (Man. Geol. Ind., 2nd Ed., 1893, 71, 72) to be equivalent to or in part younger than the Gwaliors.

Denwa stage.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, X, 153, 1872) from the Denwa river, one of the rivers draining the northern slopes of the Pachmarhi range in the Central Provinces. The Denwa is the middle stage of the Mahadeva series in the Satpura region, and is approximately equivalent to the Kota-Maleri stage of the Godavari valley.

Deoban limestone.—Named by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XVI, 195, 1883) from the Deoban peak (30° 45′; 77° 56′) north of Chakrata. Pale-grey limestones, often dolomitic, mephitic and sometimes oolitic, with cherty concretions. Sometimes shows stromatoporoid structures which have been found in similar dolomitic limestones in other parts of the Outer Himalayas (*cf.* T. H. Holland, *Rec., Geol. Surv., Ind.*,

XXVII, 58, 1894). The Deoban limestones were regarded by Oldham to be older than the Simla carbonaceous system. Rocks of this kind strongly resemble some of those among the Cuddapahs and other parts of the Purana group in Peninsular India.

Deola and Chirakhan marl.—Middle division of the Bagh Cretaceous beds recognised by P. N. Bose (*Mem., Geol. Surv., Ind.*, XXI, 2, 35, 39, 1884) and regarded as approximately equivalent to the Trichinopoly stage of the Coromandel Cretaceous formations (*loc. cit.*, 41). Deola (22° 20′ ; 75° 12′) and Chirakhan (22° 23′ ; 75° 12′) are villages in the Lawani district of the Indore State.

Dhaman.—A Persian word meaning a skirt, often applied to the great alluvial fans formed at the base of the hills in Persia, Baluchistan and Afghanistan.

Dharwar system.—R. B. Foote in 1882 indicated that in South India three sub-divisions would have to be recognised among the crystalline rocks to distinguish those intermediate in character between the typically schistose and the typically granitoid rocks of Mysore and the South Mahratta country (*Rec., Geol. Surv., Ind.*, XV, 202). In 1886 he proposed to distinguish those which he described generally as "sub-metamorphic" by the name of *Dharwar* (*Rec., Geol. Surv., Ind.*, XIX, 98), from the district and town in the southern part of the Bombay Presidency. He regarded the Dharwars as resting unconformably on the granitoid gneisses, and to be younger generally than the rest of the crystalline complex. The bands of Dharwars exposed in South India were regarded as mere remnants of a great spread of the system of rocks which once covered the gneisses (*Mem., Geol. Surv., Ind.*, XXV, 74). The rocks of the system include—hornblendic and chloritic schists, hematitic quartzites, phyllites and sometimes metamorphosed conglomerates. The hornblende-schists are sometimes altered basic igneous rocks which occasionally retain the original diabasic structure. The whole assemblage of rocks thus resembles generally those known as the Lower Huronian of Canada, and various occurrences of the kind associated with the Archæan basement complex in different parts of the world. Some of the gneissose granites show locally an intrusive trespass with regard to the Dharwars ; in other cases pebbles of gneiss are found in the conglomerates of

the Dharwars. It thus appears that some of the gneissose granites are younger and some much older than the typical Dharwars. But there is a marked contrast between the age of the Dharwars and associated gneisses and schists and the unmetamorphosed Cuddapahs and other sedimentary rocks resting on them; hence the various kinds of gneisses and schists have been grouped with the Dharwar types to form the Archæan group (T. H. Holland, Imper. Gazetteer, I, 59, 1907; *Trans., Min. and Geol. Inst., Ind.*, I, 47, 1906). This arrangement differs from that recognised by R. B. Foote, who regarded the Dharwar system as essentially younger than the associated gneisses, which he considered to be Archæan (*Mem., Geol. Surv., Ind.*, XXV, 26, 1895). T. J. Newbold and others in the earlier part of the nineteenth century referred to the Dharwars as "hypogene schists," and regarded them as older than the associated gneissose granites.

The Mysore Geological Department in their work on the Dharwars have come to the conclusion that as a whole they are older than the gneissic complex with which they are associated. The Dharwars have been split into two divisions, hornblende schists and epidiorites (altered lava flows) below, with chlorite schists above. The gneiss is considered to be intrusive into both of these and the intrusion took place by a series of lateral invasions of more or less horizontal sills of varying dimensions and different in character from the ordinary intrusion of an acid rock. The so-called "conglomerates" at the base of the hornblende schists in the Kolar belt and at various horizons above in other areas are looked on as autoclastic crush formations.

W. F. Smeeth (*Mysore Geol. Dept., Records*, xi, General Report, 36, 1910) gives the following sequence for the Chitaldrug schist belt from above downwards:

7. All dolerite dykes so far as known.
6. Chitaldrug granite.
5. General gneissic complex forming the bulk of the country on either side of the schist belt and intrusive into the latter.
4. Intrusive granitic material, including the so-called ferruginous sandstones of the Guddadrangavanhalli (G. R.) formation and Aimangala conglomerate. Age doubtful.

3. Mallapanahalli crush conglomerate.

Relative ages of 4 and 3 doubtful.

2. Chitaldrug formation.
   (*a*) Grey trap, intrusive in the chlorite schists.
   (*b*) Chalybitic traps.
   (*c*) Chloritic schists and ferruginous quartz schists.

The G. R. formation probably consists of local alterations of these rocks.

1. Javanhalli formation.
   (*a*) Dark hornblende schists and epidiorites.
   (*b*) Quartz-magnetite rocks.
   (*c*) Quartzites or quartz schists.

In the Shimoga area, the Shimoga schists would seem to correspond to the Chitaldrug formation, while in the Kolar belt the Kolar schists are equivalent to the Javanhalli.

Dhosa oolite.—Uppermost member of the Chari stage (*q.v.*) of the Jurassic series in Cutch (W. Waagen, *Pal. Ind.*, Ser. IX, Vol. I, Introduction, 1873).

Diamond sandstone, and limestone.—T. J. Newbold (*Journ., Roy. As. Soc.*, VIII, 156, 1844) used this expression to include "beds of limestone, sandstone, sandstone-conglomerate (the latter often imbedding diamonds), argillaceous, arenaceous, and siliceous schists" which he found "resting immediately on the hypogene and plutonic rocks" in Southern India. From this account of their geographical distribution Newbold evidently had in mind the formations now known as Cuddapah and Kurnool as well as the equivalent Kaladgis, etc. He describes their occurrence in isolated patches as *Cuddapah beds, Godavery beds, South Mahratta country beds* and *Hyderabad beds.* Newbold considered (*ibid.*, Vol. XII, 91) that the limestones and associated sandstones might be Carboniferous or Devonian, but he pointed out that the only apparently organic structures found were obscure.

Dihing series (Dehing).—Name applied by F. R. Mallet (*Mem., Geol. Surv., Ind.*, XII, 298, 1876) to the conglomerates overlying the Tipam sandstones in North-East Assam, and with these regarded as representatives of the Sub-Himalayan Siwalik system and the "Fossil-wood" (Irrawaddy) series of Upper Burma (*loc. cit.*, pp. 300, 301).

Disang series.—Named by F. R. Mallet (*Mem., Geol. Surv., Ind.*, XII, 286, 1876) from the Disang river in North-East Assam. Regarded on indirect evidence as older than the local Tertiary Coal Measures, and probably equivalent to the similar Negrais series of the Arakan Yoma. Similar rocks were noticed by F. H. Smith, (*Mem., Geol. Surv., Ind.*, XXVIII, 91, 1898) in the Mikir hills to be overlying the Nummulitics, and he suggested consequently that the Disangs also are post-Nummulitic.

Doab series.—Composed mainly of volcanic ejectamenta interbedded with shales, sandstones, and, locally, conglomerates, unconformably overlying Fusulina limestones, but covered apparently conformably by the plant-bearing Saighan series of Jurassic age. In the absence of fossils the stratigraphical relations are taken to indicate a probable Trias-Jura age. On account of its exposure near the Doab-i-Mekhzarin (35° 17′; 68° 2′), or junction of the Kahmard and Saighan rivers in Eastern Afghanistan, it has been named the Doab series by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXIX, 28, 1911).

Dolomite series.—One of W. Waagen's divisions of the *Ceratite beds* (*q.v.*) of the Punjab Salt Range.

"Dome" gneiss.—A descriptive term adopted for a type of supposed gneiss typically developed in the gneissic area of Northern Bengal, and so called from its weathering into huge hemispherical or ellipsoidal masses of bare rock, the only divisional planes being concentric layers of exfoliation. The hills are often several hundred feet high and form a very peculiar object in the landscape. Foliation is always more or less traceable, and in every respect of texture and composition the rock is the same as that of the thin bands alternating with schists in the adjoining ground. Both are often porphyritic, the dome gneiss generally so, containing large rounded felspar crystals. The earliest description is by H. B. Medlicott (*Rec., Geol. Surv., Ind.*, Vol. II, 42, 1868). In a more recent description, T. H. Holland (*Mem., Geol. Surv., Ind.*, Vol. XXXIV, 47, 1902) shows that the rock is a granitite, being composed of quartz, microcline, with smaller quantities of oligoclase, biotite, hornblende, accessory sphene, etc. The rock further resembles undoubtedly eruptive granites in the possession of autoliths due to local concentration of the ferromagnesian minerals, contemporaneous coarse-grained veins, xenoliths of quartzite and a well-marked zone due to contact action near its

junction with the schists. These features indicate an eruptive origin for this rock and account for its appearance at different horizons in the schists, its occurrence in roughly lenticular bosses, as well as in thin sheets intruded between the schist folia.

Dothak series.—Limestones, sandstones, quartzites, slates and shales near Dothak (27° 37′; 89° 6′) in Eastern Tibet described and named by H. H. Hayden (*Rec., Geol. Surv., Ind.*, XXXII, 162, 1905; *Mem., Geol. Surv., Ind.*, XXXVI, 141, 1907). The rocks underlie Jurassic shales. Although the fossils found were too fragmentary for determination, the beds were considered as possibly in part Triassic. Subsequently (Geog. and Geol. of the Him., part IV, 234, 1908) they are doubtfully referred to the Kanawar system (*q. v.*).

Dravidian group and era.—Name proposed by T. H. Holland (*Trans. Min. and Geol. Inst., Ind.*, I, 49, 1906; Imperial Gazetteer of India, New Ed., I, 56, 64, 1907) for the part of the stratigraphical scale in India between the *Purana* and the *Aryan groups*, that is, from the base of the Cambrian to the conspicuous break which occurs in Upper Carboniferous times. This local group therefore corresponds to the whole of the European Lower Palæozoic and part of the Upper Palæozoic.

Dubrajpur stage.—A band of sandstones and conglomerates, underlying the Rajmahal series, named by T. Oldham (*Pal. Ind.*, Ser. II, Vol. I, 1, 1862) from a village in the Rajmahal hills (24° 26′; 87° 31′). For a full description, see V. Ball (*Mem., Geol. Surv., Ind.*, XIII, 198, 1877).

Dudkur infra-trappean beds.—Term applied by W. King (*Mem., Geol. Surv., Ind.*, XVI, 205, 1880) to the Lametas of the Godavari district containing a distinctly estuarine fauna in limestones and calcareous sandstones from a village (17° 2′; 81° 38′) of that name.

Dummapett sandstones.—Name introduced by W. King (*Rec., Geol. Surv., Ind.*, Vol. X, 56, 1877) for an upper sub-division of the Kamthis in the Godavari district. Later (*Mem., Geol. Surv., Ind.*, XVI, 205, 1880) he drops the term and seems to consider the whole as one formation under the name Chintalpoody sandstones. (See also *Mem., Geol. Surv., Ind.*, XVIII, 115, 116.)

Dunghan limestone.—R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXIII, 94, 1890) proposed this name for a series of beds in Eastern Baluchistan from the high hill (29° 52′; 68° 22′) east of Spintangi. This limestone "caps the bare hog-backed hills east of the Hurnai route to Quetta," but in other places gives way to shales. It is said to be conformably overlaid by the Ghazij series, and to contain a fauna which indicates an age near the gap between the Cretaceous and Tertiary of Europe (*Rec., Geol. Surv., Ind.*, XXV, 23, 1892). Subsequent examination of echinoid fossils obtained from beds which would be included in the Dunghan series indicated a Danian age (F. Noetling, *Rec., Geol. Surv., Ind.*, XXVII, 124, 1894; *Pal. Ind.*, Ser. XVI, Vol. I, Part 3, 7, 1897).

Dwarka beds.—Name proposed by F. Fedden (*Mem., Geol. Surv., Ind.*, XXI, 78, 125, 1884) for a series of beds exposed on the north-west coast of Kathiawar (22° 14′; 69° 1′). They consist of soft, yellow, earthy, gypsiferous clays below, with foraminiferal sandy limestones above. They contain no recognisable fossils, and their relation to the underlying fossiliferous (Gáj) beds was not determinable, but it is probably one of conformity. It is for this reason that they are considered by Vredenburg (Summary of the Geology of India, Table) as equivalent to or synonymous with his Hinglaj series.

Dzongbuk shales.—The uppermost unfossiliferous shales of the Kampa system (*q.v.*) overlying the Alveolina limestone on the Dzongbuk-la (28° 16′; 88° 41′) in Eastern Tibet (H. H. Hayden, *Mem., Geol. Surv., Ind.*, XXXVI, 177, 1907).

Echinosphærites limestone.—Term used by F. Noetling (*Rec., Geol. Surv., Ind.*, Vol. XXIII, 79, 1890) for his Pyintha limestone on account of the occurrence of fossils identified as *Echinosphærites Kingi*. This is really a *Camarocrinus*, allied to the Bohemian genus *Lobolithus* (La Touche, *Mem., Geol. Surv., Ind.*, Vol. XXXIX, 55, 1913; Cowper Reed, *Pal. Ind.*, New Ser., Vol. II, Mem. No. 5).

Encharani quartzites.—Name used by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 229, 1881) for his lowest sub-division of the Sullavai series (Kurnools) in the Godavari valley. Encharani is the name of a conspicuous hill, 1,362 ft. (18° 28′; 79° 46′) in the valley of the Maner river.

Fars series.—Name proposed by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 25, 26-51, 1908) for a series of beds very extensively developed in Southern Persia and the Gulf region. Equivalent to the lower part of Loftus' Gypsiferous series, which name is dropped. Divided into three divisions—

3. Coast beds or *Pecten vasseli* beds (Sarmatian).
2. Plateau beds or *Ostrea verleti* beds (Tortonian).
1. Basal gypsum beds (Helvetian).

Fermorite.—Mineral named by G. T. Prior and G. H. F. Smith after L. L. Fermor (*Nature*, LXXXIII, 513, 1910; *Min. Mag.*, XVI, No. 74, 84, 1911). Arsenate, phosphate, and fluoride of calcium and strontium, isomorphous with apatite. Found by L. L. Fermor among the manganese-ores at Sitapar in the Chhindwara district, Central Provinces.

Fossiliferous limestone of Pondicherry.—T. J. Newbold (*Journ., Roy. As. Soc.*, VIII, 213, 1844) thus refers to the Cretaceous rocks of the Pondicherry area, quoting the conclusions of Forbes and Murchison regarding the Cretaceous age of the fossils collected by himself and Messrs. Kaye and Cunliffe.

Fossil-wood series.—Term originally suggested by W. Theobald (*Rec., Geol. Surv., Ind.*, II, 79, 1869; *Mem., Geol. Surv., Ind.*, X, 247, 1873) for the sandstones in the Irrawaddy valley characterised by large quantities of silicified wood. Afterwards named *Irrawaddy system*, or series, by F. Noetling with the consent of W. Theobald (*Rec., Geol. Surv., Ind.*, XXVIII, 151, 1895).

Freshwater beds of Sur.—G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 54, 1908). A series of shaly and sandy limestones, 30 miles from Sur (22° 34′; 59° 30′) on the coast of 'Oman, south-east of Muscat. Age unknown; possibly Pliocene and at least Miocene from their position.

Freshwater limestone and chert.—T. J. Newbold (*Journ., Roy. As. Soc.*, VIII, 219, 1844) used this term for the freshwater limestones under the Deccan Trap now known as Lametas (*q. v.*). He regarded the fossils as of Tertiary age.

Frog beds.—Name given by A. B. Wynne (*Mem., Geol. Surv., Ind.*, Vol. VI, 385, 1869) to certain shale bands intercalated with ash beds which were exposed during the reclamation works of Back Bay, Bombay, showing numerous skeletons of frogs determined by F. Stoliczka (*ibid.*, 387) as *Oxyglossus pusillus=Rana pusilla*, Ow.

Gaj series.—"A superb section of the strata forming this group is exposed on the banks of the Gaj river.....which cuts..... through the Kirthar range, south-west of Mehar in Sind," and from this river the series was named by W. T. Blanford (*Rec., Geol. Surv., Ind.*, IX, 9, 1876; *Mem., Geol. Surv., Ind.*, XVII, 53, 1880). The beds rest with stratigraphical conformity on the Nari series, and above appear to pass up into a series of estuarine clays and sandstones, which Blanford regarded as part of the Manchhar series, but which, according to E. Vredenburg, are distinctly older and should be separated under the name Hinglaj (*q.v.*). Blanford regarded the Gaj as Miocene, possibly Upper Miocene, in age. This agrees with the conclusions of P. M. Duncan and W. P. Sladen [*Pal. Ind.*, Ser. XIV, I, (1), 104, 1880; (3), 276, 1885]. E. Vredenburg however (*Rec., Geol. Surv., Ind.*, XXXIV, 267, 1906) regards the Gaj as Upper Aquitanian (Oligocene). G. E. Pilgrim has shown (*Rec., Geol. Surv., Ind.*, XL, 187, 188, (1910), *Pal. Ind.*, New Ser., II, pt. 2 (1912), that the Kuldana beds, which underlie the Murrees and the Bugti bone beds are of Upper Aquitanian (*i.e.*, Gaj age). A characteristic fossil of the uppermost Gaj in Western India, *Ostrea latimarginata* Vred., has been found at about the middle of the Yenangyaung series in Upper Burma and partly in consequence it has been proposed to use Theobald's term Prome series for this and the beds below, regarding them as equivalent to the Gaj of Western India, while the overlying Kama clay series is equivalent to part of the Hinglaj series of Baluchistan (E. Vredenburg and M. Stuart, *Rec., Geol. Surv., Ind.*, XXXVIII, 127, 129, 1909). Fossiliferous rocks of Gaj age have been found by G. H. Tipper (*Mem., Geol. Surv., Ind.*, XXXV, 202, 1911) in the Andaman Islands and in the Arakan Yoma.

Ganurgarh shales.—The lowest stage of the Lower Bhander series in the Upper Vindhyans, distinguished by F. R. Mallet (*Mem., Geol. Surv., Ind.*, VII, 27, 28, 1869) and named from the Ganurgarh hill fort, north-west of Hoshangabad.

Ghazij series.—R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXIII, 95, 1890) provisionally used the name Ghazij for a series overlying his Dunghan limestones in Eastern Baluchistan, and consisting of "a great thickness of grey and olive-green shales, with subsidiary beds of lime and sandstone and, locally, coal." The name adopted is that of the valley which runs down from

near the Dunghan mountain (29° 52′ ; 68° 22′) to Spintangi (29° 55′ ; 68° 8′). This series is correlated by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIV, 87, 182, 1906) with the upper part of the Laki series of Sind, being regarded as Lower Lutetian in age. The same series has been recognised in Sarawan (E. Vredenburg, *Rec., Geol. Surv., Ind.*, XXXVIII, 195, 1909), and is the most conspicuously coal-bearing among the Tertiary beds of Western India.

Giri limestone.—A series of limestones at the base of the Kam-pa system of Eastern Tibet. The limestones are unfossiliferous, but rest on Spiti shales and are probably Lower Cretaceous. Described by H. H. Hayden (*Mem., Geol Surv., Ind.*, XXXVI, 162, 1907).

Giumal sandstone.—Named by F. Stoliczka (*Mem., Geol Surv., Ind.*, V, 114, 1866) from the village of Giumal (Gieumal) in Spiti (32° 10′ ; 78° 14′). Correlated with the Upper Jurassic, or *Malm*, although the fossils found were regarded by Stoliczka as not quite satisfactory evidence (p. 139). Now regarded as Cretaceous in age (Hayden, *Mem., Geol. Surv., Ind.*, XXXVI, 86, 1904). Examination of the fossil collections by A. Spitz (*Rec., Geol. Surv., Ind.*, Vol. XLI, 69) indicates a range in age from Middle Neocomian to the base of the Upper Cretaceous.

Godavery beds.—A number of small outlying patches of Newbold's "Diamond Sandstone, and Limestone" system, which stud the plains of the Kistna and the Godavery (T. J. Newbold, *Journ., Roy. As. Soc.*, VIII, 159, 1844). The rocks referred to are those afterwards described by W. King (*Mem., Geol. Surv., Ind.*, VIII, 1872) as the Kistna beds.

Gokteik series.—Name applied by P. N. Datta (Director's General Report for 1899-1900, 118) to some shales 2 miles north of the village of Gokteik (22° 20′ ; 96° 55′) in the Northern Shan States. Some arthropod remains found in these beds were taken to indicate a Mesozoic age. The name has been dropped, as T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 287, 1912) considers the beds to be part of the Napeng or Rhætic stage.

Golapilli series.—Formally introduced as a part of the Upper Gondwanas by W. King (*Rec., Geol. Surv., Ind.*, X, 1877, 56 ; *Mem., Geol. Surv., Ind.*, XVI, 18, 1880). The lowest division of the Upper Gondwanas in the Godavari area, named from the village

of Golapilli (16° 43′ ; 80° 58′) in the Kistna district. Contains typical Rajmahal plant-remains.

Gondite series.—Named by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 306, 1909) from the aboriginal Gonds of the Central Provinces. The rocks are crystalline, and are a local, manganiferous facies of the Dharwar system. Rocks largely composed of spessartite, rhodonite and quartz. Gondite proper is a spessartite-quartz rock, supposed to be the product of metamorphism of sediments, sand and clay, with manganese-oxides. As the result of the oxidation of the silicates, workable manganese-ore deposits have been formed. The oxidation took place, at least in part, in Archæan times, or, at any rate, before the formation of the pegmatites which occur so frequently as part of the fundamental crystalline complex in Peninsular India, for fragments of the fully developed oxide ores have been found as inclusions in these pegmatites (L. L. Fermor, *Rec., Geol. Surv., Ind.*, XLI, 1-11, 1911). Gondites are typically developed in the Balaghat, Bhandara, Chhindwara, Seoni and Nagpur districts of the Central Provinces, but have also been found in the Narukot State, Bombay, in Jhabua State, Central India, in Banswara State, Rajputana, and in Gangpur State, Bengal.

Gondwanaland.—Name given by E. Suess to the great continent which stretched from South Africa to India permanently or temporarily during the Gondwana period from Upper Carboniferous to Jurassic times (Das Antlitz der Erde, Band II, 318, 1888). For a discussion of this question see W. T. Blanford (*Rec., Geol. Surv., Ind.*, XXIX, 52-59, 1896). On this continent were formed the great coal-bearing formations of Africa (Karroo) and India (Gondwana), and the northern shore of the continent was not far from the present line of the Central Himalayan, snow-covered peaks (T. H. Holland, *Rec., Geol. Surv., Ind.*, XXXII, 153, 1905). The name is derived from the Gonds, one of the aboriginal tribes of India.

Gondwana system.—Proposed by H. B. Medlicott in 1872 in his report on the Satpura basin, but omitted from the report when published as *Mem., Geol. Surv., Ind.*, X, Part 1, 1872 (see also *Rec., Geol. Surv., Ind.*, XIV, 11, 1881); and revived by O. Feistmantel in 1876 (*Rec., Geol. Surv., Ind.*, IX, 28). The Gondwana system is composed of conglomerates, sandstones, shales and coal-measures formed typically in fresh water, mainly

in rivers. The beds range in age from about Upper Carboniferous to Jurassic, and are the main source of coal in India, being similar in origin and age to the Karroo system of South Africa. The base of the system (Talchir stage) was regarded from indirect evidence as Permian (W. T. and H. F. Blanford and W. Theobald, *Mem., Geol. Surv., Ind.*, I, 82, 1859). From a consideration of the fossil flora it was moved up to the Trias (O. Feistmantel, *Rec., Geol. Surv., Ind.*, IX, 79, 1876), but more recent work shows the characteristic fossil plants of the Lower Gondwana to be not younger than Upper Carboniferous (H. H. Hayden, *Rec., Geol. Surv., Ind.*, XXXVI, 38, 1907).

Goolcheroo.—See **Gulcheru quartzites.**

Grandite.—Mineral name proposed by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 165, 181, 1909) for a garnet intermediate in composition between grossularite ($3CaO.Al_2O_3.3SiO_2$), but with sometimes an appreciable quantity also of MnO (manganese-grandite). Found in the Ganjam district, Madras Presidency, in rocks similar to the kodurite series.

Great limestone zone.—Name used by C. S. Middlemiss (Director's General Report, 1899-1900, 130) for a great spread of limestones forming the main part of the Southern Shan States plateau. This zone was divided into the following tentative groupings of no precise stratigraphical value. The names are given from the localities where the exposures are best seen.

Pyinnyaung limestone: a massive, dark and light-grey limestone without definite bedding and of high dip, typically exposed near Pyinnyaung in the Karenni country. It is separated from other limestones by purple sandstones, and is compared to the massive limestones and dolomites of the Himalayas like the Krol.

Thamakan limestone: a limestone sometimes massive, but also thin-bedded and marly in places and occasionally sandy. It lithologically resembles the grey limestones of Hazara.

Heho limestone: a blue-grey, fairly well bedded and sometimes concretionary limestone, with ferruginous layers, but without recognisable fossils and of unknown age.

Taunggyi-Hopong-Htam Sang limestone: a varied lot of limestones and associated thin-bedded shales with a few sandy limestones, exposed between Taunggyi, Hopong and Htam Sang villages. Many of the limestones have been completely brecciated and

recemented. Towards the east they contain fossils of apparently Middle Productus Limestone age.

Loi Sampu limestone: shales and inter-banded limestones, the latter containing layers of compacted shells. The limestones resemble those of Heho.

Bamping-Nongsewik limestone: a light-grey limestone resembling that of Thamakan, but slightly more crystalline.

T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 182, 1913) considers that these limestones are in great part the same as the Plateau limestone of the Northern Shan States, but that they are more widely developed.

Grey limestone.—Term used by C. S. Middlemiss (*Mem., Geol. Surv., Ind.*, XXVI, 39, 1896) for beds overlying the Middle Cretaceous and underlying the Nummulitic beds in Hazara. In the absence of recognisable fossils the limestone has been mapped with the Nummulitics.

The name *Grey Limestone* has also been used by A. von Krafft (*Mem., Geol. Surv., Ind.*, XXXII, 132, 1902) for a formation in the Kumaon Himalaya which includes Triassic and Jurassic fossils, and has been named *Kioto Limestone* by H. H. Hayden (Geog. and Geol. of the Him., Pt. IV, 236, 1908).

Gritty sandstones (Cuddalore series?).—Name applied by R. B. Foote (*Mem., Geol. Surv., Ind.*, XX, 35, 1883) to a series of interrupted outcrops of coarse and friable unfossiliferous sandstones and grits along the coast of the Carnatic, petrologically resembling the Cuddalore sandstones with which they are doubtfully correlated.

Gulcheru quartzite.—The lower division of the Papaghni series, and the lowest stage of the Cuddapah system. Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 148, 1872) from the village of Gulcheru (Gulvala Cheruvu) in the Cuddapah district (14° 18′; 78° 49′).

Gwalior system.—Named by C. A. Hacket (*Rec. Geol. Surv. Ind.*, III, 34, 1870) from the city of Gwalior (26° 13′; 78° 12′) in Central India. Divided into two series—

2. Morar series.
1. Par series.

Similar to the typical (original) Bijawars and now regarded as part of the Purana group.

Gypsiferous series.—Name applied by W. T. Loftus (*Quart. Journ. Geol. Soc.* XI, 254, 1855) to the Upper Tertiary rocks in Northern Persia, and apparently including everything above the Nummulitics (*i.e.*, Oligocene). According to G. E. Pilgrim (*Mem., Geol. Surv. Ind.*, XXXIV, 52, 1908), it can be separated into two series, the Fars below and Bakhtiyari above, with a great unconformity between.

Haimanta system.—Named by C. L. Griesbach (*Mem. Geol. Surv. Ind.*, XXIII, 50, 1891) from the fact that this system of rocks is largely developed in the snowclad Central Himalayan mountains. Used for all the strata in the Central Himalaya lying between the crystallines (gneiss and Vaikritas) and the Lower Silurian. Discarded by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXVI, 19, 1904) on determination of the age of the different divisions of the system, the Middle and Upper Haimantas being Cambrian, the Lower Haimantas not being identified (Hayden, *loc. cit.*, p. 9).

Hajigak limestone and hematite.—To the west and north-west of Kabul in Afghanistan there occurs as a narrow band, running about east-north-east to west-south-west, a series of beds composed of hematite below, covered in turn by slate and limestone, the hematite bed resting on the Kalu series. This composite formation has been named by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXIX, 24, 1911) from the Hajigak pass (34° 39′; 68° 7′) and was regarded as Devonian from a preliminary determination of the fossils in the limestones. F. R. Cowper Reed (*Rec. Geol. Surv. Ind.*, XLI, 103, 1911) finds that the fossils in the limestones show an Upper Devonian age.

Halorites limestone.—An Upper Triassic horizon exposed on the southern slope of the Bambanag range above the Girthi valley in the Central Himalaya of Kumaon has become generally so known on account of the Ammonite, *Halorites*, being prominent among the abundant fossils which it has yielded. According to E. von Mojsisovics (*Pal. Ind.*, Ser. XV, III, Pt. 1, 131) this limestone can be correlated with the Lower Noric (Lacic) stage of the Hallstatt limestone including, however, certain fossils of Middle Noric (Alaunic) age. These conclusions are accepted by C. Diener (*Rec. Geol. Surv. Ind.*, XXXIV, 1, 1906).

Hatat series.—Name proposed by G. E. Pilgrim (*Mem. Geol. Surv. Ind.*, XXXIV, 7, 8, 1908) for a series of mica schists, talc schists, and

quartzites bearing a considerable resemblance to the Dharwars, and for this reason supposed to be Archæan. The name is derived from the plain of Saih Hatat in Oman, Arabia.

Hauerites beds.—Name introduced by C. Diener (*Denks. k. Akad. Wiss.* Wien, LXII, 544, 548, 1895) for a nodular limestone forming the lowest noric stage of Painkhanda. It was replaced later by the name of the Zone of *Proclydonautilus Griesbachi*. The fragments of ammonites assigned to the genus *Hauerites* have been proved by Diener (*Pal. Ind.*, Himal. Foss., ser. XV, V, Mem. No. 3, 108) to belong to a new sub-genus closely related to the Alpine *Carnites floridus* Wulf.

Haveli series.—Name proposed by E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIII, 259, 1906) for the beds previously known as Lower Bhander in the Upper Vindhyan system. The beds so grouped are mostly shales and limestones with subordinate sandstone, and are thus contrasted with the prevalent sandstones of the next series above (Betwa, old Upper Bhander). Name from the elevated valley plain known as the Haveli, in Southern Bundelkhand.

Hedenstræmia beds.—Name proposed by A. v. Krafft (Director's General Report for 1899—1900, 207) from the characteristic ammonite to replace "Subrobustus beds" (*q.v.*), proposed by Diener.

Helmand series.—An extensive series composed mainly of highly folded quartzites and slates, locally altered into chiastolite schists in contact with granite, and occasionally crystalline limestone and conglomerate. No fossils have been found in the series, but its relations to some of the Fusulina limestones near Ak Robat (34° 55′; 67° 42′) in Eastern Afghanistan suggest a Lower or Middle Carboniferous age, thus filling the gap between the Upper Devonian Hajigak series and the Upper Carboniferous Fusulina limestones. The series has been described by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXIX, 25, 1911) from its occurrence in the upper Helmand valley.

Hingir stage.—Named by V. Ball (*Rec. Geol. Surv. Ind.*, VIII, 112, 1876) from the Zamindari of Hingir (21° 57′; 83° 46′) north of Sambalpur. The beds consist of coarse ferruginous sandstones and conglomerates with beds of red shale, overlying the Barakars unconformably. They have been correlated with the Kámthis (Man. Geol. Ind. Ed. 1, 210, 1879).

Hinglaj stage.—E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIV, 90, 1906) applies the name of the Hinglaj mountain range in the Makran to the shales and sandstones which conformably overlie the Gaj series in that area. They are regarded as mostly Burdigalian in age, but possibly reaching to the Sarmatian in the upper beds (*loc. cit.*, 175), and it is asserted that, in consequence of a lithological resemblance between the two formations, some areas mapped as Manchhar in Sind (*loc. cit.*, 181) are really part of the older Hinglaj.

Hircine.—Name given by H. Piddington (*Journ. As. Soc. Beng.*, XXI, 76, 1853; XXII, 279, 1854) to a fossil resin from the oilfields of Burma.

Hislopite.—Name given by S. Haughton (*Journ. Roy. Dub. Soc.*, II, 176, 1858-59; *Phil. Mag.*, 4th Ser., XVII, 16, 1859, XXIII, 50, 1862) to a mineral from the amygdaloidal Deccan Trap. The name is after S. Hislop. W. T. Blanford pointed out (*Mem. Geol. Surv. Ind.*, VI, 141, f. n., 1867) that the mineral referred to was evidently calcite coloured by green earth inclusions, and T. H. Holland (*Rec. Geol. Surv. Ind.*, XXVI, 166, 1893) showed that beside the "green earth" (related to celadonite), there are included crystals of heulandite, both of these inclusions occurring in variable proportions. The name hislopite is thus without specific value.

Hollandite.—Mineral named after T. H. Holland by L. L. Fermor (*Trans. Min. and Geol. Inst. Ind.*, I, 76, 1906). A crystalline form of psilomelane, being a complex mixture of manganates of Fe, Al, Ba, Ca, Mg, K, Na, and Mn. Crystalline form, doubtful; occurs in separate crystals, massive crystalline aggregates and in fibrous forms resembling coronadite. Found in the manganese-ore deposits of Jhabua State and the Central Provinces. Largely mined for export as a manganese-ore.

Hormuz series.—Named by G. E. Pilgrim (*Mem. Geol. Surv. Ind.*, XXXIV 7, 15, 1908) from the island of Hormuz (27° 31′; 54° 55′) for a series of lavas and tuffs with interbedded clays and sandstones. Considered to be Upper Cretaceous or Lower Eocene. W. T. Blanford (*Rec. Geol. Surv. Ind.*, IV, 42, 1871) used a very similar name, the Hormuz Salt formation, for the salt and its associated volcanic rocks, and beyond the fact that they are younger than the overlying Makrán series, he was unable to assign any age to them.

Hsipaw series.—Name used by P. N. Datta (Director's General Report for 1899-1900, 118) for shales and purple sandstones, "will

exposed on the railway cutting 2 miles east of Thibaw" (Hsipaw) the capital of one of the Northern Shan States (22° 37′; 97° 21′). They were not found to be fossiliferous, but were regarded as younger than the Kyinsi (Kyaukkyan) beds. The same series of beds has been referred to by T. H. D. La Touche under the name Namyau (*Mem. Geol Surv. Ind.*, Vol. XXXIX, 305, 1913).

Hundes ossiferous gravels.—Term applied to a large area of pleistocene gravels in the upper valley of the Sutlej. The bones were originally considered by Dr. Falconer to be of Tertiary age and to correspond to some part of the Siwaliks. C. L. Griesbach first discovered the fact that the bones came from the sub-recent deposits (*Rec. Geol. Surv. Ind.*, XIII, 91, 1880) and a revision of the fauna by R. Lydekker (*Rec. Geol. Surv. Ind.*, XIV, 178, 1881) settled the question of their age.

Hunterite.—Mineral name given by S. Haughton (*Phil. Mag.*, XVII, 18, 1859; XXIII, 50, 1862) to a substance obtained by Messrs. S. Hislop and R. Hunter near Nagpur from a pegmatite vein traversing the gneiss. The specific gravity (2·319) and chemical composition given below indicate one of the amorphous clay-like hydrous silicates of alumina similar to Klaproth's cimolite. The analysis reported by Haughton is as follows:—

SiO_2	65·93
Al_2O_3	20·97
CaO and MgO	0·75
Loss on ignition	11·61
	99·26

Hydrabad beds.—T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 160, 1844) gave this name to the outliers of his "Diamond Sandstone, and Limestone" system between the Southern Mahratta country and Hydrabad "at Mudibhal and Talicota on the banks of the Bhima, ... and also in the vicinity of Digaye, between Muktul and Gulberga." The rocks described are evidently those referred to by R. B. Foote under King's name Bhima (Kurnool) series. The term appears to be of purely geographical significance, for Newbold (*ibid.*, 225) also used the name "Hyderabad beds" for some occurrences of freshwater limestones (Lametas) underlying the Deccan Trap between Beder and Hydrabad. He evidently was aware that this was a different

and younger formation than the members of his "Diamond Sandstone and Limestone" system.

Hypogene series.—Name used by T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 145, 1844) for the fundamental crystalline complex of Southern India, "penetrated and broken up by prodigious outbursts of plutonic and trappean rocks." Gneiss and hornblende schist are by far the most prevalent rocks, according to Newbold, but he describes also mica-schist, talcose schist, chlorite schist, actinolite schist, marble and clay-slate.

Indianite.—Proposed by Count de Bournon (Cat. Coll. Min. du Roi, Paris, 1817, 60) for the granular mineral forming the matrix of corundum in South India, described by him in 1802 (*Phil. Trans.*, 1802, 233—326). The name *anorthite* was given to the same mineral by Gustav Rose in 1823, and by common usage replaced indianite in literature.

Indus or Shingo beds.—Name used by F. Stoliczka (*Mem. Geol. Surv. Ind.*, V, 338, f.n., and described 354, 1866) for some slates exposed in the Indus valley from the mouth of the Zanskar river up towards Hanle from which Dr. Thomson in 1848 brought down nummulites. These are presumably the same as those previously (*ibid.*, 129) called the sandstones and slates of the Upper Indus valley and considered to be very much older.

Infra-Krol.—The carbonaceous slate series underlying the Krol limestone in the Simla area. Named by H. B. Medlicott (*Mem. Geol. Surv. Ind.*, III, part 2, 17, 29, 1864) who proposed to include the Krol quartzite and its probable equivalent near Simla known as the Boileauganj quartzite.

Infra-trappean.—See **Dudkur infra-trappean beds**, **Lameta.**

Inter-trappean beds.—Term in general use for the freshwater sedimentary deposits intercalated between the various flows of the Deccan trap, but, as a rule, more common among the lower flows. The fossils of the lower intertrappeans are generally those indicating freshwater conditions, *i.e.*, *Physa prinsepii*, *Limnæa*, *Paludina*, *Melania*, *Unio*, with entomostracous crustacea and numerous plant remains. At Rajahmahendri, in an outlier of the Deccan trap, the intertrappean beds have a distinctly estaurine fauna. Fossils belonging to the genera *Cerithium* and *Potamides* are found associated with *Physa*, *Limnæa*, *Corbicula*. The upper intertrappeans, known as the Frog beds, have only been investigated in

the island of Bombay. Here, again, the fauna, is freshwater containing numerous skeletons of frogs, described by Stoliczka as belonging to the genus *Oxyglossus*, a tortoise and an entomostracous crustacean (*Cypris*). There can be very little doubt that the intertrappeans as a whole are Cretaceous, and this is very greatly strengthened by the occurrence of *Physa prinsepii* in the Mæstrichtian of Baluchistan (E. Vredenburg, *Rec. Geol. Surv. Ind.*, XXXV, 114, 1907).

Irlakonda quartzites.—The lowest beds in the Kistna series of the Cuddapah system, named by W. King (*Mem. Geol. Surv. Ind.*, VIII, 255, 1872) from the hill (16° 2′; 78° 41′) which is formed of these rocks, in the Kurnool district.

Iron Clay.—Dr. H. W. Voysey's name for laterite. See *Journ. As. Soc. Beng.*, II, 302, (1833); XIX, 190, (1850). The term did not, however, oust the older term laterite; but in 1876 it was revived by R. Bruce Foote (*Mem. Geol. Surv. Ind.*, XII, p. 200) for the high-level laterite of the Ghats in the Southern Mahratta Country, whilst he restricted the term laterite to the low-level variety of the Konkan. But the term has again fallen into disuse.

Ironstone shales.—Term retained for the stage of the Damudas intermediate between the Lower Damudas (Barakars) and the Raniganj stage (W. T. Blanford, *Mem. Geol. Surv. Ind.*, III, 28, 1861). Worked for the clay-ironstone nodules in the neighbourhood of Barakar. They are found also in the Jherria field where the shales are comparatively poor in clay-ironstone.

Irrawaddy system.—Name adopted by F. Noetling (*Rec. Geol. Surv. Ind.*, XXVIII, 76, 1895) roughly to correspond in Burma to the "Fossil-wood group" of W. Theobald (*Rec. Geol. Surv. Ind.*, II, 79, 1869; *Mem. Geol. Surv. Ind.*, X, 247, 1873). In 1869 Theobald regarded the age of the beds as probably Miocene, but inclined in 1873 to the arguments of W. T. Blanford (*Journ. As. Soc. Beng.*, XXXI, 225) in favour of a younger age, which he gave as Pliocene to "Post-Pliocene." Noetling (*Rec.*, XXVIII, 76) included in the Irrawaddy system "all beds above the Yenangyaung stage which are characterised by the remains of terrestrial and fluviatile animals, but below the unconformity which separates the post-tertiary from those of tertiary age." M. Stuart, from evidence collected in Western Prome (*Rec. Geol. Surv. Ind.*, XXXVIII, 271, 1910), concluded that the Irrawaddy system in that area should be extended down to include marine beds which

are said to be separated from the Kama clays of the Pegu system by an unconformity. These "Marine Irrawaddy" beds were afterwards distinguished by Stuart under the name Akauktaung series (Director's General Report, *Rec. Geol. Surv. Ind.*, XLI, 79, 1911). The lowest beds of the Irrawaddy system near Yenangyaung contains a fauna which, according to G. E. Pilgrim (*Rec. Geol. Surv. Ind.*, XL, 196, 1910), is of Middle Siwalik age, or equivalent to the Pontian (Upper Miocene) of Europe. The age of the basement unconformity in Lower Burma is estimated by Stuart (*loc. cit.*, 278) to be about Upper Tortonian (Middle to Upper Miocene) in age, and he correlates it with Noetling's so-called "*Anoplotherium birmanicum* zone" of Upper Burma.

Jabalpur group.—Named from the town (23° 11′; 80° 0′) by T. Oldham (*Rec. Geol. Surv. Ind.*, IV, 75, 1871) for a series of beds originally recognised by J. G. Medlicott in the Narbada valley (*Mem. Geol. Surv. Ind.*, II, 176, 1860), and distinguished by him as Upper Damuda. The group consists of clays, shales and earthy sandstones with some thin seams of coal. Limestone is rare. The beds are unconformable on the lower Damudas and contain a very different flora. They are probably conformable on the underlying Mahadewas. The flora examined by O. Feistmantel (*Rec. Geol. Surv. Ind.*, IX, 125, 1876, *Pal. Ind.*, XI, 2) shows an affinity both with the Rajmahal and Umia beds of Cutch and is probably intermediate between the two in age.

Jabbi stage.—A stage of the Upper Productus Limestone of the Salt Range, so-named by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891), in the Shahpur district. Also referred to in his memoir as the Cephalopoda bed and regarded as Upper Permian in age.

Jadeolite.—Name suggested by G. F. Kunz (*Min. Ind.* for 1907, Vol. XVI, 810, 1908) for a dark-green chromiferous syenite said to be found at a jadeite mine near Bhamo, Upper Burma. Possibly pseudo-jadeite (*q. v.*).

Jaipurite.—The name probably intended for the mineral described as Syepoorite by J. Nicol (Man. Min. 1849, 458) on the assumption that the specimens came from "Syepoore," a probable typographical error for 'Jyepoore.' Major W. A. Ross (*Proc. Roy. Soc.*, XXI, 292, 1873) corrects the name and refers to the mineral as a "sulph-antimonial arsenide of cobalt," but his analysis,

showing oxides of Co, Sb and As, is at variance with this description. A substance stated by J. Middleton (*Phil. Mag.*, XXVIII, 352, 1846) to have the composition Co_2S appears to have been the origin of the idea that a mineral species of the kind exists among the cobalt ores of Jaipur in Rajputana, and F. R. Mallet (*Rec. Geol. Surv. Ind.*, XIV, 190, 1881), having found only danaite and cobaltite among the minerals from the well known Khetri area, considers that the existence of the species jaipurite needs verification.

Jaisalmer limestones.—Distinguished by W. T. Blanford (*Rec. Geol. Surv. Ind.*, X, 19, 1877) as one of the stages in the Jurassic rocks of Jaisalmer, Rajputana. The limestones are highly fossiliferous and of about the same age as the Chari stage in Cutch. (See also R. D. Oldham, *Rec. Geol. Surv. Ind.*, XIX, 159, 1886; Manual, 2nd Ed., 227, 1893.)

Jammalamadugu stage.—The second stage of the Kurnool series, including the Narji limestones and the Auk shales. Named from the *tahsil* station (14° 51′; 78° 26′) on the west side of the Kundair valley in the Cuddapah district (W. King, *Rec. Geol. Surv. Ind.*, II, 8, 1869; *Mem. Geol. Surv. Ind.*, VIII, 40, 1872).

Jaunsar system.—Named by R. D. Oldham (*Rec. Geol. Surv. Ind.*, XXI, 131, 1888) from the Himalayan state (30° 43′; 77° 54′) southeast of Simla. Formerly known (1883) as the Chakrata series (*q. v.*). Divided into three divisions: the lowest, composed of grey slates with a band of blue limestone; the middle, composed of red quartzites and slates; and the uppermost division of trap and volcanic ash. Unconformably underlies the Deoban limestone system. Now regarded as a local development of the Purana group which became involved in the Himalayan folds.

Jhakmari stage.—Term applied by F. Noetling (Director's General Report 1900-01, 24) to the Upper Cretaceous as exposed in Sind, including the beds with *Cardita beaumonti*. The name is derived from a locality (26° 9′; 67° 55′) in the Laki range.

Jhiri shales.—The highest stage of the Lower Rewah series in the Upper Vindhyans according to the classification of F. R. Mallet (*Mem. Geol. Surv. Ind.*, VII, 27, 28, 1869). Named from a town in the Gwalior State lying near the foot of the escarpment which marks the outcrop of the beds.

Jodhpur sandstones.—Red sandstones doubtfully referred by W. T. Blanford (*Rec. Geol. Surv. Ind.* X, 18, 1877) to the

Vindhyan system. They are developed over large areas to the west, north and east of Jodhpur city, the capital of Marwar. Chert-bearing limestones were found associated with the sandstones by C. A. Hacket (*Rec. Geol. Surv. Ind.*, XIV, 300, 1881).

Juddite.—Mineral named after J. W. Judd by L. L. Fermor (*Mem. Geol. Surv. Ind.*, XXXVII, 159, 1909). A manganiferous, highly pleochroic amphibole found in the manganese-ore deposits of Kacharwahi, Nagpur district, Central Provinces.

Jummulumudugoo.—See **Jammalamadugu.**

Jutana stage.—Name given by F. Noetling (*Rec. Geol. Surv. Ind.*, XXVII, 74, 79, 1894) for a division of the Cambrian strata in the Punjab Salt Range, previously distinguished as the Magnesian sandstone beds (*cf.* A. B. Wynne, *Mem. Geol. Surv. Ind.*, XIV, 87, 1877, and papers by A. Fleming quoted). Fossils found by Noetling were thought to indicate a Lower Cambrian age for the formation (*loc. cit.*, p. 80). Subsequent examination of the fossils by K. Redlich (*Pal. Ind.*, New Ser., I, i, 1899) and C. D. Walcott (*Proc. Wash. Acad. Sci.*, VII, 251-256, 1905) pointed to a Middle or Upper Cambrian age. Jutana (32° 45′ ; 73° 15′) is a village in the eastern part of the Salt Range, Jhelum district.

Juvavites beds.—Name proposed by A. von Krafft (Director's General Report for 1899-1900, 220) for a series of brown weathering limestones alternating with shales and sandstones lying unconformably above the dolomitic limestones with *Lima* cf. *austriaca* and *Dielasma julicum*. Cephalopods of the genus *Juvavites* are particularly common. It is the lower Noric stage of Spiti.

Kadapah.—See **Cuddapah.**

Kailassa gneiss.—A garnetiferous mica-gneiss forming the Kailassa *massif*, the Elephant hill and the Dolphin's nose near Vizagapatam. Distinguished by W. King (*Rec. Geol. Surv. Ind.*, XIX, 150, 1886) as part of the Bezvada group of gneisses.

Kaimur series.—Named by T. Oldham (*Journ. As. Soc. Beng.*, XXV, 251, 1856) for the lowest series in his Vindhyan system. Named from the Kaimur range in the Central Provinces, Rewah and Shahabad district, dividing the valley of the Tons from that of the Son river. United with the Rewah by E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIII, 259, 1906) to form his new *Tons series*.

Kalabagh beds.—Name used by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) for the upper division of the Middle

Productus Limestone of the Punjab Salt Range, and regarded as about equivalent to the Zechstein and Kupferschiefer of Western Europe. Kalabagh is a small town on the Indus (32° 58′; 71° 36′) in the Mianwali district.

Kaladgi system.—Unfossiliferous rocks resembling the Cuddapahs, preserved in a basin lying mainly between the Kistna and Malprabha rivers in the Southern Mahratta country. Named by R. B. Foote (*Mem. Geol. Surv. Ind.*, XII, 17, 70, 1876) from the town of Kaladgi (16° 12′; 75° 34′) in Bijapur district. The system was divided as follows :—

Upper Kaladgi series :

	Feet.
6. Shales, limestones and hematite schists .	2,000
5. Quartzites, with local conglomerates and breccias	1,200—1,800

Lower Kaladgi series :

4. Limestones and shales	5,000—6,000
3. Sandstones and shales	3,000—5,000
2. Siliceous limestones and cherty breccias .	
1. Quartzites, conglomerates and sandstones .	

Like the equivalent Cuddapahs, this system would now be included in the Purana group.

Kalu series.—A series of unfossiliferous rocks—conglomerates, graphitic slates, etc.—underlying the Devonian Hajigak limestone and hematite, and recalling in some features the Haimantas of the Himalayan region. The series is typically exposed near Kalu (34° 41′; 68° 2′) to the west-north-west of Kabul in Afganistan, and has been described by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXIX, 23, 1911).

Kama clays.—Fossiliferous blue shales and sandstones recognised by W. Theobald (*Rec. Geol. Surv. Ind.*, II, 80, 1869; *Mem. Geol. Surv. Ind.*, X, 273, 1873) as a constituent of his Pegu system, and named from the town of Kama (19° 0′; 95° 11′) 18 miles above Prome on the Irrawaddy river. M. Stuart (*Rec. Geol. Surv. Ind.*, XXXVIII, 274, 1910) regards the age of these clays as Helvetian-Tortonian above and Burdigalian below, and considers them to be the uppermost of three divisions of the Pegu system, separated by an unconformity from the overlying marine (Akauktaung) beds of the Irrawaddy system. Stuart (*loc.*

cit., 265, 290) regards this as the main oil-bearing formation in Burma. The Kama clays correspond in age approximately to the Lower Hinglaj of Baluchistan (*cf.* E. Vredenburg, *Rec. Geol. Surv., Ind.*, XLI, 38, 1911).

Kam=pa system.—Name applied by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXVI, 161, 1907) to the Cretaceous and Tertiary rocks which form a narrow strip running from Kampa Dzong (28° 17′; 88° 34′) to Tüna in Eastern Tibet. The strata range from cenomanian to eocene, but the uppermost bed preserved—the Dzongbuk shale—is apparently unfossiliferous.

Kamthi (Kamptee) series.—Named from the military station (21° 13′; 79° 15′) near Nagpur by W. T. Blanford (*Rec. Geol. Surv. Ind.*, I, 26, 1868) but defined by T. Oldham (*Rec. Geol. Surv. Ind.*, II, 100, 1869) as the Central Indian representatives of the Panchet series of Raniganj, Jharia, etc. The beds consist of conglomerates, grits, micaceous sandstones, shales and clays, usually soft and friable. Carbonaceous markings are extremely rare. The beds lie on the Barakars with apparent conformity but the break between the two is usually distinct. They have been correlated with the Hingir beds.

Kanawar system.—Term used by H. H. Hayden (Geog. and Geol. of the Him., Part IV, 233, 1908) to include certain Devonian and Carboniferous strata in Spiti, divided into—

Po series including Fenestella shales with *Protoretepora ampla.*
Lipak series including limestones with *Syringothyris cuspidata* above and *Atrypa aspera* below.

These beds are missing from the record in Kumaon and Garhwal, but may be represented by the Dothak series in E. Tibet.

Kankar.—A vernacular term meaning a stone of any kind, recently tending to become restricted by common usage to the concretions of carbonate of lime occurring as nodules in the alluvium. It is also used to denote calcareous tufa. These nodules form the chief source of lime.

Kantkot (Kuntkote) sandstones.—Name proposed by F. Stoliczka (MS. report) and adopted by W. Waagen (Jurassic fossils of Cutch. *Pal. Ind.*, Ser. IX, Introduction, 75) for the lower division of the Katrol group (*q. v.*), which is divided as follows:—

Katrol { Katrol beds proper
Kantkot sandstone

and probably corresponding to the Sequanian (Vredenburg, Summary of the Geology of India, 81). Kantkot is a small town in Cutch (23° 29′; 70° 31′).

Kapra quartzites.—The uppermost of three divisions of the Sullavais near Kapra (18° 30′; 79° 48′) in the Godavari valley. Named by W. King (*Mem. Geol. Surv. Ind.*, XVIII, 229, 1881). The rocks weather into forms which resemble the "pinnacled" quartzites of the Paneum stage in the Kurnool area.

Karewahs.—The Kashmiri name for masses of alluvium often forming low hills or terraces left by erosion. Regarded by H. H. Godwin-Austen (*Quart. Journ. Geol. Soc.*, XV, 221, 1858; also XX, 383) as of recent lacustrine origin. Considered by R. D. Oldham to be ordinary fluviatile alluvium (*Rec. Geol. Surv. Ind.*, XXXII, 152, 1905). The occurrence of equivalent deposits in Spiti, with their frequent earth-pillars formed by erosion, is described by F. Stoliczka (*Mem. Geol. Surv., Ind.*, V, 119, 1866). R. Lydekker (*Rec. Geol. Surv. Ind.* XI, 32, 1878) distinguished between the Upper, horizontally bedded, and the Lower, tilted, Karewahs, and regarded the latter as probably as old as the Upper Siwaliks or pliocene (see also *Mem. Geol. Surv. Ind.*, XXII, 80, 1883).

Karharbari stage.—The Lower Gondwana coal-seams in the Karharbari (Giridih) field were originally correlated with the Barakar stage of the Raniganj coalfield (T. W. H. Hughes, *Mem. Geol. Serv. Ind.*, VII, 221, 1868). The affinities between the plants in the lowest coal-bearing beds and those in the Talchirs being noticed, W. T. Blanford urged the separation of the Karharbari beds from the Damuda series, regarding them as older than the Barakar stage and more closely related to the Talchirs (*Rec. Geol. Surv. Ind.*, XI, 145, 150, 1878). W. Saise (*Rec. Geol. Surv. Ind.*, XXVII, 89, 1894) considered that the grounds for separating the Karharbari beds from the Damudas were insufficient. Name from the village of Karharbari (24° 10′; 86° 20′) near Giridih in the Hazaribagh district.

Karnul.— See **Kurnool.**

Kasauli stage.—A division of the Lower Sub-Himalayan system of H. B. Medlicott (*Mem. Geol. Surv. Ind.*, III, 12, 17, 85, 1864), named from the hill station (30° 54′; 76° 57′) in the Simla district, Punjab. With the more modern nomenclature (Man. Geol. Ind., 1st Ed., 1879, 524) the Kasauli beds are taken to be

the uppermost stage in the Sirmur series, which, with the overlying Siwalik series, make up the Sub-Himalayan system. The Kasauli stage is correlated with the Murree beds further to the north-west by fossil plants (O. Feistmantel : *Rec. Geol. Surv. Ind.*, XV, 51, 1882), a connecting link occurring in plant-bearing beds in the Ravi valley (H. B. Medlicott : *Rec. Geol. Surv. Ind.*, IX, 52, 1876). R. D. Oldham (unpublished notes) regarded the Kasauli and associated Dagshai beds to be local variations of the same stage. G. E. Pilgrim (*Rec. Geol. Surv. Ind.*, XL, 188, 1910) shows that the Murree beds are of about Burdigalian and Helvetian age, thus bringing the stage distinctly into the Miocene, as the Murree beds are above the Aquitanian Kuldanas (*q. v.*). At the same time the latter author (*Rec. Geol. Surv., Ind.*, XLI, 83, 1911-12) considers that the Kasauli succeeds the Dagshai in time and represents only the upper portion of the Murree.

Katha beds.—Name given by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) to the lower division of the Middle Productus Limestone of the Punjab Salt Range. Katha village and fort (32° 31′ ; 72° 30′) are on the southern edge of the range in the Shahpur district.

Katrol group.—Name used by F. Stoliczka (MS. report) for one of the upper divisions of the Jurassic of Cutch (Kachh) occurring above the Chari beds. W. Waagen (*Pal. Ind.* Ser. IX, Vol. 1) gives the following classification :—

2. Katrol beds proper. Sandstones and shales with *Phylloceras ptychoicus, Oppelia trachynotus, Perisphinctes torquatus, P. pottingeri,* etc.	Zone of *Perisphinctes mutabilis.* Zone of *Oppelia tenuilobatus.*	Kimmeridge.
1. Kantkot sandstones. Red and yellow ferruginous sandstones with *Stephanoceras maya, Aspidoceras perarmatus,* etc.	?Zone of *Peltoceras bimammatus.* ?Zone of *Peltoceras transversarius.*	Upper Oxford.

Katrol (23° 12′ ; 69° 50′) is a small village in Cutch.

Kattra shales.—H. J. Carter's middle division of his "Oolitic series" (*q. v.*) named from their occurrence at Kattra ghat (Geol. Papers,

1857, 657). In this group Carter included formations of widely different ages, crystalline limestones of the Archæan complex, Vindhyan limestones as well as Gondwana coals and shales.

Ken series (or sub-system).—Used by E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIII, 258, 1906) for the lower of his two main divisions of the Vindhyan system, including the Rewah and Kaimur series of the old Upper Vindhyan with the old Lower Vindhyan. Named from the river which traverses these formations in Central India.

Khadar.—Vernacular term in use to denote the flood plain of a river.

Kharian beds.—W. Theobald (*Rec. Geol. Surv. Ind.*, XIV, 107, 1881) used this term as equivalent to the Upper Siwaliks in the Sub-Himalayan region, and divided it into an upper and lower division. The term has dropped out of use.

Kheinjua stage.—Term proposed by P. N. Datta (*Rec. Geol. Surv. Ind.*, XXVIII, 145, 1895) for beds 6, 7 and 8 in the classification of the Lower Vindhyans adopted by F. R. Mallet (*Mem. Geol. Surv. Ind.*, VII, 28, 1869). From the Kheinjua hills (24° 10′; 80° 50′) in Central India.

Khewra stage.—Name used by F. Noetling (*Rec. Geol. Surv. Ind.*, XXVII, 74, 1894) for the lowest division of the Cambrian strata in the Punjab Salt Range, previously known as the Purple Sandstone stage. The beds overlie the Salt Marl and are conformably succeeded by the Middle Cambrian, so-called Neobolus, or Kussak beds. Named from the town of Khewra (32° 39′; 73° 31′) near the Mayo Salt Mines in the Jhelum district.

Khingil series.—Provisional name proposed by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXIX, 22, 1911) for a composite series, mainly of limestones, ranging in age from Carboniferous to Upper Trias, and forming a large part of the Khingil range on the east of the Kabul plain in Eastern Afghanistan.

Khondalite series.—Named by T. L. Walker (*Mem. Geol. Surv. Ind.*, XXXIII, 11, 1902) from the Khonds, or hill-men who live on the Vizagapatam and Kalahandi hill-tracts, where the rocks were first distinguished. They are para-schists including garnetiferous quartz-sillimanite rocks with garnetiferous quartzites, calciphyres and graphitic schists, overlying, and apparently metamorphosed by, the great igneous massif of charnockite and associated granitoid gneisses (*cf.* Mercara group for similar rocks in Coorg).

Khongbu series.—Named by H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXVI, 141, 1907) from the Khongbu valley (27° 46′ ; 89° 2′) in Eastern Tibet. The rocks are unfossiliferous slates and schists doubtfully correlated with the unfossiliferous Purana rocks of the Outer Himalaya.

Khoond-air.—See **Kundair stage.**

Khussak stage.—See **Kussak stage.**

Khymore.—See **Kaimur series.**

Kioto limestone.—Name applied by H. H. Hayden (Geog. and Geol. of the Him., Part IV, 236, 1908) to a great limestone formation, over 2,000 feet thick, in the north-western Himalaya. The upper part contains Jurassic fossils (Tagling limestone of F. Stoliczka), while the lower part is Upper Triassic (Para limestone of Stoliczka) ; but the intermediate part is mostly unfossiliferous and forms a stratigraphical unit that cannot be sub-divided. Named from Kioto (32° 26′ ; 77° 58′) in Spiti. Previously referred to as the " Grey Limestone " (A. von Krafft, *Mem. Geol. Surv. Ind.*, XXXII, 132, 1902 ; C. Diener, *Pal. Ind.*, Ser. XV, Vol. V, No. 3, 148, 1908).

Kirthar (Khirthar) series.—Named by W. T. Blanford (*Rec. Geol. Surv. Ind.*, IX, 9, 1876 ; *Mem. Geol. Surv. Ind.*, XVII, 32, 45, 1880) from the Kirthar range, which divides Upper Sind from Kalat. Regarded by the author as Eocene in age. Blanford included with the Kirthar, rocks corresponding to those distinguished by C. L. Griesbach (*Mem. Geol. Surv. Ind.*, XVIII, 9, 1881) as the *Alveolina limestone* from the nature of the most characteristic member. This formation, having been recognised in Sind also, was separated by F. Noetling (*Centralblatt f. Min.*, 1903, 521 ; 1905, 135) as the *Laki series* (*q. v.*). The massive white limestones of the Kirthar and Laki series in Sind are sufficiently similar in appearance to cause confusion, but E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIV, 89, 182, 1906) has shown from the foraminifera that, while the Laki is Lower Lutetian in age, the Kirthar corresponds to the Middle and Uppper Lutetian, with a stratigraphical break between the two.

Kistna series.—The uppermost series of the Cuddapah system. Named by W. King (*Mem. Geol. Surv. Ind.*, VIII, 126, 1872),

from the river which flows near and over the series. Composed of—

(*c*) Srisailam quartzites (*b*) Kolamnala slates (*a*) Irlakonda quartzites	}	about 2,000 feet.

Kodurite series.—Named by L. L. Fermor (*Rec. Geol. Surv. Ind.*, XXXV, 22, 1907 and *Mem. Geol. Surv. Ind.*, XXXVIII, 243, 1909) from Kodur (18° 16′ ; 83° 37′) in the Vizianagram State. The kodurites are associated with the Archæan gneisses and schists, and are supposed to be igneous in origin, probably later in age than the khondalite series (*q. v.*). They vary in composition from acid (quartz-orthoclase rock) through basic (kodurite proper) to ultra-basic (spandite-rock and manganese pyroxenites). Kodurite itself is composed of potash-felspar, spandite (a garnet intermediate between spessartite and andradite) and apatite. By chemical alteration rocks of the kodurite series have yielded lithomarges, chert, ochres and workable manganese-ores. They are developed largely in the Vizagapatam district of the Madras Presidency.

Koil-Kuntla limestones.—The limestones conformably underlying the Nandyal shales and with them forming the uppermost stage of the Kurnool series. Named by W. King (*Mem. Geol. Surv. Ind.*, VIII, 45, 1872) from the village of Koil-Kuntla (15° 14′ ; 78° 23′) in the Kurnool district.

Kojak shales.—Term applied by C. L. Griesbach (*Mem. Geol. Surv. Ind.*, XVIII, 7, 32, 33, 1881) to a series of generally unfossiliferous greenish shales and sandstones typically exposed on the Kojak pass over the Kojak (Khwaja) Amran range separating Baluchistan from Afghanistan, and also in the Ghaziband range where they were called for some time Karnak beds, but this term was merged in the former. Griesbach from their position considered them as the flysch facies of the Ranikot beds of Sind. Later (*Rec. Geol. Surv. Ind.*, XVIII, 59, 1884) these same beds are correlated with a set of lithologically similar beds occurring below the Upper Cretaceous of the Sulaiman range. R. D. Oldham (Manual, Geol. Ind., 2nd edition, 142, 143, 1893) from lithological resemblance refers them to Carbon-Trias along with other unfossiliferous rocks, with a warning that they may prove to be much younger. E. Vredenburg

(*Rec. Geol. Surv. Ind.*, XXXIV, 89, f. n., 1906) announces the discovery of Oligocene fossils in this usually unfossiliferous series, and later he (*Rec. Geol. Surv. Ind.*, XXXVIII, 202, 1909) discusses the extension of this series in Western Baluchistan and the Makran, assigning an Oligocene age and comparing it with the Oligocene flysch of Europe.

Kokulam stage.—Named by R. B. Foote (*Mem. Geol. Surv. Ind.*, XX, 11, 12, 1883) from a village in the Madura district, which stands close to where the ridge is crossed by the high road from Tirumangalam to Sholavandan. A coarse granular rock forming the lowest but one of the divisions of the crystalline rocks of that area (see Allagiri stage).

Kolamnala shales.—The shales underlying the Shrishalam (Srisailam) quartzites in the Kistna series of the Cuddapah system. Named by W. King (*Mem. Geol. Surv. Ind.*, VIII, 253, 1872) from a small river in the Kurnool district, which cuts through and exposes these shales west and south of the sacred village of Shrishalam (16° 5′; 78° 53′).

Konghsa Marls.—See **Namhsim beds.**

Kota-Maleri stage.—The outcrops of these Upper Gondwana rocks came to be known through the discovery of ganoid fish remains by W. Walker (*Journ. As. Soc. Beng.*, X, 341, 1841; *Madras Journ. Lit. Sci.*, 1857, 261) at Kota (18° 55′; 80° 2′), a village on the east bank of the Pranhita, eight miles above the confluence with the Godavari and five miles north of Sironcha; and by the find of reptilian bones by the Revd. S. Hislop (*Quart. Journ. Geol. Soc.*, XX, 280, 1864) at Maleri (19° 11′; 79° 40′), a village 32 miles north-west of Sironcha. A discussion of the palæontological results by W. T. Blanford (*Pal. Ind.*, Ser. IV, Part 2, 22, 1878) indicated an age approximately corresponding to the Jurassic of Europe, the reptiles showed Triassic affinities, some of the fishes appeared to be Liassic, while the plants were regarded as Middle or Upper Jurassic (*loc. cit.*, p. 21). The Maleri beds are older than those at Kota.

Kothair beds.—Beds regarded by A. Verchère [*Journ. As. Soc. Beng.*, XXXV, (2) 163, 190, 1866; XXXVI, (2) 221, 1867] as Triassic in age and overlying the Weean beds of Carboniferous age in the Kashmir valley.

Krol group or series.—Name given by H. B. Medlicott (*Mem. Geol. Surv. Ind.*, III. pt. 2, 25, 1864) to the limestone and quart-

zitic sandstone forming the uppermost division of his Himalayan series. The limestone forms the conspicuous Krol mountain (30° 57′ ; 76° 10′) near Solan in the Simla Himalayas.

Kuldana series.—The beds of calcareous conglomerate, sandstone and red shale between the Nummulitics and the Murree series were regarded as probably equivalent to the Subathus of the Simla region, and were described by A. B. Wynne (*Rec. Geol. Surv. Ind.*, VII, 68, 1874) and distinguished by the name Kuldana from the village (33° 56′ ; 73° 27′), 3 miles north of Murree in the Rawalpindi district. C. S. Middlemiss (*Mem. Geol. Surv. Ind.*, XXVI, 42, 1896) similarly regarded the Kuldanas as passage beds between the Nummulitic limestones and the Murree series. G. E. Pilgrim (*Rec. Geol. Surv. Ind.*, XL, 187, 1910) discovered well preserved vertebrate remains in these beds which were identical with known Bugti species, indicating an Upper Aquitanian (equivalent to Gáj) age. He also noticed that the Eocene Nummulites found in the Kuldanas were derived specimens.

Kuling series.—Named by F. Stoliczka (*Mem. Geol. Surv. Ind.*, V, 24, 1866) from the village of Kuling (32° 3′ ; 78° 9′) in the Pin valley, Spiti. Regarded by Stoliczka as Carboniferous in age ; considered by C. L. Griesbach (*Mem. Geol. Surv. Ind.*, XXIII, 12, 1891) to be in part Carboniferous but including also the Permian Productus-shales and some Lower Triassic beds. The term was thus abandoned as unnecessary after more complete analysis and correlation of the constituent beds ; but H. H. Hayden has revived the term *Kuling system* (Geog. and Geol. of the Him., Part IV, 234, 239, 1908) to include—

(*c*) Productus shales of Permian age, with *Xenaspis* and *Cyclolobus* above and *Marginifera himalayensis* below.
(*b*) Calcareous sandstone with *Spirifer fasciger* and *S. marcoui*.
(*a*) Conglomerate and sandstone on the Kanawar or older rocks.

This proposal limits Stoliczka's term at both ends, by the removal of the Triassic rocks above, and the Carboniferous below. C. Diener (*Pal. Ind.*, Ser. XV, Vol. I, Part 2, p. 4, 1899) had previously suggested the retention of Stoliczka's term Kuling series modified only by removal of the Triassic strata.

Kuling shales.—Distinguished by F. Stoliczka (*Mem. Geol. Surv., Ind.*, Vol. V, p. 24, 1866) as Carboniferous and named from a village (32° 3′ ; 78° 9′) in Spiti. C. L. Griesbach (*Mem. Geol. Surv. Ind.*,

XXIII, 67, 1891) noticed that Stoliczka had included the somewhat similar Lower Triassic shales in Spiti with the Permian *Productus* bearing shales as one formation, regarding the whole as Carboniferous. Griesbach consequently used the term *Productus shales* to replace the term Kuling shales for the lower formation which is so rich in *Productidæ*. H. H. Hayden (*Mem. Geol. Surv. Ind.*, XXXVI, 53, 1904) agrees with this change in nomenclature and defines the Productus shales of Spiti and Bashahr "as a band of dark shale with irregular sandstone partings, included between the top of the calcareous sandstone and the ferruginous limestone containing the zone of *Otoceras Woodwardi* Griesbach." The age of the Productus shales is regarded as Permian (*loc. cit.*, 55), a correlation confirmed by C. Diener (*Mem. Geol. Surv. Ind.*, XXXVI, Part 3, 1912).

Kundair (Khoond-air) stage.—Named by W. King (*Rec. Geol. Surv. Ind.*, II, 7, 1869; *Mem. Geol. Surv. Ind.*, VIII, 39, 40, 42, 1872) on account of the fact that the rocks are exposed mainly in the Kundair valley (14° 50′; 78° 40′) a tributary of the Penner river. The Kundair is the uppermost stage of the Kurnool series, and is composed of—

(*b*) Nandyal shales.
(*a*) Koil-Kuntla limestones.

Kund-ghat (Khund-ghat) beds.—Name given by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) to the lower and middle divisions of the Upper Productus Limestone of the Punjab Salt Range. Kund-Ghat (32° 25′; 72° 16′) is in the Shahpur district, leading up over the southern edge of the range from the alluvial plains. In conjunction with the Chidru beds this stage was regarded as about equivalent to the Upper Permian.

Kurnool series.—Named by W. King (*Rec. Geol. Surv. Ind.*, II, 5, 1869; *Mem. Geol. Surv. Ind.*, VIII, 1, 1872) from one of the districts in which it is well developed in the Madras Presidency. The rocks are entirely unfossiliferous and are included, with the great underlying Cuddapah system, in the Purana group of supposed pre-Cambrian age. The Kurnools are possibly equivalent to the Lower Vindhyans of Central India.

Kussak stage.—Name used by F. Noetling (*Rec. Geol. Surv. Ind.*, XXVII, 75, 1894) for the division of the Cambrian beds in the

Punjab Salt Range known as the Neobolus beds. Named from the hill surmounted by an old Sikh fort in the Jhelum district (32° 42′; 73° 7′). The beds are divided into five zones, in the uppermost of which occurs a trilobite, which was determined by Noetling to be a species of *Olenellus*, but was found afterwards by K. Redlich to be generically new (*Pal. Ind.*, New Ser., I, i, 1899). The name proposed by Redlich was changed by Cossman to *Redlichia* (*Revue crit. Paléozool.*, 6th Ann., 52, 1902); and C. D. Walcott (*Proc. Wash. Acad. Sci.*, VII, 255, 1905) has shown that this and the associated fossils indicate a Middle Cambrian age for the Neobolus beds.

Kyaukkyan series.—This name is used by P. N. Datta (Director's General Report for 1899-1900, 118) for some fossiliferous shales and limestones exposed in a railway cutting near Kyaukkyan (22° 18′; 96° 46′) in the Northern Shan States. The fossils were regarded as Devonian. In a footnote (*loc. cit.*, 120) the age is considered to be Mesozoic—a view which subsequently proved correct, as this series is equivalent to the Napeng beds. The name has been discarded.

Kyinsi beds.—Name used by T. H. D. La Touche (Director's General Report for 1899-1900, 114) for shales and concretionary limestones lying under the Namyau (Hsipaw) beds. From the occurrence of *Conocardium* they were regarded at first as Upper Palæozoic, but were afterwards found to be Jurassic in age. They are equivalent to the Napeng beds (*q. v.*). Kyinsi (22° 34′; 97° 14′) is a village in the Northern Shan States.

Kymore.—See **Kaimur series.**

Lake laterite.—Name proposed by L. L. Fermor (*Geological Mag.*, Dec. V, Vol. III, 461, 1911) for those forms of laterite deposited chemically in lakes and other bodies of water.

Laki series.—W. T. Blanford (*Rec. Geol. Surv. Ind.*, IX, 11, 1876; *Mem. Geol. Surv. Ind.*, XVII, 32, 45, 1879) grouped together the very similar limestones of the Laki and Kirthar ranges in Western Sind as one series, named after the latter area. F. Noetling and E. Vredenburg in 1900 detected the difference in the fossil contents, and the former (*Centralblatt f. Min.* 1903, 521) proposed the separation of the older beds under the distinct name, *Laki series*, from the hill range and village (26° 14′; 67° 56′) in Lower Sind. The Nummulites in the Laki series indicate according to E. Vredenburg (*Rec. Geol. Surv. Ind.*

XXXIV, 86, 182, 1906) a Lower Lutetian age. The series can be divided into :—

3. Upper, equivalent to the Ghazij of Baluchistan.
2. Middle, equivalent to the Alveolina limestone.
1. Lower, or Meting shales.

The Laki series is the coal-bearing formation of Baluchistan, Punjab and Rajputana. It is separated from the Ranikot below and the Kirthar above by stratigraphical breaks.

Lameta series.—Limestones, sandstones and shales of freshwater origin found below the Deccan Trap in Central and Western India ; so named from their occurrence at Lameta Ghat (23° 6′ ; 79° 53′) on the Narbada river near Jubbulpore, by J. G. Medlicott (*Mem. Geol. Surv. Ind.*, II, 196, 1860) who regarded the series as a lithological variation locally of the Mahadevas. It was shown by W. T. Blanford, however, that the Lametas are the freshwater representatives of the Cretaceous Bagh beds (*Mem. Geol. Surv. Ind.*, VI, 216, 1869 ; *Rec. Geol. Surv. Ind.*, V, 88, 1872), and are thus of about Cenomanian age.

Laterite.—Named by Francis Buchanan-Hamilton (Journey from Madras through Mysore, Canara and Malabar, 1807, Vol. II, 441). From the Latin *later*, a brick, on account of the fact that it is usually and conveniently cut into the form of bricks for building, and was called brick-stone (*Itica cullu*) by the natives in Malabar. The two forms *high-level laterite* and *low-level laterite* were first definitely distinguished by W. T. Blanford (Man. Geol. Ind., I, 351, 1879), but the terms were intended to imply merely the position occupied by the two varieties on the high lands, or near the coast, without involving any theory of the origin of the rock. For recent papers and a discussion on this interesting subject see *Geological Magazine*, 1903, 1906, 1908, 1909, 1910 and 1911.

Lateritite.—Name proposed by L. L. Fermor (*Geol. Mag.*, Dec. V, Vol. VIII, p. 507, 1911) for detrital or re-constructed laterites.

Lateritoid.—Name proposed by L. L. Fermor (*Mem. Geol. Surv. Ind.*, XXXVII, p. 383, 1909) to distinguish those forms of lateritic rocks formed by metasomatic replacement at the surface.

Lathi group.—Named by R. D. Oldham (*Rec. Geol. Surv. Ind.*, XIX, 157, 1886) from a village (27° 2′; 71° 33′) on the road from Pokran to Jaisalmir. A series of sandstones with silicified wood.

Lilang limestone.—Named by F. Stoliczka (*Mem. Geol. Surv. Ind.*, V, 30, 1866) from the village of Lilang (32° 9′; 78° 18′) on the Lingti river in Spiti. Regarded as Triassic in age by Stoliczka. The term was subsequently discarded when the Triassic system in Spiti became studied in sufficient detail to establish a detailed classification of the beds (Hayden: Geology of Spiti, *Mem. Geol. Surv. Ind.*, XXXVI, 87, 1904).

Lilang system.—Defined by H. H. Hayden (Geog. and Geol. of the Him., Part IV, 235, 1908) as the system of sediments in Spiti and Kumaon ranging from the base of the Otoceras zone, that is above the Productus shales, to and including the Upper Triassic beds of juvavic age. The system is over 3,000 feet thick in Spiti and rather less in Kumaon. The system is zoned as below:—

Quartzite series with *Spirigera maniensis*	
Monotis shales with *M. salinaria*	Juvavic.
Coral limestone with *Spiriferina griesbachi*	
Juvavites beds with *J. angulatus*	
Tropites beds with *T. cf. subbullatus*	Carnic.
Grey shales with *Joannites cymbiformis*	
Halobia beds with *H. cf. comata*	
Daonella limestone with *D. indica*	Ladinic.
Daonella shales with *D. lommeli*	
Muschelkalk limestone with *Ptychites rugifer*	Muschelkalk.
Nodular limestone	
Hedentrœmia beds with *H. mojsisovicsi*	Lower Trias.
Meekoceras zone with *M. varaha*	
Ophiceras zone with *O. sakuntala*	Permo-Trias passage.
Otoceras zone with *O. woodwardi*	
PRODUCTUS SHALES.	PERMIAN

Lingagoodium sandstones.—Name introduced by W. King (*Rec. Geol. Surv. Ind.*, Vol. X, 56, 1877) for an upper sub-division of the Kamthis in Hyderabad and corresponding to the Dummapett sandstones of the Godavari district. The term was discarded.

Lipak series.—Applied by H. H. Hayden (Geog. and Geol. of the Him., Part IV, 233, 1908) to the lower of the two divisions of

the Kanawar system in Spiti. Composed chiefly of limestone with *Syringothyris cuspidata* above and *Atrypa aspera* below. Age, partly Devonian and partly Lower Carboniferous. Named from the Lipak river in the valley of which near Lio (31° 53′; 78° 39′) the rocks are well exposed.

Lituola beds.—Term used by E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXVIII, 200, 1909) for the uppermost division of the Lower Cretaceous beds in South Baluchistan. Named from the occurrence of the foraminiferal genus *Lituola*.

Lochambel beds.—The upper part of the Spiti shales include fossils of Berriasian, Velanginian and Upper Tithonian age. The name was introduced by C. Diener (*Denk. k. Akad. Wiss.* Wien., Math-Naturw. Classe., Bd. LXII, 507, 1895). The ammonite fauna is described by V. Uhlig (*Pal. Ind.*, Ser. XV, Vol. IV, fasc. 1, 2, and 3).

Lower Gondwana.—See **Gondwana**.

Lower Vindhyan.—See **Vindhyan, Semri, Son, Sub-Kaimur,**

Lowo beds.—See **Pokaran beds.**

Magnesian sandstone beds.—Name used by A. Fleming (*Journ. As. Soc. Beng.*, 1853, 255) for a division of the beds in the Punjab Salt Range, which was found afterwards to be of Middle or Upper Cambrian age; named also the Jutana stage (*q. v.*). The rocks are sandy dolomites and light-coloured sandstones, with oolitic or flaggy bands and shales.

Mahabar schists.—Identified by H. B. Medlicott (*Rec. Geol. Surv. Ind.*, II, 42, 1869) and named from a hill-range in Behar (24° 35′; 85° 55′). They are regarded as equivalent to the Rajgir (Rajagriha) schists further north in the same area, and, according to F. R. Mallet, are at a higher horizon than the Bhiaura quartzites (*cf. Rec. Geol. Surv. Ind.*, VII, 39, 1874), although considerably metamorphosed in places.

Mahadeva series.—Named by T. Oldham (*Journ. As. Soc. Beng.*, XXV, 252, 1856) from the Mahadeva hills to the north-west of Nagpur, where beds of this series were described by Hislop and Hunter. When first separated from the Lower Gondwanas no age was assigned to the Mahadevas in consequence of the absence of fossils, but a conjecture was made, on account of their passing up conformably into beds with fossil bones, as to their possible

equivalence with the Siwaliks. Divided by H. B. Medlicott (*Mem. Geol. Surv. Ind.*, X, 150—158, 1873) into three stages :—

3. Bagra.
2. Denwa.
1. Pachmarhi.

The vertebrate remains afterwards found in the Denwa stage show an imperfect correspondence with the Kota-Maleri stage.

Ma-i formation.—Name used by W. Theobald (*Mem. Geol. Surv. Ind.*, X, 311, 1873) for rocks in the district of Sandoway, Arakan, which were not mapped or worked out in detail, but yielded a single Cretaceous fossil *Ammonites* (*Schlœnbachia*) *inflatus* Sow. near the village of Ma-i (19° 20′ ; 94° 13′).

Makran (Mekran) group.—So called by W. T. Blanford (*Rec. Geol. Surv. Ind.*, V, 43, 1872) from the name of the littoral tracts of Baluchistan. The formation consists essentially of thick beds of pale-grey clay, more or less indurated, with occasional bands of shelly limestone, calcareous grit and sandstones. From the fossils it was considered to be of marine origin and to be newer than the Nummulitics. It was thought that they might represent the "miliolites" of Kathiawar and south-east Arabia. The only fossils examined in detail were the echinoids. From these P. M. Duncan and W. P. Sladen (*Pal. Ind.*, XIV, 1, part 3, fasc. V, 1880) thought the strata were of Pliocene age. E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIV, 89, 175, 1906) discusses the extent of this group and points out its comprehensive character including beds equivalent to the Nari and Gáj and even newer. He also suggests its equivalence with the Pegu group of Burma. He separates off the newer beds under the name of the Hinglaj stage (*q. v.*). G. E. Pilgrim (*Mem. Geol. Surv. Ind.*, XXXIV, 3, 26, 34, 1908) discusses its extension in Persia.

Malani beds.—Name given by W. T. Blanford (*Rec. Geol. Surv. Ind.*, X, 17, 1877) for a volcanic series of rocks in the Western Rajputana desert, specially well developed in the Malani district of Marwar (Jodhpur) State. The rocks are mainly rhyolitic lavas and tuffs, which rest with marked unconformity on the Aravalli schists and were subjected to considerable weathering before the deposition of the Jodhpur (Vindhyan) sandstone (see T. H. D. La Touche, *Mem. Geol. Surv. Ind.*, XXXV, 19, 26, 1902). Exposures of the Malani rocks are found at intervals for

145 miles westward from Jodhpur, and for 120 north and south between Pokaran and Jalor (La Touche, *loc. cit.*, 21, 22). Boulders were carried in Upper Carboniferous times as far as the Salt Range probably by the action of ice (C. S. Middlemiss, *Rec. Geol. Surv., Ind.*, XXV, 29, 1892; E. Koken, *Neues Jahrb. f. Min.*, 1907, 454).

Maleri.—See **Kota-Maleri.**

Manchhar series.—Distinguished by W. T. Blanford (*Rec. Geol. Surv. Ind.*, IX, 9, 1876; *Mem. Geol. Surv. Ind.*, XVII, 32, 57, 1880) as "the highest sub-division of the Sind tertiary series," and named after the Manchhar Lake (26° 25′; 67° 42′), a few miles west of Sehwan. The strata were sub-divided into Upper and Lower Manchhars, the lower beds being possibly Upper Miocene, while the rest of the series was regarded as Pliocene, the whole corresponding roughly to the Siwaliks. In Lower Sind (*loc. cit.*, 1880, 61) there is a considerable intercalation of marine or estuarine beds, the evidence for deposition in salt water being more pronounced nearer the present coast-line, while there is a gradual passage down into the Gáj beds. As the result of later work on the Sind-Baluchistan border, W. T. Blanford (*Mem. Geol. Surv. Ind.*, XX, 160, 1883) thought that the name Manchhar might be dropped in favour of the older name Siwalik. E. Vredenburg (*Rec. Geol. Surv. Ind.*, XXXIV, 180, 1906) thinks that such supposed passage beds in Lower Sind should not be included in the Manchhars, and that they are representatives of the Hinglaj sandstone, which follows conformably on the Upper Oligocene Gáj and is Lower Miocene (Burdigalian) in age. G. E. Pilgrim (*Rec. Geol. Surv. Ind.*, XXXVII, 163, 1908; XL, 189, 1910) has shown that the vertebrate remains near the base of the Lower Manchhars in Sind indicate a Tortonian age. The Upper Manchhars of Sind are distinguished from the Lower by the great predominance of conglomerates in which there occur pebbles of Nummulitic limestones, showing that considerable changes in the elevation of the older Tertiary strata occurred between Middle Miocene and Pliocene times. These Upper Manchhars are unfossiliferous but probably correspond in age to the well known fossiliferous Upper Siwaliks of the Himalayan region. It appears from Pilgrim's work (*loc. cit.*, 1908, 166) that the ossiferous beds described as Lower Manchhar (Lower Siwalik) in the Bugti hills

included also (Aquitanian) and Nari (Stampian) beds by oversight of a separating unconformity.

Mandalay limestone.—Name instituted by F. Noetling (*Rec. Geol. Surv. Ind.*, XXIV, 104, 1891) for a series of unfossiliferous limestones occurring near Mandalay (21° 59′ ; 96° 8′). They were considered by P. N. Datta (Director's General Report, 1899-1900) as probably the same as his *Tonbo* limestone. T. H. D. La Touche (*Mem. Geol. Surv. Ind.*, XXXIX, 7, 1913) shows that this is a mixed group, and the name is consequently discarded.

Mandan group.—Name given by C. A. Hacket (*Rec. Geol. Surv. Ind.*, X, 85, 1877) to a division of his Aravalli system, and originally regarded as above the Alwar series, but afterwards (*Rec. Geol. Surv. Ind.*, XIV, 281, 1881) regarded as equivalent to the Raialo sub-division of the Alwars.

Mandhali series.—Named by R. D. Oldham (*Rec. Geol. Surv. Ind.*, XVI, 196, 1883) from the village of Mandhali (30° 51′ ; 78° 1′) north-east of Chakrata. Found to occur above the Deoban limestones and afterwards correlated with the Blaini series of Simla (R. D. Oldham, *Rec. Geol. Surv. Ind.* XXI, 137, 1888).

Mangli beds.—Named by T. W. H. Hughes (*Mem. Geol. Surv. Ind.*, XIII, 71, 1872) (Manual Ed. 1, 129, 1879), after a small deserted village (20° 22′ ; 79° 4′) about 50 miles south of Nagpur and 35 north-west of Chanda, near which Hislop found the remains of the first Indian labyrinthodont (*Brachyops laticeps* Owen). The beds are very fine red and yellow sandstones with coarser grits containing estheriæ and poorly preserved plant remains. They are considered to be part of the lower Kámthis.

Marine sandstone of Coromandel.—T. J. Newbold (*Journ. Roy. As. Soc.*, XII, 86, 1850) uses this term as evidently equivalent to his " Marine sandstone beds of Ramnad and Cape Comorin."

Marine sandstone beds of Ramnad and Cape Comorin.—The occurrences of sandstone on the south-eastern coast of the Madras Presidency described by T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 243, 1844) are evidently those afterwards known more widely distributed as the Cuddalore sandstones. Newbold says that the fragmentary shell remains are species existing in the adjacent sea ; and he regarded the beds as Tertiary like the laterite and the Pondicherry sandstone.

Martaban system.—W. Theobald (*Mem. Geol. Surv. Ind.*, X, 328 1873) used this name for the schists and gneisses in the Tenasserim division of Burma, where, he says, there are "true crystalline rocks, undistinguishable in character from the ordinary gneissose rocks of Bengal." Similar rocks occur further north along the western border of the Shan plateau.

Maymyo limestone.—Sandy limestones, forming the main mass of the Northern Shan States plateau and well exposed near the hill station of Maymyo (22° 1′; 96° 30′). Fossils found by T. H. D. La Touche (Director's General Report for 1899-1900, 84), indicated a Devonian or uppermost Silurian age. The name was instituted by Datta (Gen. Rep., 1899-1900, 117), and has since been discarded in favour of Plateau limestone (*q. v.*).

Megalodon limestone.—See **Para limestone.**

Mekran.—See **Makran.**

Melur stage.—Named by R. B. Foote (*Mem. Geol. Surv. Ind.*, XX, pp. 11, 14, 1883) after the village of Melur, Madura district. Uppermost but one of the divisions of the crystalline rocks of that area (see Allagiri stage).

Meting shales.—The lower division of the Laki series is so distinguished by E. Vredenburg (*Rec. Geol. Surv. Ind.*, 86, 1906); from Meting (25° 12′; 68° 10′) a station on the North-Western Railway, south-west of Kotri and 83 miles from the terminus at Karachi. The fossils of the Meting shales indicate a Lower Lutetian age.

Middle Siwalik.—In describing the Siwalik strata of the Sub-Himalaya of the United Provinces C. S. Middlemiss (*Mem. Geol. Surv. Ind.*, XXIV, 77, 82, 1891) adopted a petrological sub-division into Lower Siwalik, or Nahan sandstone, Middle Siwalik, or Sandrock stage, and Upper or Siwalik conglomerate. G. E. Pilgrim, however (*Rec. Geol. Surv. Ind.*, XL, 191, 1910), adopted the name *Middle Siwalik* for a definite fossiliferous horizon, found in the Punjab Salt Range, and containing a fauna similar to that of Pikermi and Samos taken as the standard of Pontian age. No precise correlation is possible with the barren "Sand-rock" beds of the United Provinces, but Pilgrim inclines to the conclusion that this lithological stage of Middlemiss should be included with the Upper Siwalik, corresponding to the Upper Siwalik of the Salt Range, Pabbi Hills of Baluchistan and Kangra which include a fauna distinctly younger than that of Pikermi.

Miliolite.—See **Porebandar stone.**

Môgok gneiss.—Name proposed by T. H. D. La Touche from the district of that name in Upper Burma for a series of scapolite-garnetiferous biotite-gneisses with bands of crystalline limestone and lenticular beds of graphite. Rubies and other gems occur in the limestones. The first comprehensive description particularly with respect to the minerals is by C. Barrington Brown and J. W. Judd (*Phil. Trans. Roy. Soc.*, Vol. 187A, 151). La Touche (*Mem. Geol. Surv. Ind.*, XXXIX, 33, 1913) discusses the extension of this series in Upper Burma and compares it with similar types of the Dharwarian from the Peninsula. An Archæan age is assigned to it.

Mogoung (Mogaung) sands.—Name used by W. Theobald (*Mem. Geol. Surv. Ind.*, Vol. X, 260, 1873) for a varied assemblage of beds of sand and shale, with silicified wood and mammalian bones, and appearing to pass downward into beds containing marine shells and corals. Theobald seems to have considered these beds as the lower part of the Fossil Wood group or Irrawaddy series and to partake to some extent of the general character of the upper beds. The lower part of this division was correlated by M. Stuart (*Rec. Geol. Surv. Ind.*, XXXVIII, 267, 1909) with part of his Marine Irrawaddis or Akauktaung Stage (*q. v.*).

Möng Lông mica schists.—Name used by T. H. D. La Touche (*Mem. Geol. Surv. Ind.* XXXIX, 46, 1913) for a series of schists in the Northern Shan States developed to the south of the Môgok gneissic area occupying the valley of the Nampai in which is situated Möng Lông (22° 47′; 96° 40′), the capital of the Sub-state of that name. The chief rock is an ordinary biotite schist. It is the lowest division of the Tawng-peng system (*q. v.*).

Morar series.—The upper of the two divisions of the Gwalior system composed of shales, ribboned jasper, hornstone, limestone and contemporaneous basic lavas. Named by C. A. Hacket (*Rec. Geol. Surv. Ind.*, III, 35, 1870) from Morar city (26° 14′; 78° 17′) in Gwalior State.

Motur stage.—Named by H. B. Medlicott (*Mem. Geol. Surv. Ind.*, X, 161, 1872) from the village (22° 17′; 78° 37′) about 12 miles south-south-east of Pachmarhi. This stage belongs to the Lower Gondwanas intermediate between the Barakars and the Bijori stage.

Moulmein system.—This name was applied by T. Oldham (Sel. Records Govt. Ind., X, 33, 1856) to the reddish sandstones, marl and associated massive limestone, conspicuously developed in the neighbourhood of Moulmein (16° 30′ ; 97° 38′) and since recognised throughout large areas of the Shan States. On account of the fossils found in the limestone, the system was regarded as Carboniferous in age ; but recent work in the Shan States has indicated the existence of various Palæozoic strata from Silurian to the Anthracolithic *Productus*-bearing limestones, and it is probable that the rocks included in the Moulmein system during a confessedly superficial reconnaissance are similarly varied in age. See *Plateau limestone*, *Maymyo limestone*, *Namhsim sandstones*, *Naungkangyi beds*, *Nyaungbaw beds*, *Pyintha liemstone*, *Tonbo limestone*, *Wetwin series* and *Zebingyi series*.

Murree series.—Distinguished and mapped in the neighbourhood of the well known hill station of Murree (33° 54′ ; 73° 27′) in the Rawalpindi district, by A. B. Wynne (*Rec., Geol. Surv., Ind.*, VII, 66, 1874). They were found to be resting in apparent conformity on the Kuldanas which rested similarly on the Nummulitic limestone series. In stratigraphical position they correspond to the Dagshai and Kasauli series of the Simla foot-hills, where the rocks are also conspicuous purple shales and sandstones. This correlation is confirmed by the occurrence of leaf impressions of *Sabal major* Heer, in both areas (O. Feistmantel : *Rec., Geol. Surv., Ind.*, XV, 51, 1882). The series has generally been regarded by the Geological Survey as Oligocene and Lower Miocene in age. As G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, XL, 187, 188, 1910) has shown that the Kuldana beds, which underlie the Murrees, contain Bugti vertebrates of Upper Aquitanian age, the Murrees must be later, possibly Burdigalian and Helvetian.

Muscat series.—Name proposed by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 19, 1908) for beds of Laki (Lower Lutetian) age typically developed to the west and south-east of Muscat (23° 39′ ; 58° 35′) consisting of pebble beds with interbedded gypsiferous clays and ferruginous sandstones passing up into a yellow, arenaceous limestone with *Nummulites atacica*, *Assilina granulosa*, etc.

Muth series.—Name used by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 21, 1866) from Muth (31° 57′ ; 78° 6′) in Spiti. Regarded by Stoliczka as probably Silurian in age ; but R. D. Oldham suggested,

an equivalence with the Carboniferous of Kashmir (*Rec., Geol. Surv., Ind.*, XXI, 151, 1888), a correlation adopted also by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XXII, 161, 163, 1889; and *Mem., Geol. Surv., Ind.*, XXIII, 12, 1891). The lower and middle beds of the Muth series were shown by H. H. Hayden to be Upper Silurian, whilst the uppermost bed—the white Muth quartzite—is of doubtful age, though not younger than Devonian (*Mem., Geol. Surv., Ind.*, XXXVI, 24, 29, 1904). Later (Geog. and Geol. of the Him., Part IV, 233, 1908) Hayden used the term *Muth system* to include—

(*d*) White Muth quartzite possibly ranging up to Devonian.
(*c*) Coral limestones with Silurian (Gothlandian) fossils.
(*b*) Red quartzite without determinable fossils.
(*a*) Dark coral limestone with doubtfully Ordovician fossils.

A quartzite similar in character to the white Muth rock has been found by C. S. Middlemiss (*Rec., Geol. Surv., Ind.*, XL., 216, 1910) in Kashmir in contact with Upper Silurian beds below and Lower Carboniferous beds above. It is thus equivalent to the white quartzite of Spiti described by Hayden.

Mysore gneiss.—See **Bellary gneiss.**

Mysorin.—Name applied by Dr. Thomson (*Phil. Trans.*, 1814, 45; Heyne, Tracts on India, 441) to an amorphous copper ore from Ganmanipenta, Nellore district, Madras Presidency, and considered to be an anhydrous carbonate of copper with impurities. F. R. Mallet (*Rec., Geol. Surv., Ind.*, XII, 166, 1879; Man. Geol. Ind., Pt. IV, Mineralogy, 157) proved it to be an impure malachite.

Nagamalai stage.—Named by R. B. Foote (*Mem. Geol. Surv. Ind.* XX, 11, 13, 1883) after the Nagamalai ridge, Madura district, forming the western side of the Vaigai valley for many miles. The third division into which the crystalline rocks of the district are divided (see Allagiri stage).

Nagari quartzites.—The lower part of the Cheyair series of the Cuddapah system. Named from the prominent hill known as the Nagari (Naggery) nose (13° 23′; 79° 39′) in the North Arcot district, by W. King (*Mem., Geol. Surv., Ind.*, VIII, 168, 1872).

Nahan (Nahun) stage.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, Part 2, 13, 1864) from the town and state of Nahan (30° 32′; 77° 21′) for the rocks now distinguished as the lowest stage of the Siwalik series. Medlicott divided the Sub-Himalayan

series into a lower, or Subathu, stage, a middle, or Nahan stage, and an Upper, or Siwalik, stage. The last two are now grouped in one as the Siwalik series, the Nahan being the lowest of the three stages in the series. C. S. Middlemiss (*Mem., Geol. Surv., Ind.*, XXIV, 86, 1891) noticed the development of red shales in the lower part of the Nahan stage in the United Provinces as indicative of conditions resembling those under which the Sirmur beds were deposited, but no superposition of the two series (Sirmur and Siwalik) was seen, such as has been noticed by G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, XL, 188, 1910) in the North-West Punjab. Pilgrim has also summarised the evidence for the age of the Lower Siwaliks (Nahan) and concludes that the beds are Tortonian to Sarmatian (*loc. cit.*, 190, 193). For references to the Lower Siwaliks of Sind and Baluchistan, see *Manchhar.*

Nallamalai series.—Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 127, 1872) from the principal range of hills in the Cuddapah district. One of the four series of the Cuddapah system composed of—

(*b*) Cumbum slates.
(*a*) Bairenkonda quartzites. } about 3,400 feet.

Namhsim beds.—Name used by T. H. D. La Touche (Director's General Report, *Rec., Geol. Surv., Ind.*, XXXVII, 53, 1908), for a series occurring in the gorge of the Namhsim river in the Northern Shan States. Later work (*Mem., Geol. Surv., Ind.*, XXXIX, 130, 1913) proved the existence of two fairly well-marked divisions :—

(2) The Upper Namhsim stage or Konghsa marls, a thinner band of marly beds with hard limestones.
(1) The Lower Namhsim stage, consisting of sandstones.

The fossils, which were examined by F. R. Cowper Reed (*Pal. Ind.* New Ser., Vol. II, Mem. No. 3) had been collected before the detailed stratigraphy had been worked out. They indicate a horizon corresponding closely to the Wenlock.

Namyau beds.—Red or purple sandstones and shales so named by T. H. D. La Touche (Director's General Report for 1899-1900, 85) from the Namyau valley, Northern Shan States, where they are well exposed. The same beds were referred to by P. N. Datta (*loc. cit.*, 118) as the Thibaw (Hsipaw) series. The sandstones are unfossiliferous, but the beds below are interstratified with

limestones, which have yielded Jurassic fossils. See La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 304, 1912).

Nandyal shales.—The uppermost part of the Kundair stage of the Kurnool series; so named from the most important village in the Kundair valley (15° 29′; 78° 32′) by W. King (*Mem., Geol. Surv., Ind.*, VIII, 42, 1872). They are mostly purple in colour and often calcareous, gradually passing into the underlying Koil-Kuntla limestones.

Napeng stage.—Name used by T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 284, 1913), for the Rhætic beds developed capriciously in patches at widely separated points over the Northern Shan States. The beds consist principally of yellow, or variegated highly argillaceous shales or indurated clays. Occasionally they are impregnated with calcareous matter and pass into clunchy, sandy marls or tough argillaceous thin-bedded limestones. The fossils have been described by Miss M. Healey (*Pal. Ind.*, New Ser., Vol. II, Mem. No. 4), whose determination of their Rhætic age set at rest all the discussions caused by the survival of one or two Palæozoic forms. The principal fossils are *Pteria contorta, Grammatodon Lycetti, Gervillia præcursor, Burmesia La Touchei,* with *Myophoria, Pecten, Palæoneilo, Modiolopsis,* and *Conocardium.* Only three species are identical with European forms. Napeng (22° 29′; 97° 8′) is the name of a small village, 9 miles east of Pyaung-gaung Railway station.

Narbada gravels.—Term applied to the older alluvial deposits of the Narbada river. The fauna was partly studied by Dr. Falconer and later by R. Lydekker (*Pal. Ind.*, X, 111).

Nari series.—Named by W. T. Blanford (*Rec., Geol. Surv., Ind.*, IX, 9, 1876) from the Nari Nai, a stream which drains the hills to the south of the Gáj in Sind, and the upper course of which lies almost entirely amongst the formations named from it. Correlated originally by the author as lower miocene or upper eocene. According to E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIV, 89, 1906) a portion of the beds of the complex *Makran system* are of Nari age, while the Kojak series also includes the flysch facies of the Nari in Baluchistan. The Lower Nari, mainly of limestone in Sind, is regarded as Stampian in age, while the Upper Nari shales and sandstones are regarded as Lower and Middle Aquitanian (Vredenburg; *loc. cit.*, 182, 267). The study of the echinoids by P. M. Duncan and W. P. Sladen (*Pal. Ind.*, Ser.

XIV, Vol. I, 248, 270, 1884) had already indicated an Upper Oligocene age. G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, XXXVII, 140, 1908; XL. 187, 1910) found that some of the ossiferous beds near the Sind-Baluchistan border had been grouped by mistake with the younger Lower Siwaliks (L. Manchhars), and that these, which are of Nari and Gáj age, are widely distributed over North-West India.

Narji limestones.—Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 70, 1872) from the village of Narji (Nerjee) in the Cuddapah district (14° 39′; 78° 35′). These limestones form the lower part of the Jammalamadugu stage of the Kurnool series, and are typically fine-grained, grey, or buff-coloured limestones largely quarried in the Cuddapah district for building purposes, and suitable sometimes as lithographic stone.

Naungkangyi beds.—Strata mapped in the Northern Shan States and so named by T. H. D. La Touche (Director's General Report for 1899-1900, 83) from a village (22° 4′; 96° 30′) to the north of Maymyo. The fossils indicate a general correspondence with the Lower Ordovician of North-West Europe (F. R. Cowper Reed, *Pal. Ind.*, New Ser., Vol. II, Mem. No. 3). Later this was sub-divided (*Mem., Geol. Surv., Ind.*, XXXIX, 67,84, 1913) into—

(2) Upper Naungkangyi stage, which has a much wider distribution at the surface than the lower beds. The strata are peculiar argillaceous shales and claystones often resembling lithomarge in texture and of every variety of colour. In all cases they show evidence of intense crushing, resulting in a general distortion of the fossils. Two lithological varieties can be distinguished, one composing all the beds of this age west of Lashio of the variegated type, and the second, the predominating type in the eastern range, consisting mainly of purple claystones. These latter have been distinguished under the name of *Hwe-Mawng* beds. The detailed examination of fossils collected with due regard to stratigraphy has not yet been completed.

(1) The Lower Naungkangyi stage, consisting of yellow or buff coloured sandy marls with strong lenticular bands of coarsely crystalline limestone, all containing fossils. There is very great variation in the lithological character of the rocks at different localities. Particular fossils are,

as a rule, confined to one locality. They are considered to correspond very closely with the Middle Ordovician rocks of the Baltic province.

Negrais formation.—Originally distinguished by W. Theobald as "a series of beds stretching northward from Cape Negrais along the Arakan range and coast....and regarded as probably embracing the beds of the Nummulitic group." No fossil evidence being obtainable, Theobald (*Mem., Geol. Surv., Ind.*, X, 299, 1873) proposed to "retain the term with a somewhat extended application, making it embrace all the rocks met with in the above district older than the Nummulitic, and newer than the Triassic" (Axials). The rocks are mainly hardened and contorted sandstones and shales, seamed with quartz and calcite veins, with occasional limestones. The degree of alteration is irregular and capricious, and their distinction from the fossiliferous Cretaceous and Nummulitic rocks may be a matter of secondary alteration.

Neobolus beds.—Originally described by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 86, 1877) as the "Obolus or Siphonotreta beds," from the prominent brachiopod. The beds form a part of the Cambrian strata of the Punjab Salt Range, which was named by F. Noetling the Kussak (Khussak) stage (*q. v.*).

Neogene.—Term used by F. Noetling (*Pal. Ind.*, New Ser., I, 51, 1899-1901) for those fossils in the Tertiary of Burma which are identical with, or are closely related to, species living in the Indian Ocean.

Nepaulite.—Name given by H. Piddington (*Journ. As. Soc. Beng.*, Vol. XXIII, 170, 1854) to specimens from Nepal, which were subsequently proved by F. R. Mallet (*Rec., Geol. Surv., Ind.*, Vol. XVIII, 235, 1885; Man. Geol. Ind., Pt. IV Mineralogy, 30) to be tetrahedrite of an ordinary type.

Nerinea beds.—The uppermost Cretaceous beds of the Pondicherry area (Warth's Horizon F, *Rec., Geol. Surv., Ind.*, XXVIII, 18, 1895). So named by F. Kossmat (*Rec., Geol. Surv., Ind.*, XXX, 54, 1897) from the presence of large specimens of *Cerithium*, originally described as *Nerinea*. Correlated by Kossmat (*loc. cit.*, 70) with the Danian on account of the presence of *Nautilus danicus*, and with part of the Ninniyur beds in the Trichinopoly area.

Newboldite.—Name given by H. Piddington (*Journ. As. Soc. Beng.*, Vol. XVI, Pt. 2, 1129, 1847) to a mineral from Kurnool which he believed to be a double sulphide of iron and an earth. **F. R.**

Mallet (Man. Geol. Ind., Part IV, Mineralogy, 1st. Ed., 19) believes this to be simply ferruginous blende.

Newer or Overlying trap.—The name given by T. J. Newbold (*Journ. Roy. As. Soc.*, IX, 1844-1848) to the lava flows now generally known as the Deccan Trap. Newbold regarded the Trap as Tertiary in age (*Ibid.*, Vol. XII, 84) formed between the deposition of the "freshwater limestone" (Lametas) and the development of laterite.

Nga-tha-mu beds.—Described by W. Theobald (*Mem., Geol. Surv., Ind.*, X, 277, 1873) as occurring on Koranji island and adjoining portion of the Arakan coast near the village of Nga-tha-mu (16° 30′; 93° 49′). The rocks are cream-coloured, calcareous sandstones, containing fossils similar to some of those in the Gáj beds of Sind. In character the beds resemble in some ways the Porebandar miliolites of the Kathiawar coast.

Ngwetaung sandstones.—Name instituted by T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 66, 1913) for fine-grained brown sandstones, sometimes calcareous, with occasional lenticular bands of limestone, forming the summit of the peak, Ngwetaung, due east of Mandalay. They are of only local development in the Northern Shan States, and fossils are rare. They are considered to be the lowest sub-division of the Ordovician.

Nilgiri or mountain gneiss.—Proposed by W. King (*Mem., Geol. Surv., Ind.*, XVI, 125, f. n., 1880) for rocks of the kind that prevail in the Nilgiris, and other high ranges of South India and Ceylon. These rocks were later described as the charnockite series (*q. v.*) and are characterised by the constant occurrence in them of hypersthene and other pyroxenes; they are typically blue-grey in colour, slightly foliated, compact and fresh. They form the chief mass of the Nilgiris, Palnis, Travancore hills, Shevaroys and hills near St. Thomas' Mount, Madras. For these rocks R. B. Foote afterwards used the term Salem gneiss (*Mem., Geol. Surv., Ind.*, XXV, 30, 1895).

Nimar sandstone.—Named by P. N. Bose (*Mem., Geol. Surv., Ind.*, XXI, 3, 23, 1884) and regarded as probably Lower Cretaceous in age. Regarded by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, XXI, 1884, preface to part 2, pp. vi-viii) as part of the Upper Gondwana system of Jurassic age. These sandstones were afterwards shown by E. Vredenburg (Genl. Report, *Geol. Surv., Ind.*,

for 1902-1903, 20) to be equivalent to the Bagh (Upper Cretaceous) beds.

Ninniyur beds.—The uppermost beds of the Cretaceous formation in the Trichinopoly district, included by H. F. Blanford in his Ariyalur (Arrialoor) group (*Mem., Geol. Surv., Ind.*, IV, 141, 1862). Named from a village (11° 16′ ; 79° 13′) in the Trichinopoly district. The fossils are mainly of Danian facies, and thus the beds have been separated as a higher stage from the Ariyalur (Upper Senonian) stage (H. Leveillé, *Bull. Soc. Geol. Fr.*, 3rd ser., XVIII, 144, 1888, and F. Kossmat, *Rec., Geol. Surv., Ind.*, XXX, 1897, 67, 68, 81). The Ninniyur beds of the Trichinopoly area correspond to the Nerinea beds of the Pondicherry area. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 195, 211, 1908) points out that these beds are, in part at least, equivalent to the *Cardita Beaumonti* beds and Pab sandstones of the Baluchistan area, while the *Orbitoides* and *Cerithia* indicate a Mæstrichtian age for a portion of the Ninniyur beds.

Nithahar quartzites and bedded trap.—The lowest of five local sub-divisions of the Alwar quartzite group. Named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 86, 1877) from a village (26° 58′ ; 77° 4′) in the Alwar State, Rajputana.

Niti limestone.—F. Noetling uses this term (Lethea geognostica, IInd Theil, Das Mesozoicum, Bd., 1, Trias, 1905, 140) for the beds at the base of the Muschelkalk in the Spiti and Kumaun Himalaya. The Niti pass (30° 58′ ; 79° 53′) is in the Kumaun Himalaya. For these beds the term *Nodular Limestone* was previously used by H. H. Hayden in Spiti (*Mem., Geol. Surv., Ind.*, XXXVI, 67, 1904). C. Diener uses the term in the sense of Noetling throughout his memoir on the Trias of the Himalaya (*Mem., Geol. Surv., Ind.*, XXXVI, pt. 3, 1912).

Nodular limestone.—Name used by P. N. Bose (*Mem., Geol. Surv., Ind.*, XXI, 2, 36, 1884) for the lowest of his three sub-divisions of the marine Cretaceous formations of Bagh (*q. v.*). He regarded the formation as of the same age as the Gault and the South Indian Utatur stage, but the evidence was admittedly imperfect.

The term *Nodular Limestone* has also been used in a definite stratigraphical sense by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXVI, 67, 1904) for some beds at the junction of the Lower Trias and Muschelkalk in the Spiti Himalaya. *Cf.* Niti limestone.

Nyaungbaw beds.—Name given by T. H. D. La Touche (Director's General Report for 1899-1900, 82) to red or chocolate brown limestones with interbedded red clays covering a very restricted area in the Northern Shan States which contain fossils of Upper Ordovician age (F. R. Cowper Reed, *Pal. Ind.*, New Ser., Vol. II, Mem. No. 3). The beds are described (*Mem., Geol. Surv., Ind.*, Vol. XXXIX, 121, 1913) as the formingуppermost division of the Ordovician. The village of Nyaungbaw (21° 51 ; 96° 21′) is in the Northern Shan States.

Obolus beds.—See **Neobolus beds.**

Oldhamite.—Name given by N. Story Maskelyne (*Phil. Trans.*, 1870, 195) after Dr. T. Oldham, first Superintendent of the Geological Survey of India, to a mineral (calcium sulphide) occurring in the Basti meteorite.

Olive group.—Name used by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 104, 1877) for the *Cardita Beaumonti* beds of the Eastern Salt Range. With the *Cardita Beaumonti* beds Wynne seems to have included boulder beds belonging to the much older Speckled Sandstone series (*cf.* Waagen : *Rec., Geol. Surv., Ind.*, XIX, 22, 1886 ; Warth : *Ibid.*, XX, 117, 1887). See Conularia beds.

Olive shales.—The *Cardita Beaumonti* beds of Sind, on account of their colour, are sometimes referred to by this name, but the name has no technical value.

Oman series.—Name proposed by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 9, 1908) from the district of 'Oman (Arabia) for a series of rocks consisting for the most part of limestones varying in colour from black to grey, with fossils at certain localities indicating ages from Carboniferous to Trias.

Oolitic series.—One of the rashest examples of attempting prematurely the identification of Indian beds with the standard stratigraphical scale of Europe is that due to H. J. Carter, who (Geol. Papers, 1857, 651) grouped under this name various rocks ranging in age from the Crystalline complex to the uppermost Gondwanas of the Geological Survey.

Ophiceras beds.—Name applied by H. H. Hayden and A. v. Krafft from the characteristic Ammonoid genus to the second fossiliferous zone of the Lower Trias of Spiti, which is, however, so intimately connected with the overlying Meekoceras beds as to be almost indistinguishable. For a summary of the data and

literature see C. Diener, *Mem., Geol. Surv., Ind.*, XXXVI, 18-20 and 45, 1912.

O'Rileyite—Name given to a mineral from Burma by Dr. D. Waldie (*Proc., As. Soc. Beng.*, 1870, 279) after Mr. O'Riley, Deputy Commissioner of Martaban, and composed of copper, iron, arsenic and antimony. No formula was assigned to it. A recalculation of his results by F. R. Mallet (Man. Geol. Ind., Pt. IV, 1st Ed. Mineralogy, 1883, 15) shows it to be a mineral allied to domeykite. The exact locality in the Tenasserim division is unknown.

Otoceras beds.—The name *Otoceras* was given by C. L. Griesbach to a new genus of Ammonites found by him in the Central Himalaya of Kumaon (*Rec., Geol. Surv., Ind.*, XIII, 105, 1880) in beds which he correlated with the Campil or Upper Werfen beds of Europe. These beds were included in the Triassic system, but were regarded as passage beds in a conformable sequence from Permian to Trias (*Rec., Geol. Surv., Ind.*, XXIII, 165, 1889; *Mem., Geol. Surv., Ind.*, XXIII, 68, et seq., 1891). W. Waagen (*Pal. Ind.*, XIII, Part IV, 215, 232, 1891) correlated the beds containing *Otoceras* with those of Djulfa, regarding them as transitional between the Palæozoic and Mesozoic, but on the Palæozoic (Permian) side of the boundary. E. v. Mojsisovics (*Sitzungs. kais. Akad. Wien*, CI, Part 1, 377, 1892) considered the fauna to be distinctly Triassic, pointing out that the *Otoceras* of the Djulfa beds represented a lower stage in the development of the genus. C. Diener (*Pal. Ind.*, Ser. XV, Vol. II, pt. 1, 168-172, 1897; *Ibid.*, XV, Vol. VI, Mem. No. 1, 169, 1909; *Centralblatt f. Min.* 1900, 1; 1901, 513, 655; 1905, 1; *Mem., Geol. Surv., Ind.*, XXXVI, 42, 1912) gives evidence in favour of regarding the Otoceras beds as Triassic, in opposition to the views of A. v. Krafft (*Centralblatt f. Min.*, 1901, 275) and F. Noetling (*Centralblatt f. Min.* 1900, 216; *Neues Jahrb. f. Min.*, Beilagebd., XIV, 467; Lethaea Palæozoica, II, 656, 1901, *Neues Jahrb. f. Min.*, XVIII, Beilage Bd., 546, 552), who regarded the beds as Permian. A. Bittner corroborated Diener's views by an examination of the lamellibranch fossils (*Pal. Ind.*, Ser. XV, Vol. III, Part 2, 74, 1899), and a full discussion of the case is given by Diener in *Mem., Geol. Surv., Ind.*, XXXVI, Part 3, 42-55, where new evidence is given to show that the Otoceras beds are equivalent to the lowest division of the Werfen (Lower Seis) beds. The boundary of the Permian and Trias would thus be drawn between the

Otoceras beds and the Kuling shales in the Himalaya, and between the Chidru stage and Lower Ceratite limestone in the Salt Range, that is, a horizon equivalent to the line between the Bellerophonkalk and Lower Seis beds in the Eastern Alps. As the beds lie in a perfectly conformable sequence according to every observer who has seen them in the field, the question is one of small importance. F. Noetling (*Neues Jahrb. f. Min.*, XVIII, Beilagebd., 1904, 546, 552) distinguishes the following three zones among the Otoceras beds of Painkhanda :—

3. Zone of *Ophiceras tibeticum* Griesb.
2. ,, ,, *Episageceras Dalailamæ* Dien.
1. ,, ,, *Otoceras Woodwardi* Griesb.

C. Diener (*Centralblatt f. Min.*,1905, 2 ; *Pal. Ind.*, XV, Vol. VI, Mem. No. 1, 165, 166, 1909) objects to an artificial division into separate zones of a perfectly uniform fauna ; he points out that *Ophiceras tibeticum* is not restricted to the top layer, *Otoceras Woodwardi* is not confined to the base, while *Epi. Dalailamæ* is found in the main layer of *O. Woodwardi* and the overlying shales. Diener thus regards the whole bed as one zone, that of "*Otoceras Woodwardi* and *Ophiceras sakuntala*."

Owk shales.—Named from the large village of Owk (Auk) (15° 12′; 78° 10′) in the Kurnool district by W. King (*Mem., Geol. Surv., Ind.*, VIII, 67, 1872). Typically white or buff-coloured, non-calcareous shales shading into purple and brown forms. The Auk shales form the upper part of the Jammalamadugu stage of the Kurnool series.

Pab sandstones.—Name used by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXV, 117, 1907) for a thick formation mainly of coarse sandstones in the Pab range in Jhalawan, Baluchistan. They correspond in age with the *Cardita Beaumonti* beds of Sind which E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 192, 1908) regards as Mæstrichtian reaching to Lower Danian. Beds of this age occur also in the Suleiman range (*Rec., Geol. Surv., Ind.*, XXXVI, 241, 1908).

Pachmarhi stage.—The lowest stage of the Mahadevas in the Satpura region, but in thickness greater than the upper two stages, Denwa and Bagra, together. Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, X, 155, 1872) from the summer headquarters of the Central Provinces Administration (22° 27′ ; 78° 29′) in the Hoshangabad district.

Pakhal system.—Name used by W. King (*Mem., Geol. Surv., Ind.* XVIII, 164, 209, 1881) for the probable equivalents of the Cuddapahs in the Godavari valley. Named from the village of Pakhal (17° 58′; 80° 1′), which stands near the western boundary of the Pakhal series at its junction with the Archæan gneisses. The system is divided into—

2. Albaka series, 2,500 feet.
1. Pakhal series, 5,000 feet.

Palæogene.—Term proposed by F. Noetling (*Pal. Ind.*, New Ser., I, 51, 1899-1901) for the extinct species among the Tertiary fossils of Burma. These were divided into four groups:—(*a*) Indigenous, or species related to forms occuring in the older eocene rocks of the Indian region; (*b*) Gallic, or species related to forms known in the eocene of the Paris basin; (*c*) Pacific, or forms with descendants now in the Pacific Ocean, and (*d*) Mediterranean, or those nearly related to species now living in the Mediterranean sea.

Palezkar beds.—Name used by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XIX, 49, 1886) for the lowermost part of his Plant-bearing system in Afghanistan. For recent work on this, see Hayden (*Mem., Geol. Surv., Ind.*, Vol. XXXIX, part 1, 1911).

Palkua shales.—One of the stages recognised by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 1869) in his Semri (afterwards Lower Vindhyan) series in Bundelkhand. From the Palkua hill (24° 30′; 79° 53′) in Chattarpur State.

Palnad beds.—Name used by W. King (*Mem., Geol. Surv., Ind.*, VIII, 107, 1872) for rocks lithologically resembling the Kurnools in the Palnad and adjoining districts of Hyderabad; according to a footnote (*ibid*, 115), R. B. Foote considers these rocks as belonging to the Cuddapahs.

Panchet series.—Named by W. T. Blanford (*Mem., Geol. Surv., Ind.*, III, 29, 30, 1861) from the Panchet hill (23° 37′; 86° 49′), which is partly composed of this series in the Raniganj coalfield.

Panghsa-pye Graptolite band.—Name applied by T. H. D. La Touche (Director's General Report, *Rec., Geol. Surv., Ind.*, XXXVII, p. 54 1908; *Mem., Geol. Surv., Ind.*, XXXIX, 125, 1913) from the village of Panghsapye, 8 miles north-west of Hsipaw, to a white shale band in the Northern Shan States occurring immediately above the Upper Naungkangyi beds and forming an

important stratigraphical horizon. A provisional determination of the fossils shows it to be Llandovery in age and the lowermost division of the Silurian in the Northern Shan States.

Paniam (Paneum) stage.—Named by W. King (*Rec., Geol. Surv., Ind.*, II, 7, 1869; *Mem., Geol. Surv., Ind.*, VIII, 40, 52, 1872) from the village of Paniam (15° 31′; 78° 25′) in the district of Kurnool. One of the stages in the Kurnool series distinguished by being composed of coarse, rusty, so-called "plateau quartzites" below, covered by finer-grained, more compact, white sandstones, named from their mode of weathering, the "pinnacled quartzites."

Panjal system.—Originally applied by R. Lydekker (*Rec., Geol. Surv., Ind.*, XI, 34, 1878) to the great slaty and volcanic series of the Kashmir valley. Afterwards (*Mem., Geol. Surv., Ind.*, XXII, 211, 1888) used "to denote all the rocks below the Kuling series, and above the metamorphics" in the Kashmir region. Named from the Pir Panjal range (*loc. cit.*, 213). The boulder-beds in this system were regarded as equivalent to those of the Blaini stage in the Simla area. The system is probably of a very composite character, which may be unravelled by more detailed work. For recent work in Kashmir, see C. S. Middlemiss (*Rec., Geol. Surv., Ind.*, XXXVII, 319—327, 1909; XL, 206—260, 1910).

Panna sandstone.—The name applied by H. J. Carter (Geol. Papers, 1857, 674) to the lowest of three divisions of his "Oolitic Series" (*q. v.*), from the town of Panna (24° 43′; 80° 14′) in Bundelkhand. Strata of various ages were included in this sub-division including some of those grouped by the Geological Survey with the Vindhyan system.

Panna shales.—Lowest stage according to F. R. Mallet's classification (*Mem., Geol. Surv., Ind.*, VII, 27, 28, 1869) of the Rewa series in the Upper Vindhyan system. Named from the capital of Panna State (24° 43′; 80° 14′) in Bundelkhand.

Papaghni series.—Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 127, 1872) from the river Papaghni (Paupugnee) which joins the Penner to the north-west of Cuddapah town. It is the lowest series in the Cuddapah system, composed of—

(*b*) Vempalli slates	}	about 4,500 feet.
(*a*) Gulcheru quartzites	}	

Par series.—The lower of two divisions of the Gwalior system recognised by C. A. Hacket (*Rec., Geol. Surv., Ind.*, III, 34, 1870). Composed of quartzitic sandstone and shales resting without disturbance on the eroded surface of the basement gneiss. Named from a village (26° 3′ ; 78° 6′) in the Gwalior State.

Para limestone.—Named from the river Para in Rupshu by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 62, 1866) and considered to be Rhætic in age. Found later to include Upper Triassic and Liassic beds, and abandoned as an unnecessary term by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXVI, 87, 1904), who used the terms *Megalodon limestone* for the rock (*loc. cit.*, 84) on account of the prominent fossil found in it near the base. The same formation has been referred to as the *Grey Limestone* by A. von Krafft (*Mem., Geol. Surv., Ind.*, XXXII, 132, 1902) and C. Diener (*Pal. Ind.*, Ser. XV, Vol. V, pt. 3, 148 1908), a name already used in a stratigraphical sense for a sub-division of the Nummulitic beds in Hazara (Middlemiss, *Mem., Geol. Surv., Ind.*, XXVI, 39, 40, 1896). H. H. Hayden afterwards proposed to use the name *Para stage* for the lower part of the limestone formation containing *Megalodon* (Geog. and Geol. of the Him., Part IV, 236, 1908), using the name *Tagling stage* for the higher part of the formation and combining the two under the name Kioto limestone.

Parh limestone.—See **Belemnite beds.**

Parihar beds.—Named by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 158, 1886) from the Parihar hills, North-West of Jaisalmer. The rocks lithologically resemble the Umia beds of Cutch, and overlie the Bedesar beds which contain fossils similar to those of the Katrol series.

Patcham group.—Named from the island of Patcham in the Runn of Cutch (Kachh) by F. Stoliczka (MS. report) for the lowermost division of the Jurassic in that region. The rocks, consisting of grey and yellow limestones with sandstones and marls, have been grouped as follows :—

1. Light grey limestones and marls with *Oppelia serriger*, corals and brachiopods.
2. Yellow sandstones and limestones, with lamellibranchs, chiefly *Trigoniæ*, *Corbulæ*, *Cuculeæ*, etc,

According to W. Waagen (*Pal. Ind.*, Ser. IX, Vol. I) this division corresponds generally to the Bathonian.

Pathanian stage.—Name proposed by F. Noetling (Director's General Report, Geol. Surv., Ind., for 1898-1899, 52, 57, 61; *Centralblatt f. Min.*, 1903, 521) for beds in Baluchistan which he regarded as lower Eocene. In this stage were included the *Radiolites* beds and the *Cardita subcomplanata* and *C. Beaumonti* zones in the Mari hills. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 191, 192, 1908) points out that these beds correspond to the Cretaceous Mæstrichtian of Europe, and that the name is unnecessary.

Paupugnee.—See **Papaghni.**

Pavalur sandstones.—The uppermost of the three stages of the Upper Gondwana rocks, south of the Kistna river, corresponding approximately to the Tirupati sandstones of the Ellore area. Named by R. B. Foote (*Rec., Geol. Surv., Ind.*, XI, pt. 3, 256, 1878; *Mem., Geol. Surv., Ind.*, XVI, 69, 1880).

Pegu system.—Name given by W. Theobald (*Rec., Geol. Surv., Ind.*, II, 80, 1869 and *Mem., Geol. Surv., Ind.*, X, 268, 1873), for the beds in Burma between the Nummulitic rocks and the fossil-wood (Irrawaddy) system. Regarded as covering the Miocene and Pliocene periods. Theobald included in this system—

5. Sandstones and shales.
4. Kama clays.
3. Compact marly sandstone (B). } Prome beds.
2. Massive argillaceous sandstones in thick beds (A). }
1. Sitsayan shales.

F. Noetling (*Pal. Ind.*, New Ser., I, 7, 1899-1901) divides these into two series :—

II. Yenangyaung (including 3, 4 and 5).
I. Prome including 1 and 2.

M. Stuart (*Rec., Geol. Surv., Ind.*, XXXVIII, 261, 1910) reverts to Theobald's scheme, objecting to the modified use of the word Prome, which Theobald applied to his sections A and B (2 and 3). Stuart, however, transfers bed No. 5 to the Irrawaddy system (*loc. cit.*, 266, 267, 269), on account of an unconformity which he regards as separating 4 and 5 in the Prome district (*cf.* Akauktaung series).

Stuart (*loc. cit.*, 279) gives the following as the ages of the divisions of the Pegu system :—

4. Kama clays.	Burdigalian to Tortonian.	
3. Upper Prome series (B).	Aquitanian.	Oligocene.
2. Lower Prome series (A).	Stampian.	
1. Sitsayan shales.	Tongrian.	

Stuart asserts that oil is not known to exist below the Kama clays, and that the petroliferous beds in the Upper Burma oil-fields belong to the Kama formation, all above the base of the Miocene.

Penganga beds.—In the Pranhita valley, west of the Wardha valley coalfield there occurs a series of limestones and shales, which was identified by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 224, 1881) as similar to the Pakhals and Cuddapahs. These had previously been regarded by the Geological Survey as probable equivalents of the Vindhyans, but King recognised two divisions, one of which resembled his Sullavais (Kurnools) and the other, the Pem beds, his Pakhals (Cuddapahs).

Physa beds.— Name equivalent to Intertrappean and used by W. T. Blanford (*Rec., Geol. Surv., Ind.*, V, 93, 1872), so-called from the common occurrence of *Physa prinsepii* in them.

Plant-bearing system of Afghanistan.—Name provisionally used by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XIX, 49, 53, 1886) to include beds above the Permo-Carboniferous limestones as far up as the Red Grit series (*q. v.*). Subsequent papers show these beds distributed to positions on the European stratigraphical scale as Permian to Neocomian (*Rec., Geol. Surv., Ind.*, XX, 95, 1887). The correlations are revised for part of the area by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXIX, Part I, 1911).

Plateau gravels.—Term used by F. Noetling (*Mem., Geol. Surv., Ind.*, XXVII, 54, 1898) for one of the divisions of his Diluvium in Upper Burma. The beds consist of pebbles of various sizes set in a deep-red ferruginous sand. E. H. Pascoe (*Mem., Geol. Surv., Ind.*, XL, 49, 1913) in his account of these deposits says that the pebbles are derived from the Irrawadian conglomerates. Broken bones have been found in the beds. Traced laterally this gravel passes into the *Plateau red earth*, a name used by Pascoe (*op. cit.*, 49).

Plateau limestone.—Descriptive name given by T. H. D. La Touche (Director's General Report, *Rec., Geol. Surv., Ind.*, XXXVII, 54, 1908) to a limestone forming the plateau country of the Northern Shan States and with a considerable extension to the south. The prevailing type is a whitish or light-grey rock, weathering to a darker tint and stained by iron oxide. It only becomes arenaceous near its boundary with the older rocks. The composition varies from a pure calcite through dolomitic limestones to almost true dolomites. The dolomitisation is more complete in the unfossiliferous, massive limestones. Brecciated dolomites recemented by calcite are not uncommon. Oolitic dolomites also occur. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 186, 187, 1913) divides this system into two sections :—

(2) Upper Plateau Limestones (Anthracolithic). Pure limestones, dark grey or blue black in colour, with *Fusulina*, *Productus*, etc., occurring only in detached masses, but not separable from the lower beds. The fossils described by C. Diener (*Pal. Ind.*, New Ser., Vol. III, Mem. No. 4) indicate an age corresponding to the Upper and Middle Productus Limestones of the Salt Range.

(1) Lower Plateau Limestone (Devonian). Finely crystalline dolomites and dolomitic limestones, almost invariably greatly crushed, with traces of fossils, minute foraminifera and corals. This includes at one locality (the Padaukpin Coral Reef) an extremely rich Devonian fauna corresponding to the Eifelian (F. R. Cowper Reed, *Pal. Ind.*, New Ser., Vol. II, Mem. No. 5). The Wetwin shales (*q. v.*) are also included in this division.

Plateau quartzites.—See **Paniam stage.**

Pokaran beds.—The Lowo and Pokaran beds were first distinguished by W. T. Blanford (*Rec., Geol. Surv., Ind.*, X, 17, 1877), and regarded as older than the Vindhyan (Jodhpur) sandstones. The boulders, mainly of Malani rhyolites, were considered to be ice-borne, as underlying rocks near Pokaran were striated. Later work by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XIX, 123, 1886) revealed similar beds near Bap, 40 miles to the north-east of Pokaran in Jaisalmer State, and here the boulders were partly composed of Vindhyan limestone. The boulder-beds were thus regarded as probably equivalent to those of the Talchir

series and those of the Salt Range, that is Upper Carboniferous in age. Pokaran (26° 55′; 71° 58′) is a village in Marwar (Jodhpur) State.

Pondicherry silicified wood deposit.—Beds of loose ferruginous grit forming the Red Hills near Pondicherry, described by T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 240, 1844) as containing abundant silicified wood, dicotyledonous and monocotyledonous. He was disposed to regard this formation as distinct from the beds including fossil-wood in association with the Deccan Trap. Very probably equivalent to the Trivicary grits (*q. v.*).

Poolavaindla.—See **Pulivendala quartzites.**

Poolumpett.—See **Pullampet slates and limestones.**

Poonahlite.—Name given by W. H. Brooke (*Phil. Mag.*, X, 110, 1831) to a zeolite from the Deccan Traps of Poona. The composition and character of the specimens described fall within the specific limits of Gehlen and Fuchs' scolecite (skolezit).

Porcellanic stage.—Name used by P. N. Datta (*Rec., Geol. Surv., Ind.*, XXVIII, 145, 1895) to link up beds 3, 4 and 5, including the so-called "porcellanites," recognised by F. R. Mallet (*Mem., Geol. Surv., Ind.*, VII, 28, 1869) in the Lower Vindhyans.

Porebandar stone.—So named from the port in Kathiawar from which it is shipped. For this rock H. J. Carter (*Journ. Bo. Br. Roy. As. Soc.*, III, pt. 1, 170, 1849, and V., 313, 1857; Geological Papers on Western India, 1857, 756) proposed the name of miliolite from the abundance of the foraminiferal genus *Miliolina*. It is a fine-grained limestone consisting chiefly of foraminiferal tests cemented by calcite, with a few oolitic granules and mineral fragments. Its æolian origin has been conclusively proved by J. W. Evans (*Quart. Journ. Geol. Soc.*, LVI, 1900, 559) and the organic remains investigated by F. Chapman (*ibid.*, 584). The rock is essentially a coastal deposit and is well developed in Kachh, Kathiawar, south-east of Arabia and the Persian Gulf region.

Po series.—Named by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXVI, 44, 1904) from the village of Po (32° 3′; 78° 23′) in Spiti, consisting of—

(*a*) Quartzites and shale with Culm plants.
(*b*) Fenestella-shales and quartzite.

The name was used by Hayden afterwards in the same sense (Geog. and Geol. of the Him., Part IV, 234, 1908) for the upper of the two series composing his Kanawar system in Spiti.

Productus limestone.—As for many years the only conspicuous limestone with *Productus* in India was that of the Salt Range in the Punjab, the name gradually acquired a technical value as a stratigraphical term; but with the more recent discoveries in the Central Himalaya, the Shan States and elsewhere the term now requires its full expression, Productus Limestone of the Salt Range, to be understood. The name was used by W. Waagen in his palæontological memoirs (*Pal. Ind.*, Ser., XIII, Part I, 7, 1879 *et. seq*) to replace the term "Lower Limestone" used by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 69, 1877), who regarded the beds as Carboniferous in age. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 234, 1891) concluded that the Productus Limestones of the Salt Range were mainly Permian in age, the lowermost beds being correlated with the Artinskian stage, while the topmost (Chidru) beds were regarded as passage between the Permian and Triassic. Waagen divided the Productus Limestone as follows:—

Upper . . .	7. Chidru beds. 6. Cephalopoda or Jabi beds. 5. Kundghat beds.
Middle . . .	4. Kalabagh beds. 3. Virgal beds. 2. Katha beds.
Lower . . .	1. Amb beds and Upper Speckled Sandstone.

F. Noetling (*Neues Jahrb.*, XIV, 369, 1901) considers that the Lower Productus beds are even younger than the Artinskian of Russia, and correlates even the underlying sandstones and glacial boulder-beds with the *Rothliegende*, while the Productus Limestone is referred to the Thuringian stage of the *Zechstein*, with a gradual passage up into the Trias through the Chidru beds. Th. Tschernyschew (*Mem. du Com. Geol. Russ.*, XVI, No. 2, 1902, and *Rec., Geol. Surv., Ind.*, XXXI, III, 1904) argues strongly in favour of regarding the Productus Limestone as mainly Carboniferous. The Amb beds he correlates with the Omphalotrochus horizon of the Ural, while the Katha, Virgal and Kalabagh beds between them are equivalent to the Cora and Schwagerina

horizons, and the Kund-ghat and Jabbi beds correspond to the horizons CP*c* and CP*g* of the Artinskian. This leaves the Chidru beds as possibly similar in age to the Lower Permian of Russia. He draws attention to the great palæontological break between the Chidru and Triassic beds of the Salt Range as a possible time break in spite of lithological parallelism of the two formations.

Productus shales of Spiti and Bashahr.—Term used by C. L. Griesbach (*Mem., Geol. Surv., Ind.*, XXIII, 66, 1891) to replace Stoliczka's term Kuling shales (*q. v.*).

Prome beds.—W. Theobald (*Mem., Geol. Surv., Ind.*, X, 270 , 1873) described as Prome beds two stages in his Pegu system well displayed in the Irrawaddy river bank opposite Prome (18° 43′; 95° 15′) in Burma. F. Noetling (*Pal. Ind.*, New Ser., I, 7, 1899) divided the Pegu system into two series, attaching the Upper Prome beds (Theobald's section B) to the Upper or Yenangyaungian and the Lower Prome beds (Theobald's section A) to the Lower or Promeian series. M. Stuart (*Rec., Geol. Surv., Ind.*, XXXVIII, 261, 1910) objects to this scheme, and revives Theobald's system. According to Stuart (*loc. cit.*, 279) the Lower Prome section of Theobald is Stampian and the Upper Prome section, Aquitanian in age. The Prome beds are thus all regarded as of Oligocene age, and are considered to be all below the petroliferous beds of the Upper Burma oilfields.

Pseudojadeite.—A. W. G. Bleeck (*Zeit. prakt. Geol.*, XV, 353: *Rec., Geol. Surv., Ind.*, XXXVI, 267, 1908) = albite.

Pseudomorphic salt crystal zone.—See **Salt Pseudomorph stage.**

Pulivendla quartzites.—A local equivalent of the Nagari quartzites, named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 168, 1872) from the headquarters town of the taluk of that name (14° 25′; 78° 17′) in the Cuddapah district.

Pulkoa schists.—See **Semri series.**

Pullampet slates and limestones.—The upper stage of the Cheyair series of the Cuddapah system. Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 203, 1872) from the village of Pullampet (Poolumpett; 14° 8′; 78° 16′) in the Cuddapah district. Also known by the name Tadputri slates and limestones.

Punjabian series or stage.—Name used by F. Noetling (*Neues Jahrb f. Min.*, XIV, 424, 1901) to include the strata from the Boulder bed to the Lavender clays of the Warcha stage in the Punjab Salt Range. The whole series is regarded as about equivalent

to the European *Rothliegende* or Lower Permian. The series is divided as follows :—

Warcha	Lavender clay, Speckled Sandstone.
Dandot	Olive sandstone. Zone of *Conularia lævigata.* Zone of *Eurydesma globosum.* Olive sandstone.
Talchir	Glacial boulder-beds.

Th. Tschernyschew (*Rec., Geol. Surv., Ind.*, XXXI, 116, 132, 1904) regards these beds as about Middle Carboniferous. E. Koken, in reviewing the question, supports the correlation adopted by Noetling (*Neues Jahrb. f. Min.*, 1907, 483).

Purana group.—Named by T. H. Holland (*Trans. Min. Geol. Inst. Ind.*, I, 47, 1906). Group established to include the unfossiliferous formations lying unconformably on the schists and gneisses of assumed Archæan age, including such formations as the Gwaliors (Original), Bijawars, Cuddapahs, Kurnools and Vindhyans on the Peninsula, and the supposed equivalent unfossiliferous formations of the Outer Himalayas, such as the Baxa series, the 'Carbonaceous' system of the Simla rigion, the Mandhalis, Jaunsar and Deoban systems. Regarded as wholly or in part pre-Cambrian in age, thus corresponding to the Keweenawan and Animikie systems in America.

Purple sandstone stage.—Name commonly used on account of the prevailing lithological type for the lowest division of the Cambrian beds in the Punjab Salt Range. Also named by F. Noetling the Khewra stage (*q. v.*).

Purple sandstone zone.—Descriptive name used by C. S. Middlemiss (Director's General Report, 1899-1900, 143) for a series of dark brick-red or chocolate-purple, sandstones and shales with occasional conglomerates appearing to have been folded in with and let down by faults among the underlying limestones and occurring in the Southern Shan States and Karenni. T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 306. 1913) looks upon those

as the same as his Nam-yau series, but they differ in the presence of conglomerates and thin seams of coal.

Pyintha limestone.—Name given by F. Noetling (*Rec., Geol. Surv., Ind.*, XXIV, 103, 1891) for the beds composed mainly of limestone forming the western foothills of the Shan Plateau, and regarded as Silurian in age. P. N. Datta (Director's General Report for 1899-1900, 98) points out that the name is inappropriate, as the village of Pyinsa or Pyintha (21° 52′; 96° 24′) stands on a higher series of beds. The beds so named are included by Datta (*loc. cit.*, 116) in his Tonbo series. The name has since been dropped, as the group so designated is composed of strata of various ages (La Touche, *Mem. Geol. Surv., Ind.*, XXXIX, 7,63,119, 1913).

Quilon beds.—H. J. Carter (Geological Papers 1857, 740, 743) refers to marine Eocene fossils found by General Cullen in limestone near Quilon (8° 53′; 76° 37′) on the Travancore coast. W. King (*Rec., Geol. Surv., Ind.*, XV, 93, 1882) failed to verify the existence of these beds, but described some fresh-water deposits in the same area under the name of Warkalli beds (*q. v.*). Mr. Logan (quoted by H. B. Medlicott: *Rec., Geol. Surv., Ind.*, XVII, 9, 1884) rediscovered the limestone, but his specimens cannot now be traced. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 323, 1908) pointed out that the species in General Cullen's collection determined by H. J. Carter are of Gaj, that is, Lower Miocene or Upper Oligocene age.

Raghavapuram shales.—Formally distinguished as the middle division of the Upper Gondwanas in the Godavari area by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877; *Mem., Geol. Surv., Ind.*, XVI, 218, 1880). Named from the village of Raghavapuram (17° 2′; 81° 23′), 28 miles west by north of Rajahmundry in the Kistna district. Correlated by King with the Kota and Maleri beds of the Central Provinces.

Raialo stage.—Name used by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 1877, 85) for limestones and quartzites considered to be a lower stage of the Alwar series. Name abandoned by R. D. Oldham (Man. Geol. Ind., 2nd Ed., 1893, 69).

Rajahmundry sandstones.—Name applied by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877, and *Mem., Geol. Surv., Ind.*, XVI, 205, 248, 1880) to the conglomerates and sandstones in the Godavari

district, resting unconformably on the various formations. They are equivalent to the Cuddalore sandstones.

Rajgir (Rajagriha) group.—Named by H. B. Medlicott (*Rec., Geol. Surv., Ind.*, II, 42, 1869) from a hill-range in Bihar (25° 0′ ; 85° 30′). Quartzites are the most important constituents, forming the prominent hills in this area, associated with mica-schists. The Rajgirs and Mahabar schists (*q. v.*) are supposed to be equivalent. Similar rocks occur in the Kharakpur (Kurruckpur) hills farther east.

Rajmahal series.—Named by T. Oldham (*Mem., Geol. Surv., Ind.*, II, 313, 1860 ; *Pal. Ind.*, Ser. II, Vol. I, 1, 1862 ; Ball, *Mem., Geol. Surv., Ind.*, XIII, 209, 1877) from the hill range which takes its name from the town of Rajmahal (24° 30′ ; 87° 30′). The series chiefly consists of trap flows with intercalated grits and carbonaceous shales. The shales have yielded a very interesting flora described by T. Oldham and J. Morris (*Pal. Ind.*, Ser. II, Vol. I, 1862). The traps have been examined by C. A. McMahon (*Rec., Geol. Surv., Ind.*, XX, 104, 1887) and C. S. Middlemiss (*ibid*, XXII, 226, 1889). They have been compared with the Sylhet traps. Isolated outcrops yielding a similar flora have been found on the east coast with associated marine fossils (see Athgarh, Ragavapuram, Pavulur, etc.) and until these fossils are examined the age of the Rajmahal flora must remain in doubt. It is usually accepted as being older than the Jabalpur stage and approximately Oolitic or Liassic.

Raniganj stage.—Named by W. T. Blanford (*Mem., Geol. Surv., Ind.*, III, 29, 1863) from the town of Raniganj (23° 36′ ; 87° 8′), which stands on the formation in the Burdwan district, Bengal. Regarded as the highest stage in Damuda series.

Ranikot series.—Named by W. T. Blanford (*Rec., Geol. Surv., Ind.*, IX, 9, 1876 ; *Mem., Geol. Surv., Ind.*, XVII, 37, 1880) from the stronghold of the Sind Amirs in the Laki range to the north-west of Kotri (25° 54′ ; 67° 56′). Regarded by the author as lower eocene in age, being below the Nummulitic Kirthar (and Laki) series in Sind. The Ranikot series consists of a lower division, mainly of sandstones with lignite, and an upper stage characterised by limestone and shales in which the fossils roughly indicate an age corresponding to that of the London clay. The Upper Ranikot is divided into four principal zones, mainly by means of the Echinoidea. The distribution of these and of the

Foraminifera has been revised by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIV, 85, 186, 1906). There is a distinct stratigraphical break between the Lower Ranikot and the Deccan Trap or associated Cardita Beaumonti beds, and between the Upper Ranikot and the Laki series. P. M. Duncan and W. P. Sladen (*Pal. Ind.*, Ser. XIV, Vol. I, 99, 1882) considered that the fossil echinoids of the Ranikot showed an indefinite Cretaceous facies, with an absence of distinctive Lower Eocene forms.

"Red bed" of the Irrawaddy series.—A ferruginous conglomerate has been adopted as a conspicuous and widespread basement bed of the Irrawaddy sandstones in Upper Burma (F. Noetling, *Rec., Geol. Surv., Ind.*, XXVIII, 77, 79, 1895; *Mem., Geol. Surv., Ind.*, XXVII, 105, 1898). (See also *Irrawaddy system.*) E. H. Cunningham Craig (according to M. Stuart, *Rec., Geol. Surv., Ind.*, XXXVIII, 279, 1910) is of opinion that the "white bed," which immediately underlies the "red bed" in the Yenangyaung area, is well above the natural base of the Irrawaddy system. Stuart (on the authority of G. E. Pilgrim) regards the "red bed" as Pontian in age, and considers it to be a local and slight interruption in the deposition of the Irrawaddy system. The use of the name as a definite horizon appears to be due to E. H. Pascoe (*Mem., Geol. Surv., Ind.*, XL, 30, 1913).

Red Clay zone.—Descriptive name used by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XI, 24, 1875) to designate the beds overlying the Salt in the Trans-Indus salt range, Kohat district.

Red Grit series of Afghanistan.—Distinguished by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XIX, 49, 1886) as part of his Plant-Bearing System (*loc. cit.*, 53). They were finally regarded as partly Jurassic, but mainly Neocomian (*loc. cit.*, and *Rec., Geol. Surv., Ind.*, XX, 94, 1887); but H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXIX, 34, 1910) considers the series to be wholly Cretaceous, as the underlying beds at Firaiman, south-east of Mashhad (36° 19′; 59° 35′), contain Lower Cretaceous fossils.

Regur.—Indian name for the black soil which is prominent especially in the Deccan (Telugu, *regada*). The soil in properties resembles the characteristic soils of the American prairies. For discussion regarding its nature and origin, see Man. Geol. Ind., 2nd Ed., 410, 1893.

Reh.—*Reh* or *kallar*, the white alkaline efflorescence on *usar* (barren) lands, forms in the dry regions of India as in the so-called "bad-

lands" of the United States. The most abundant salts are carbonate, sulphate and chloride of sodium. For an account of its nature and origin see W. Center, *Rec., Geol. Surv., Ind.*, XIII, 253, 1880; H. B. Medlicott, *ibid*, 273; and recent references by J. W. Leather in the *Agri. Ledger*.

Rewah stage.—The middle of three divisions of the Vindhyan (Upper Vindhyan) system as proposed by T. Oldham (*Journ. As. Soc. Beng.*, XXV, 249, 1856). Named from the State in Central India. F. R. Mallet (*Mem., Geol. Surv., Ind.*, VII, 27, 1869) divided the Rewah series as follows:—

Upper Rewah	.	Upper Rewah sandstone.
Lower Rewah	.	Jhiri shales. Lower Rewah sandstone. Panna shales.

Owing to the discontinuity of some of the beds, E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIII, 254, 1906) proposed a new grouping of the Vindhyans, placing the Rewah and Kaimur together in a new series, the *Tons series*.

Rhotas.—See **Rohtas.**

Rohtas (Rhotas) stage.—Name proposed by P. N. Datta (*Rec., Geol. Surv., Ind.*, XXVIII, 145, 1895) for the upper three beds of the Lower Vindhyans distinguished by F. R. Mallet (*Mem., Geol. Surv., Ind.*, VII, 28, 1869). Named from the ancient fort of Rohtasgarh (24° 37′; 83° 65′) in the Shahabad district.

Saighan series.—An extensive series of shales, conglomerates, sandstones and coal beds in Eastern Afganistan, lying with apparent conformity on the volcanic Helmand series, and resembling certain Jurassic strata in Russian Turkestan and other plant-bearing formations overlying Jurassic volcanic beds in the Caucasus. The series has been named from the district of Saighan (35° 10′; 67° 45′) by H. H. Hayden (*Mem., Geol. Surv., Ind.*, XXXIX, 30, 1911), who has identified the fossil plants provisionally as similar to those from Russian Turkestan described by A. C. Seward (*Mem., Com. Geol., Russ.*, New Ser., LIV, 38, 1907) as Jurassic. Hayden has shown (*loc. cit.*, 31-33) that similar beds in Western Afghanistan described by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XIX, 245, 1886) as Lower Gondwana were correlated on inaccurate data, and that the Saighan series belong to Angaraland, not to Gondwanaland.

Sakoli beds.—Disturbed beds between the western boundary of the Raipur Vindhyan basin and Bhandara, resembling the Dharwars and Chilpi Ghat beds. They were briefly mentioned by V. Ball (*Rec., Geol. Surv., Ind.*, 180, 1877) and by W. T. Blanford in a previously made unpublished report. Sakoli (21° 10′; 80° 11′) is a village in the Bhandara district, Central Provinces.

Salem gneiss.—Term proposed by R. B. Foote (*Mem., Geol. Surv., Ind.*, XXV, 30, 1895) for the prevalent rock of the Salem hills and the Nilgiri plateau. The name is equivalent to the term 'Nilgiri gneiss' (*q.v.*) previously proposed by W. King, and the rocks referred to are those now generally known as the charnockite series.

Saletekri beds.—Synonym for Chilpi-ghat beds (*q.v.*) from the Saletekri range (21°47′; 80° 52′), north-west of Raipur, Central Provinces, on the western edge of the Chhatisgarh basin (W. King, *Rec., Geol. Surv., Ind.*, XVIII, 187, 1885).

Saline group.—Term applied by A. B. Wynne (*Rec., Geol. Surv., Ind.*, III, 82, 1870) to the lowest beds exposed at Mount Tilla in the Punjab. They were sub-divided as follows:—

Purple sandstone zone.
Purple shale.
Saline marl.

This grouping was rejected subsequently in the full description of the Salt Range (*Mem., Geol. Surv., Ind.*, XIV, 70, 1878), the term Saline Series being used to designate the Salt marl with its associated gypsum and rock salt (although Saline Series is used as the section heading, Saline group occurs throughout as the page heading).

The age of the beds was considered to be pre-Silurian because of the supposed Silurian age of the Obolus beds. W. Waagen (*Pal. Ind.*, XIII, IV, 1891) showed that the fauna was really of Cambrian age. Doubt has been cast on the sedimentary origin of the salt by C. S. Middlemiss (*Rec., Geol. Surv., Ind.*, XXIV, 28, 1891) who suggests that it may be intrusive.

Salt-pseudomorph stage.—The uppermost stage of the Cambrian formation in the Salt Range, Punjab, composed of red flaggy sandstones and shales, with pseudomorphs of cubic salt crystals. Distinguished by A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 98, 1878) and regarded as possibly Triassic in age, without, however, any positive evidence. The beds are unfossiliferous, but are

intimately connected with the so-called Cambrian Magnesian sandstone beds below. The name Bhaganwala group (stage) has been proposed by F. Noetling for these beds (*Rec., Geol. Surv., Ind.*, XXVII 74, 80, 1894).

Sattivedu series.—Upper division of the Upper Gondwanas near Madras, distinguished by R. B. Foote (*Rec., Geol. Surv., Ind.*, III, 14, 1870; *Mem., Geol. Surv., Ind.*, X, 64, 1873), and named from the hills about 35 miles north-west of Madras (13° 26′; 80° 1′).

Scythian stage or series.—Name suggested for the Ceratite formation of the Punjab Salt Range by F. Noetling (*Neues Jahrb.*, XIV, 1901, 448). For sub-divisions, see *Ceratite beds.*

Sedaw limestone.—Name used by T. H. D. La Touche (Director's General Report for 1899-1900, 81) for limestones near Sedaw (21° 53′; 96° 18′) at the western foot of the Shan Plateau. These beds were included in the Mandalay limestone of F. Noetling (*Rec., Geol. Surv., Ind.*, XXIV, 104, 1891), but La Touche regarded the Sedaw limestone as distinct from the marbles of Mandalay hill. The name was subsequently discarded in favour of Plateau limestone (*q.v.*).

Semri series.—Name, from the river Semri, proposed by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 1860) as a provisional term for the rocks in Bundelkhand, which he recognised as similar to those previously referred to by him in the Son valley as Sub-Kaimur. These rocks were known from about 1864 as Lower Vindhyan, and were named *Son series* by E. Vredenburg in 1906. Sub-divided locally by H. B. Medlicott into—

5. Tirhowan limestones.
4. Pulkoa schists.
3. Dulchipore sandstones.
2. Semri shales and limestone.
1. Semri sandstone.

Sericitoid.—A mineralogical adjective used by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 680, 335, 1909) as a field term for describing phyllitic rocks in which the glistening mineral looks *like sericite*, although subsequent chemical examination may show the mineral to be some other species, such as talc.

Shillong series.—Briefly indicated in a preliminary paper by H. B. Medlicott (*Rec., Geol. Surv., Ind.*, II, 10, 1868) and afterwards described in greater detail (*Mem., Geol. Surv., Ind.*, VII,

197, 1869). Named from the hill-station in Assam (25° 32′; 91° 55′). The associated rocks are very similar to the "Transitions" of Bihar in composition and in order of succession, being largely quartzites, slates, and schists, closely folded. With the rocks of sedimentary origin is associated a mass of greenstone or epidiorite, the so-called 'Khasia trap.'

Sikandarmalai stage.—Named by R. B. Foote (*Mem., Geol. Surv., Ind.*, XX, 11, 12, 1883), after the Sikandar Malai, 3½ miles south-west of Madura. The fourth of the divisions into which the metamorphic rocks of the Madura district are divided. (See Allagiri stage.)

Siliceous Limestone group.—Term introduced by W. King (*Rec., Geol. Surv., Ind.*, XXII, 157, 1889) for one of the divisions of the Permocarboniferous of the Salt Range. He divided the group into—

Upper Productus Limestone,
Siliceous limestone (Middle Productus Limestone).

Simlaite.—Name given by A. Schrauf (*Verh., k. k. Geol. Reichs*, 43, 1870) for a kind of pholerite occurring near Simla.

Simla slates.—Name applied by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, part 2, 17, 33, 1864) to the slates occurring below the Blaini beds in the Simla area. Included by R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXI, 134, 1888) in his *Carbonaceous system.* Named after the hill station (16° 5′; 78° 56′).

Siphonotreta beds.—See **Neobolus beds.**

Sirbu shales.—One of the stages in the Lower Bhander series of the Upper Vindhyans distinguished by F. R. Mallet (*Mem., Geol. Surv., Ind.*, VII, 27, 28, 83, 1869) from Sirbu hill (24° 22′; 81° 4′), north of Amarpatan in Rewah State.

Sirmur series.—The name officially adopted (Man., Geol. Ind., 1st Ed., 1879, 524) for the lower of the two divisions of the Sub-Himalayan system, originally distinguished by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, 17, 1864) as the Subathu or Lower Sub-Himalayan series. The name Subathu having become restricted, the Sirmur series is divided as follows:—

3. Kasauli stage.
2. Dagshai ,,
1. Subathu ,,

The series was regarded as Eocene to Oligocene in age, but G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, XL, 188, 1910) has shown that the Murree beds, which are equivalent to the Dagshai and Kasauli, overlie the Aquitanian Kuldanas, and are probably Burdigalian and Helvetian (Miocene) in age. The Subathu beds contain Kirthar (Middle and Upper Lutetian) Nummulites (E. Vredenburg, *Rec., Geol. Surv., Ind.*, XXXIV, 177, 1906). Medlicott (*Op. cit.*, 92) considered that a decided break occurred between the Sirmur and the Siwalik series, as they occurred in the type area on opposite sides of the great Sub-Himalayan boundary fault. G. E. Pilgrim however (*Rec., Geol. Surv., Ind.*, XL, 188, 1910) records the gradual transition from Murree beds to Lower Siwalik in the Rawalpindi and Jhelum districts and from Kasauli to Nahan (L. Siwalik) in some of the Simla Hill States (*Rec., Geol. Surv., Ind.*, XLI, 83, 1911).

Sironcha sandstones.—Formally introduced by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877) as part of the Gondwana system in the Nizam's dominions and the Central Provinces; and supposed to correspond to the Golapilly sandstones of the Godavari District. Rejected by Hughes (*Rec., Geol. Surv., Ind.*, XI, 25, 1878) and eventually admitted by King (*Rec., Geol. Surv., Ind.*, XIII, 13—16, 1880) to be probably part of the Kamthis. See also *Mem., Geol. Surv., Ind.*, XVIII, 103, 1881. Sironcha (19° 53′; 80° 2′) is a village in the Chanda district, Central Provinces.

Sitaparite.—Mineral named by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 49, 1909) from Sitapar (21° 44′; 78° 56′), Chhindwara District, Central Provinces, where it is found with the manganese-ore deposits. Composition, approximately $9Mn_2O_3 . 4Fe_2O_3 . MnO_2 . 3CaO$. The mineral is bronze-coloured and its crystalline form doubtful.

Sitsayan shales.—Shales with subordinate sandstones regarded by W. Theobald (*Mem., Geol. Surv., Ind.*, X, 269, 1873) as the base of his Pegu system. Found lying unconformably on the Nummulitic rocks in the Prome District (M. Stuart, *Rec., Geol. Surv., Ind.*, XXXVIII, 262, 1910). No fossils are found in these shales, but from their position conformably below the Lower Prome stage they are regarded by M. Stuart (*loc. cit.*, 279) as Tongrian, or Lower Oligocene. Named from the village of Sitsayan (18° 54′; 95° 14′) $8\frac{1}{2}$ miles above Prome on the Irrawaddy river.

Siwalik system.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, part 2, 13, 14, 101, 1864) from the Siwalik hills in the United Provinces and the Punjab Sub-Himalayan belt. The term Siwalik was originally applied to the Upper Sub-Himalayan series—the beds above the Nahan stage—but it is now used as a system name to include the Nahans, which form the lowest of its three series (*Man., Geol. Ind.*, 1st Ed., 1879, 524; 2nd Ed., 1893, 356). Representatives of various parts of the Siwalik system have been found in the North-West Frontier Province, Jammu, Baluchistan, Sind and Persia, while the Tipam sandstone series of Assam and the Irrawaddy series in Burma represent a similar development to the east of the typical area. According to G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, XL, 189—205, 1910) the ages of the three divisions are as follows:—

Upper Siwalik . . .	Pliocene.
Middle Siwalik . . .	Pontian.
Lower Siwalik . . .	Tortonian and Sarmatian.

The fauna has been described by H. Falconer and P. T. Cautley (*Fauna antiqua Sivalensis*), R. Lydekker (*Pal. Ind.*, Ser. X.), and G. E. Pilgrim (*Rec., Geol. Surv., Ind.*, vol. XL, 63—71, *Pal. Ind.*, new ser., vol. IV, mems. 1, 2, 1911-12).

Son series.—Name given by E. Vredenburg to the formation known as *Lower Vindhyan* (*Rec., Geol. Surv., Ind.*, XXXIII, 258, 1906), from the Son valley in which these rocks are well developed. The old names *Sub-Kaimur* and *Semri* were superseded by *Lower Vindhyan* about 1864, but the new Son series is united by Vredenburg with his Tons series to form the Ken sub-system of the Vindhyans.

South Mahratta Country beds.—A part of the "Diamond Sandstone, and Limestone" system of T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 159, 1844) "separated by a zone of outcropping hypogene and plutonic rocks, about a degree and half in breadth, from the Cuddapah beds, and immediately to the westward of them....extending north and south from the vicinity of Chimulghi, near the confluence of the Kistna and the Gutpurba, to Gujunderghur on the south, and from Moodgul on the east, to the subordinate chains of the Western Ghauts at Gokauk, and thence stretching down southerly towards Belgaun." The rocks referred to are evidently the Kaladgis of R. B. Foote, who also correlated them with the Cuddapahs.

Spandite.—Named by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 163, 179, 1909). Portmanteau name proposed for a garnet intermediate between spessartite ($3\,MnO.\,Al_2O_3.\,3\,SiO_2$) and andradite ($3CaO.Fe_2O_3.3SiO_2$). Found in rocks of the kodurite series (*q. v.*).

Speckled sandstone series.—A. B. Wynne (*Mem., Geol. Surv., Ind.*, XIV, 69, 90, 1877) used this name for the beds intervening between the so-called Magnesian sandstone (Jutana) series and the Productus Limestone in the Western Salt Range of the Punjab. At the base of the series occurs the well known boulder-bed containing glaciated pebbles associated with sandstones and shales in which fossils have been found similar to many known in the Upper Carboniferous formations of Australia (W. Waagen : *Pal. Ind. Ser.* XIII, Vol. IV, 60, 145, 147, 1890-91). The boulder-beds recognised by Wynne as associated with the Olive series (Cardita Beaumonti beds) in the Eastern Salt Range are correlated with that in the Speckled Sandstone series (W. Waagen : *Rec., Geol. Surv., Ind.*, XIX, 22, 1886 ; H. Warth, *Ibid.*, XX, 117, 1887).

Spintangi beds.—R. D. Oldham (*Rec., Geol. Surv., Ind.*, XXIII, 96, 1890) gave this name to a division of the Tertiary formations in Baluchistan typically exposed near Spintangi (29° 55′ ; 68° 8′) in the Sibi district. The beds are said to follow conformably on the Ghazij beds and to be overlaid unconformably by the Siwaliks. The beds include a nodular limestone with thick beds of gypsum and green shales. The Spintangi beds are regarded by Oldham as equivalent to the Kirthar of Sind. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIV, 182, 1906) correlates them with the Upper Kirthar as mostly Upper Lutetian in age.

Spiti shales.—Named by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 85, 1866) from the valley in which they were first observed in the Punjab Central Himalaya. They consist typically of black shales about 500 feet thick. Regarded as Upper Jurassic in age, some of the Ammonites, however, showing even Lower Neocomian affinities (V. Uhlig, *Pal. Ind.*, Ser. XV, vol. IV, 1903). The Spiti shales have been recognised in Hazara, Spiti and Kumaon as well as north of Nepal and north of Sikkim. The palæontological results completed by Uhlig (1911) indicate a range for the Spiti Shales from Oxfordian to Valanginian inclusive (Director's Genl. Report, *Rec., Geol. Surv., Ind.*, XLI, 68, 1911). See Chidamu and Lochambel.

Sriperumbudur (Sripermatur) series.—Division of the Upper Gondwanas near Madras proposed by R. B. Foote (*Rec., Geol. Surv., Ind.*, III, 15, 1870; *Mem., Geol. Surv., Ind.*, X, 65, 1873) from a village (12° 59′; 79° 57′) 25 miles west-south-west of Madras city in the Chingleput District. The Sriperumbudur beds are older than the associated Sattevedus.

Srisailam quartzites.—The uppermost beds of the upper series of the Cuddapah system, so named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 252, 1872) from the sacred village of Srisailam, or Sreeshalum (16° 5′; 78° 53′) on the Kistna river.

Subathu series.—Named by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, part 2, p. 11, 1864) from the hill station and cantonment of Subathu (30° 58′; 77° 2′) in the Simla District, Punjab. Divided into a Subathu stage at the bottom with Nummulites, overlaid by Dagshai purple sandstones and red clays, and Kasauli grey and purple sandstones. The name Subathu was subsequently reserved for the lowest stage, the whole series being distinguished as the Sirmur series (*Man., Geol. Ind.*, 1st Ed., 524, 1879). The Nummulitics in the Subathu stage are similar to those of the Sind Kirthar, that is of about Middle and Upper Lutetian age (E. Vredenburg, *Rec., Geol. Surv., Ind.*, XXXIV, 177, 1906).

Sub-Himalayan system.—Term applied by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, pt. 2, 10, 1864) to the belt of Tertiary rocks forming the Siwaliks and other foot-hills in the Himalayan region of the Punjab and United Provinces. The term is retained with a general meaning, but is now superseded by more precise discrimination of the formations in the Sub-Himalaya. In the first edition of the official Manual of the Geol. of Ind., 1879, p. 524, the Sub-Himalayan system was divided as follows:—

Siwalik series . . .	Upper. Middle. Lower (Nahan).
Sirmur series . . .	Uppper (Kasauli). Middle (Dagshai). Lower (Subathu).

Sub-Kaimur series.—Name proposed by H. B. Medlicott (quoted by T. Oldham, *Journ. As. Soc., Beng.*, 253, 1856; *Mem., Geol. Surv., Ind.*, II, 303, 1860) for the rocks below the Kaimur series in the Son valley. Similar rocks were described by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 1860) in Bundelkhand under the

name Semri, and they were afterwards known generally as Lower Vindhyan. In 1906 E. Vredenburg used the term "Son series" for these rocks. Originally the Sub-Kaimurs probably included also rocks afterwards separated as "Transition" from the Vindhyan system; the term was not specifically limited below (*cf.* J. G. Medlicott, *Mem., Geol. Surv., Ind.*, II, 138, 1860).

Sub-metamorphic.—See **Transitions.**

Subrobustus beds.—Name proposed by C. Diener in 1895 (*Denks. K. Akad. Wiss.* Wien. 1895, 548) for the upper division of the Lower Trias in Painkhanda, because he considered the type specimen of *Ceratites subrobustus* (=*Keyserlingites Dieneri* Mojs) to have been derived from its topmost layers, in which *Flemingites rohilla* is the leading fossil. But this specimen was probably extracted from a detached block of the overlying Muschelkalk, since H. H. Hayden and A. v. Krafft have obtained numerous examples of *Keyserlingites* (*Durgaites*) *Dieneri* and its allies from the Muschelkalk, but not a single specimen from the lower Trias. The name "Subrobustus beds" must be discarded and replaced by "Hedenstræmia beds" introduced by A. v. Krafft (Director's Genl. Rep., 1899—1900, 207), for this rock group.

Sulcacutus beds.—So called by C. Diener (*Denks. K. Akad. Wiss.*, Wien, LXII, 584, 1895) from the characteristic belemnite. The bed, consisting of a ferruginous oolite, constitutes a very constant horizon (callovian) at the base of the Spiti shales from Spiti to Byans.

Sullavai sandstones.—Named by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 227, 1881) from a village (18° 12′; 80° 10′) in the Godavari valley, where the Sullavais rest unconformably on the Pakhal series, and include beds which weather into forms recalling the pinnacled quartzites of the Paneum stage in the Kurnool system. Similar rocks occur further north in the Pranhfta valley, where they were identified by W. T. Blanford (MS. report, 1866) as Vindhyans. Divided by King (*op. cit.*, 229) as follows :—

Kapra sandstones	700 feet.
Venkatpur sandstones	300 „
Encharani quartzites	600 „

Syhadrite (Syhedrite).—Name given by C. L. Sheppard (*Amer., Journ. Sci.*, 2nd ser., XL., 110, 1865) to one of the minerals in the

amygdala of the Deccan Trap, which, as W. T. Blanford (*Mem., Geol. Surv., Ind.*, VI, 141, 1867) suggested, is merely stilbite coloured by green earth as in the case of *hislopite* (*q.v*). The name is derived from *Sahyadri*, the name of the Western Ghats in the Bombay Presidency, from the Khandesh district to Goa.

Tadpatri shales and limestones.—Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 181, 1872) from a town (14° 55′ ; 78° 4′) in the Anantapur district. The upper part of the Cheyair series of the Cuddapah system, also known as the Pullampet slates and limestones.

Tagling limestone.—Named by F. Stoliczka (*Mem., Geol. Surv., Ind.*, V, 66, 1866) from the Tagling pass (32° 32′ ; 78° 5′) in Spiti. The term was applied to a series of limestones 2,000 feet thick underlying the Spiti shales and regarded as Liassic in age. H. H. Hayden has proposed (*Mem., Geol. Surv., Ind.*, XXXVI, 87, 1904) to drop the name as unnecessary ; the beds are of Middle and Lower Liassic age, possibly including Rhætic. More recently Hayden (Geog. and Geol. of the Him., Part IV, 236, 1908) used the term *Tagling stage* for the upper part of this great limestone formation, and the name *Kioto limestone* to include it and the *Megalodon*-bearing portion below to which the name *Para stage* is given. *Cf.* Grey Limestone.

Tal beds.—First recognised by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, III, Part 2, 69, 1864) in the Lower Himalaya east of the Ganges. Afterwards examined in greater detail by C. S. Middlemiss (*Rec., Geol. Surv., Ind.*, XVIII, 73, 1885) who traced and mapped the beds over a large part of British Garhwal (*Rec., Geol. Surv., Ind.*, XX, 33, 1887 ; *Mem., Geol. Surv., Ind.*, XXIV, 63, 130, 1890). Only fragmentary, indeterminable fossils have been found in these beds, which are doubtfully regarded as Mesozoic on account of their position between limestones of the Krol or Deoban type below and the Nummulitic above. The beds have not been formally named, but are generally known from the name of the valley (30° 0′ ; 78° 19′) in which they were first found.

Talchir series.—Named by W. T. and H. F. Blanford and W. Theobald (*Mem., Geol. Surv., Ind.*, I, 46, 47 and 48, 1859) from the state in Orissa, Bengal (Capital, Talcher, 20° 57′ 20″ ; 85° 16′ 11″), where the rocks were first described in detail and separated from the overlying Damuda series. Regarded originally as not

more recent than Permian, though on admittedly imperfect evidence (*loc. cit.*, p. 82). The Talchir boulder-beds are correlated by Th. Tschernyschew (*Rec., Geol. Surv., Ind.*, XXXI, 116, 132, 1904) with Middlle Carboniferous conglomerates of supposed glacial origin on the eastern slopes of the Urals. According to E. Koken (*Neues Jahrb. f. Min.*, 1907, 503), the Talchirs are somewhat younger than the boulder beds of the Punjab Salt Range, which he regards as Permian. For correlation with marine deposits of Kashmir, see *Gondwana*.

Tanawal (Tanol) series.—Named by A. B. Wynne (*Rec., Geol. Surv., Ind.*, XII, 122, 1879) from the ancient name of the country in which they are found on the North-West Frontier. The rocks are unfossiliferous, and often partly metamorphosed; they include conglomerates or boulder beds, and carbonaceous shales, and agree in many respects with the "Carbonaceous" system of the Simla region. They lie unconformably on the Attock slates and with them form the probable local development of the Purana group.

Tara sandstone.—The uppermost division of H. J. Carter's "Oolitic series" was named by him from the Tara pass or ghat which leads from the alluvial plain of the Ganges, about 10 miles south-west of Mirzapur, to the sandstone plateau of Bundelkhand (Geol. Papers, 1857, 655). This formation was regarded by Carter as equivalent to the "New Red Sandstone" of J. Franklin and V. Jacquemont, and the "Old Red Sandstone" of J. McClelland. The sandstone referred to is that known to the Geological Survey as the Kaimur stage of the Vindhyan system, which is of course much older than the Oolitic.

Tarcherla sandstones.—Term introduced by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877) for sandstones considered to be part of the Kamthis and below the Lingagoodium sandstones. T. W. H. Hughes apparently considered them (*loc. cit.*, page 61) to belong to a later series than the Kamthis. Hughes (*Rec., Geol. Surv., Ind.*, XI, 25, 1878) later considers them to be part of the Kamthis. The name was subsequently discarded.

Tawmawite.—Name proposed by A. W. G. Bleeck (*Zeit. Prakt. Geol.*, XV, 354; *Rec., Geol. Surv., Ind.*, XXXVI, 269, 1908) for a dark-green chromiferous variety of epidote occurring in jadeite quarries at Tawmaw, Upper Burma.

Tawng-peng system.—Name proposed by T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, XXXIX, 45, 1913) from the sub

State of that name in the Northern Shan States for an unfossiliferous and well-defined group of strata divided into the following :—

Bawdwin Volcanic series.
Chaungmagyi series.
Mica Schists of Möng Lông.

From their position they are supposed to be possibly Cambrian in age.

Tendau group.—Name proposed by P. N. Bose (*Rec., Geol. Surv., Ind.*, XXVI, 152, 1893) for the presumably Tertiary coal-bearing beds of Tenasserim, consisting of shales and sandstones with coal seams below and conglomerates above. Tendau (12° 6′ ; 99° 4′) is a village 19 miles north-north-east of Tenasserim.

Thibaw series.—See **Hsipaw series.**

Tipam sandstones.—Name used by F. R. Mallet (*Mem., Geol. Surv., Ind.*, XII, 296, 1876) for a thick sandstone formation overlying the Tertiary coal-measures in North-East Assam. The formation in position and characters corresponds to the Siwalik system of the sub-Himalaya and the Irrawaddy sandstones of Upper Burma, and like the latter includes fragments of fossil wood. Named from the Tipam hills (27° 16′ ; 95° 30′) east of Jaipur.

Tirhowan (Tirohan) limestone.—Name given by H. B. Medlicott (*Mem., Geol. Surv., Ind.*, II, 6, 1860) to the uppermost stage of his Semri (afterwards Lower Vindhyan) series in Bundelkhand. From the village of Tirhowan (25° 15′ ; 80° 55′) in the Banda district.

Tirpul beds.—Name used by C. L. Griesbach (*Rec., Geol. Surv., Ind.*, XIX, 48, 264, 1886) for some Tertiary plant-bearing beds of the Herat province. He divided them into two divisions :—

1. Upper sandstones and plant beds of the Herat valley,
2. Lower plant beds with gypsum,

corresponding to Lower Pliocene and Upper Miocene.

Tirumangalam stage.—Named by R. B. Foote (*Mem., Geol. Surv., Ind.*, XX, 11, 12, 1883) after the great plain of the Tirumangalam taluq, Madura district and is the lowermost division of the metamorphic rocks of that area. (See Allagiri stage.)

Tirupati (Tripetty) sandstones.—Described by W. King (*Rec., Geol. Surv., Ind.*, X, 56, 1877 ; *Mem., Geol. Surv., Ind.*, XVI, 224 1880) as the uppermost division of the Upper Gondwanas in the Kistna Godavari area. Named from the Tripati hills, some 23 miles north-east of Ellore (16°57′ ; 81° 19′) in the Kistna district.

The beds contain fossils having general affinities to those of the Umia beds of Cutch. They are also correlated with the Chikiala sandstones of the Upper Godavari valley.

Tonbo beds.—Name used by P. N. Datta (Director's General Report for 1899-1900, 99, 116) for the limestone beds forming the western foot-hills of the Shan plateau. The beds were regarded as Lower Silurian in age. Subsequent work of T. H. D. La Touche (Director's General Report for 1906, *Rec., Geol. Surv., Ind.*, XXXV, 52, 1907) resulted in the discovery of *Fusulina* and other forms, described by C. Diener (*Pal. Ind.*, New Ser., Vol. III, Mem. No. 4) indicating a Permo-Carboniferous age. The name has been discarded in favour of Plateau limestone (*q. v.*).

Tons series.—Name proposed by E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIII, 258, 1906) to include the old Rewa and Kaimur stages of the Vindhyan system. From the Tons river, which drains the broad table-land in Central India, constituted by the Kaimur and Rewa rocks. The Tons series and Son series (old Lower Vindhyan) are thus united to make up the Ken sub-system, or lower main division of the Vindhyan system.

Transition systems.—The term Transition was applied first by Werner to the sedimentary rocks which were regarded as older than the fossiliferous or *Secondary* and younger than the hypogene gneisses and granites or *Primitive* rocks of Lehman's classification. Long before the Geological Survey of India was founded, the work commenced by Murchison and Sedgwick in 1831 resulted in the recognition of fossiliferous systems among the so-called Transitions of Great Britain. The term thus became curtailed in its stratigraphical application, and in India was used to cover the older of the unfossiliferous systems in the Peninsula which were found to occupy a position intermediate between the *Vindhyans* and the *Gneissic* or *Metamorphic* (Man. Geol. Ind., 1879, pp. xiii, xix, 3, 28). The transitions thus included the Gwaliors, Cuddapahs and Kaladgis in the upper division, and the Champaners, Aravallis and what were afterwards called the Dharwars in the lower division. The Kurnools and Lower Vindhyans (Semri) were thus placed in the higher system as Vindhyans. In the 2nd Edition of the Manual, published in 1893, R. D. Oldham (chap. III) included in the Transitions the distinctly foliated formations like the Dharwars, the Aravallis, the Champaners and the similar schistose and semi-schistose rocks

of Bihar and the Shillong plateau together with the unfolded Gwaliors; but he excluded as *Older Palæozoic* (chap. IV) the Cuddapahs and Kurnools, with the Lower and Upper Vindhyans. In view of the fact that all members of these two great groups of rocks are unfossiliferous and thus of doubtful age, T. H. Holland proposed in 1906 (*Trans., Min. Geol. Inst., Ind.*, I, 47) to recognise the great unconformity between the foliated formations (Dharwars, Aravallis, etc.), and the unfoliated, but often folded, strata (Cuddapahs, Gwaliors, Vindhyans, etc.) as the main dividing line. The former were thus grouped with the *Archæan* (*q. v.*) while for the latter the group name *Purana* was proposed. The Puranas thus present characters which recall those of the pre-Cambrian formations of the great Lakes region in North America, where the Animikies and Keweenawans are formations of the rank of systems lying unconformably on the foliated Lower Huronians. Similar unfossiliferous old formations are known in other parts of the world, for instance in Finland, where the Jotnian and Jatulian systems lie on the Kalevian (J. J. Sederholm, *Bull. Comm. de Fin.*, No. 23, 95, 1907). At any time one may expect to find the Vindhyans yielding Palæozoic fossils, and thus find it necessary to exclude them from the Purana group; but it seems likely that further work will merely serve to confirm the pre-Cambrian age of the older Purana systems. The term *Transition* cannot now be used except in a purely adjectival sense. Synonymous with *Transition* in the earlier writings of the Geological Survey is the term sub-metamorphic. *Vide*, e.g., *Mem., Geol. Surv., Ind.*, XVIII, 73 (1881), and X, 125, (1873); also Man. Geol. Ind., Vol. I, XIX, 3, 9, 28 (1879).

Trappean grits.—Name used by F. Fedden (*Mem., Geol. Surv., Ind.*, XXI, 78, 90, 1884) to distinguish the laminated gritty and trap-like deposits at the base of the traps in Kathiawar where they are only poorly developed. A. B. Wynne (*Mem., Geol. Surv., Ind.*, V. IX, 56, 1872) uses the term Infratrappean grits for similar beds in Cutch (Kachh).

Trappoid beds.—Name employed by F. R. Mallet to distinguish No. 4 of his sub-divisions of the Lower Vindhyans (*Mem., Geol. Surv., Ind.*, VII, 28, 1869). The rocks include felspathic and other constituents which suggested the similarity to igneous rocks. Examination by E. Vredenburg (*Mem., Geol. Surv., Ind.*, XXXI, 93, 107, 1901) shows that the so-called "trappoids" and "por-

cellanites" are rhyolitic tuffs differing essentially in degree of coarseness. True felsites and rhyolitic lavas have been found associated with the tuffs in one place in the Son valley.

"Trap-shotten" gneiss.—Term used by W. King and R. B. Foote (*Mem., Geol. Surv., Ind.*, IV, 271, 1864) for certain gneisses in the Salem district, which appeared to be impregnated along bands with veins of dark-coloured, compact trap. The supposed trap was shown by T. H. Holland (*Mem., Geol. Surv., Ind.*, XXVIII, 198, 1900) to be mylonite formed along planes of dislocation.

Traumatocrinus limestone.—Name applied to a part of the Upper Trias of the Himalaya from the characteristic crinoid. The fauna was originally described by E. v. Mojsisovics and A. Bittner (*Pal. Ind.*, xv, III, Part 1; *ibid.*, Part 2). It was correlated with the Julic substage of the Upper Trias of the Alps, a correlation fully confirmed by C. Diener's examination of the more extensive collection of A. v. Krafft (*Pal. Ind.*, xv, VI, Memoir 2).

Tremenheerite.—Mineral name used by H. Piddington (*Journ. As. Soc., Beng.*, XVI, Part 1, 369, 1847) for a carbonaceous rock from the Tenasserim division, South Burma. The original mineral was not preserved in the Calcutta Museum (F. R. Mallet, Man. Geol., Ind., Part IV, 1887, 11), and its exact nature cannot now be verified, but it is evidently, from Piddington's analysis, a substance allied to impure graphite. The name is given after G. B. Tremenheere.

Trichinopoly fossil limestone.—Briefly referred to by T. J. Newbold (*Journ. Roy. As. Soc.*, VIII, 218, 1844) as similar in some respects to the fossiliferous limestone of Pondicherry, but, with the imperfect information then obtainable, of doubtful age.

Trichinopoly stage.—One of the divisions of the Coromandel Cretaceous beds named by H. F. Blanford (*Mem., Geol. Surv., Ind.*, IV, 23, 107, 1862) from the district in which the beds occur. The lower beds agree with the Turonian of Europe, while the upper beds are lower Senonian (F. Kossmat, *Rec., Geol. Surv., Ind.*, XXVIII, 40, 1895).

Trigonoarca beds.—Name given by F. Kossmat (*Rec., Geol. Surv., Ind.*, XXX, 54, 58, 1897) for beds in the Pondicherry Cretaceous formations included in Horizons D and E of H. Warth (*Rec., Geol. Surv., Ind.*, XXVIII, 17, 1895). According to Kossmat, the Trigonoarca beds correspond to a part of the Ariyalur stage

of the Trichinopoly area and are of uppermost Senonian age. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 195, 211, 1908) correlates these beds with the upper part of the Hemipneustes beds of Baluchistan which he regards as Mæstrichtian.

Trivicary (Tiruvacarai) grits.—Name used for a local development of the Cuddalore sandstones containing silicified exogenous fossil wood identified as *Peuce schmidiana* by M. J. Schmid and E. E. Schleiden (Uber die Natur der Kieselholzer, 1855). Tiruvakarai (12° 1′; 79° 43′) is a village 14 miles west-north-west of Pondicherry.

Tropites limestone.—Named from the characteristic ammonoid genus by A. v. Krafft and applied by him to the third fossiliferous horizon of the Carnic stage in Lilang and Tikha. (Director's General Report, 1899-1900, 218). The fossils have been described by E. v. Mojsisovics (*Sitzb. K. Akad. Wiss.*, Cl., 1892) and C. Diener (*Pal. Ind.*, xv, V, Part 1).

Umia beds.—Name instituted by F. Stoliczka (MS. report) from a small village (23° 41′; 69° 1′) in Cutch rather more than 50 miles north-west of Bhuj and used by all subsequent writers for the uppermost plant-bearing rocks of that district with which are associated marine fossils. The rocks are chiefly sandstones and shales with a calcareous conglomerate at the base. This conglomerate contains the majority of the marine fossils, cephalopods (*Perisphinctes eudichotomus, P. frequens*) and lamellibranchs of the genus *Trigonia*. Throughout the rest of the group plant remains are common, but *Trigonia smeei*, which is looked upon as the characteristic fossil, has been found at horizons well above the plant-bearing strata. This group is usually overlaid unconformably by the Deccan Trap, but at one place, Ukra hill, it passes up into beds of Aptian age, so that not only the uppermost Jurassic beds (Portlandian) but probably also the lowermost Cretaceous are represented. For reference, see W. Waagen (*Pal. Ind.*, ser. IX, 1, 1873-76); W. T. Blanford (*Rec., Geol. Surv., Ind.*, IX, 80, 1876); Man. Geol. Ind., Ed. 1, 158, 1879; J. W. Gregory (*Pal. Ind.*, ser. IX, 11, 1893, 1900); F. L. Kitchin (*id.*, 111, 1900, 1903).

Urmi series.—Name applied by G. E. Pilgrim (*Mem., Geol. Surv., Ind.*, XXXIV, 7, 22, 1908) from a well-known locality in Armenia to certain impure reddish or fawn-coloured limestones developed in two spots in Persia, with *Pecten Urmiensis, Pecten rotundatus*, etc., and considered to be Burdigalian in age.

Utatur (Ootatoor) stage.—Named by H. F. Blanford (*Mem., Geol. Surv., Ind.*, Vol. IV, 23, 52, 1862) from the town of Utatur (11° 4′; 78° 55′) in the Trichinopoly district. Term applied to the lowest stage of the marine Cretaceous rocks near the Coromandel coast, and now recognised as Cenomanian in age (F. Kossmat, *Rec., Geol. Surv., Ind.*, XXVIII, 39, 1895).

Vaikrita system.—Term proposed by C. L. Griesbach (*Mem., Geol. Surv., Ind.*, XXIII, 41, 1891) for the schistose series overlying the gneiss and underlying the Haimantas in the Central Himalaya, though no definite boundary is found between the Vaikritas and Haimantas. Named from *vaikrita*, a supposed Sanskrit word for *metamorphosed*. The exact stratigraphical value of the term is uncertain, as probably various of the associated sedimentary rocks have been metamorphosed in this region.

Vaimpalli slates and limestones.—Named by W. King (*Mem., Geol. Surv., Ind.*, VIII, 41, 126, 159, 1872) from the village of Vaimpalli (Vempalle) in the Cuddapah district (14° 21′; 78° 31′). They include the upper beds in the Papaghni series of the Cuddapah system.

Valudayur beds.—Named by H. F. Blanford (*Mem., Geol. Surv., Ind.*, IV, 26, 151, 1862) from the village and fort of Valudayur (Verdoor), an important French outpost during the war in the Carnatic, about 10 miles inland from Pondicherry (11° 59′; 79° 45′) in the South Arcot district. The latest palæontological work by F. Kossmat (*Rec., Geol. Surv., Ind.*, XXX, 54, 1897) shows that these beds correspond with the lower portion of the Ariyalur stage of the Trichinopoly area, and not to the Utatur stage as was supposed by F. Stoliczka. Kossmat thus correlates the Valudayur beds with the upper Senonian of Europe. E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXVI, 194, 211, 1908) regards these beds as equivalent to the lower and middle portions of the Hemipneustes beds of Baluchistan. The lower part of the Valudayur may thus be Campanian (U. Senonian) and the upper part Mæstrichtian (L. Danian).

Vemavaram beds.—The middle of three divisions of the Upper Gondwanas south of the Kistna river, corresponding approximately to the Ragavapuram shales of the Ellore area. Named by R. B. Foote (*Mem., Geol. Surv., Ind.*, XVI, 60, 69, 1880) from the village of Vemavaram (15° 41′; 80° 13′), north-north-east of Ongole.

Venkatpur sandstones.—A sub-division of the Sullavais distinguished by W. King (*Mem., Geol. Surv., Ind.*, XVIII, 229, 1881), and composed of salmon-red or chocolate-coloured sandstones, blotched with white and buff colour. Named from the village of Venkatpur (18° 15′; 80° 3′) in the Godavari district.

Vindhyan system.—Proposed by T. Oldham (*Journ. As. Soc., Beng.*, XXV, 249, 1856) from the Vindhyan range in Central India, where the rocks are well developed. Originally divided into—

3. Bhander.
2. Rewah.
1. Kaimur.

Below these divisions of the original Vindhyans were found a series of limestones, shales and sandstones which were named *Semri* in Bundelkhand (H. B. Medlicott, *Mem., Geol. Surv., Ind.*, II, 6, 1860) and *Sub-Kaimur* in the Son valley (H. B. Medlicott, quoted by T. Oldham, *Journ. As. Soc., Beng.*, XXV, 253, 1856; *Mem., Geol. Surv., Ind.*, II, 303, 1860). In the Annual Report, Geol. Surv., Ind., for 1864-1865 (p. 5), T. Oldham refers to the Sub-Kaimurs as if they were then known by the name *Lower Vindhyan*, but no formal announcement of the name seems to have been made, and the term was accepted by F. R. Mallet as then well known in 1869 (*Mem., Geol. Surv., Ind.*, VII, 27). Mallet's classification was as follows:—

Upper Vindhyans—

Upper Bhander	Upper Bhander sandstone.
Lower Bhander	Sirbu shales. Lower Bhander sandstone. Bhander limestone. Ganurgarh shales.
Upper Rewah	Upper Rewah sandstone.
Lower Rewah	Jhiri shales. Lower Rewah sandstone. Panna shales.
Upper Kaimur	Upper Kaimur sandstone. Kaimur conglomerate.
Lower Kaimur	Bijaigarh shales. Lower Kaimur sandstones.

Lower Vindhyans—

11. Limestone.
10. Shale.
9. Limestone.
8. Shale, sandstone.

7. Limestone.
6. Shaly sandstone.
5. Porcellanic shales.
4. Trappoid beds.
3. Porcellanic shales.
2. Limestone.
1. Conglomerate and calcareous sandstone.

P. N. Datta (*Rec., Geol. Surv., Ind.*, XXVIII, 144, 1895), from results obtained in the Son valley, proposed to divide the *Lower Vindhyans* as follows :—

IV. Rohtas=Sub-divisions 11, 10 and 9 of Mallet.
III. Kheinjua=Sub-divisions 8, 7 and 6 of Mallet.
II. Porcellanic=Sub-divisions 5, 4 and 3 of Mallet.
I. Conglomeratic=Sub-divisions 2 and 1 of Mallet.

E. Vredenburg (*Rec., Geol. Surv., Ind.*, XXXIII, 259, 1906) proposed the following new grouping of the Vindhyan beds on account of the discontinuity of the minor sub-divisions recognised locally :—

Bhander	Betwa	Sandstone.
	Haveli	Shales and limestones with sandstones.
Ken	Tons (including Rewah and Kaimur).	Sandstones with subordinate shales and limestones.
	Son (the old Lower Vindhyan).	Shales and limestones with subordinate sandstones.

Virgal beds.—Name used by W. Waagen (*Pal. Ind.*, Ser. XIII, Vol. IV, Part 2, 241, 1891) for the middle division of the Middle Productus Limestone of the Punjab Salt Range, and regarded as about equivalent to the Rothliegende of Europe. The village of Virgal (32° 27′ ; 72° 7′) is about 5 miles north-east of Warcha in the Shahpur district.

Vizianagram gneiss.—Massive, grey quartzo-felspathic gneiss only very slightly foliated, forming rounded hummocky hills near Vizianagram (18 7′; 83° 28′). Veins of white murchisonite are

associated with the gneiss, which was distinguished by W. King as part of the Bezvada group of gneisses (*Rec., Geol. Surv., Ind.*, XIX, 150, 1886).

Vredenburgite.—Named after E. W. Vredenburg by L. L. Fermor (*Mem., Geol. Surv., Ind.*, XXXVII, 42, 1909). A magnetic mineral of the composition approximately of $3Mn_3O_4$, $2Fe_2O_3$. Crystalline form doubtful. Found in the manganese-ore deposits of Beldongri, Nagpur district, and Garividi, Vizagapatam district.

Wadhwan sandstones.—Named by F. Fedden (*Mem., Geol. Surv., Ind.*, XXI, 84, 1884) from the town in Kathiawar (22° 42′; 71° 44′). Regarded as Cretaceous in age, separated from the Deccan Trap flows by an erosion unconformity. Probably equivalent to the Nimar sandstones and Bagh beds.

Warkalli beds.—Name used by W. King (*Rec., Geol. Surv., Ind.*, XV, 92, 93, 1882) for a series of sands, clays and lignite capped by laterite, and forming a fringe on the Travancore coast about 22 miles long and 5 miles broad, having been traced from about 4 miles north of Quilon to about the same distance south of Warkalli (8° 44′; 76° 46′). They are regarded as of freshwater origin, and probably corresponding in age to the Cuddalore sandstone series of the eastern coast. Somewhat similar beds occur further north near Ratnagiri (17° 0′; 73° 20′) on the Bombay coast (C. J. Wilkinson, *Rec., Geol. Surv., Ind.*, IV, 44, 1871; W. King, *loc. cit.*, p. 102).

Warthite.—After Dr. H. Warth. Synonym for Blödite.

Weean beds.—Distinguished by A. Verchère [*Journ. As. Soc. Beng.*, XXXV, (2) 168, 1866; XXXVI, (2) 12, 13, 1867] as a division of the Carboniferous rocks in the Kashmir valley, overlying the Zewan beds. C. S. Middlemiss (MS. report). finds that the Weean beds are high up in the Triassic section, and are thus removed from the Zewan series. C. Diener [*Pal. Ind.*, Ser. XV, I, (2), 1899, 8] had noticed among Verchère's specimens *Danubites nivalis*, a leading fossil of the Subrobustus beds of the Himalayan Lower Trias. The other fossils were regarded by Diener as not identifiable.

Weinbergerite.—Name given by F. Berwerth (*Tschermak. Min. Petr. Mitt.*, XXV, p. 181, 1906) after J. Weinberger of Vienna to radially fibrous aggregates occurring with diopside and bronzite in the Kodaikanal meteoric iron. Apparently orthorhombic. $(NaK)_2\ O\ (FeCaMg)O\ Al_2O_3\ 8SiO_2$.

Wer (Weir) quartzites.—The uppermost of five local sub-divisions of the Alwar quartzites in the Biana hills, Rajputana. The quartzites predominate, but the division includes some "black slaty shales," named by C. A. Hacket (*Rec., Geol. Surv., Ind.*, X, 86, 1877) from the village of Wer (27° 1′ ; 77° 14′) near the Banganga river in Bharatpur State.

Wetwin shales.—The name Wetwin series was used by P. N. Datta (Director's General Report for 1899-1900, 118) for some fossiliferous beds regarded as probably Devonian near the village of Wetwin or Wenwai (22° 6′ ; 96° 39′) in the Northern Shan States. Examination of the fossils by F. R. Cowper Reed (*Pal. Ind.*, New Ser. II, Mem. 5, 157, 1908) shows certain affinities with the Hamilton stage of North America and of Upper Devonian age, but the precise age cannot be given (*cf.* Reed, *Rec., Geol. Surv., Ind.*, XL, 31, 1910). They are included by T. H. D. La Touche (*Mem., Geol. Surv., Ind.*, Vol. XXXIX, 241, 1913) in the Plateau limestone (Devonian section), and consist of very argillaceous, yellowish buff-coloured shales occurring among the limestones. This fauna has not been found elsewhere in Burma.

Winchite.—Mineral named after H. J. Winch by L. L. Fermor (*Trans. Min. and Geol. Inst., Ind.*, I, 79, 1906). A blue manganiferous amphibole found with the manganese-ore deposits of Kajlidongri, Jhabua State, Central India. For full description see *Mem., Geol. Surv., Ind.*, XXXVII, 149, 1909.

Yenangyaung series or stage.—Name proposed by F. Noetling (*Rec., Geol. Surv., Ind.*, XXVIII, 70, 1895, and *Pal. Ind.*, New Ser. I, 7, 1899) for the upper part of the Pegu system including the Upper Prome, Kama beds and sandstones above the Kama beds as described by W. Theobald (*Mem., Geol. Surv., Ind.*, X, 268, 1873). The name is from that of the principal oilfield (20° 25′; 94° 56′) in the Magwe district, Upper Burma. M. Stuart (*Rec., Geol. Surv., Ind.*, XXXVIII, 271, 1910) transfers the uppermost sandstones to the Irrawaddy system, and regards the petroliferous beds of the Yenangyaung and other oilfields as equivalent to the Kama formations of the Prome district. He consequently drops Noetling's term Yenangyaungian as unnecessary. (See also Vredenburg and Stuart, *Rec., Geol. Surv., Ind.*, XXXVIII, 129, 1909.)

Zamia beds.—Name used by W. T. Blanford (*Mem., Geol. Surv., Ind.*, VI, 18, 27, 1867) for some plant-bearing beds in Cutch. The term was absorbed into Umia beds (*q.v.*).

Zanskar (Zangskar) system.—The formations, largely of limestone, above the Panjal system in Kashmir were so grouped by R. Lydekker (*Mem., Geol. Surv., Ind.*, XXII, 122, 1888), and named from the Zangskar range (34° 0′; 77° 20′). Sub-divided into the—

(*c*) Chikkim.
(*b*) Supra-Kuling } series.
(*a*) Kuling

The oldest among the beds grouped together in this comprehensive system are of Upper Carboniferous age, while the Chikkim series is Cretaceous. The name has thus been found to be of provisional and local value only.

Zebingyi stage.—Name given by T. H. D. La Touche (Director's General Report for 1899-1900, 83) to soft, yellow sandy beds with bands of nodular limestones in the neighbourhood of Zebingyi (21° 53′; 96° 21′) and other parts of the Northern Shan States. Examination of the fossils collected indicates, according to F. R. Cowper Reed (*Pal. Ind.*, New Ser., Vol. II, Mem. No. 3), Uppermost Silurian or Lower Devonian age. In the most recent account (*Mem., Geol. Surv., Ind.*, XXXIX, 163, 1913) these beds are classed as distinct from the underlying Namhsim and are included in the Silurian rather than in the Devonian, although forming true passage-beds.

Zewan beds.—Name employed by H. H. Godwin-Austen (*Quart. Journ. Geol. Soc.*, XXII, 33, 1866) for shales and limestones in Kashmir containing fossils regarded by T. Davidson (*Quart. Journ. Geol. Soc.*, XXII, 39) as Carboniferous in age and displayed typically in the Zewan (Ziawan) spur near Panduchak (34° 10′; 74° 55′) in the Vihi district of Kashmir, south-east of Srinagar. The section has been described in detail by H. H. Hayden (*Rec., Geol. Surv., Ind.*, XXXVI, 27, 1907) who found *Gangamopteris* in the shales underlying the Zewan beds conformably. For other localities with the same association of Lower Gondwana forms and marine fossils, *cf.* C. S. Middlemiss, *Rec., Geol. Surv., Ind.*, XXXVII, Part 4 and XL, Part 3. The fossils found by Middlemiss (*Rec., Geol. Surv., Ind.*, XL, 237, 257, 1910) indicate

a Permo-Carboniferous age, thus confirming the conclusions of C. Diener (*Pal. Ind.*, Ser. XV, Vol. I, Part 2, 1899) from an examination of a smaller collection previously made.

The term Zewan was also used by A. Verchère [*Journ. As. Soc., Beng.*, XXXV (2), 89-134, 159-203, 1866; XXXVI, (2), 201-229, 1867] for a part of the section described by Godwin-Austen, but he appears to have included a portion of the associated Lower Trias according to the re-examination of his fossils by C. Diener (*Pal. Ind.*, Ser. XV, Vol. I, Part 2, 5-7, 1899). Verchère divided the beds as follows :—

3. Kothair beds	.	Triassic
2. Weean ,,	}	Carboniferous.
1. Zeewan ,,	}	

C. S. Middlemiss finds that the Weean beds are in reality high up in the Triassic system (MS. Report, 1911). According to Diener (*loc. cit.*, 1899, 92) the Kashmir Anthracolithic fossils are more nearly related to those of the European Carboniferous than to the Productus Limestone of the Salt Range. The Zeewan fossils also show strong affinities with those of Loping in China, and less markedly with the Australian rocks.

EXPLANATION OF PLATES.

PLATE 1.—Map of India. Index to Geological Place Names.

PLATE 2.—Index Map to the Salt Range.

PLATE 3.—Index Map to the Systems of Southern India.

PLATE 4.—Index Map to the Central Himalayan Systems.

PLATE 5.—Index Map to the Geology of the Northern Shan States.

ABBREVIATED TITLES USED.

Agri. Ledger.—The Agricultural Ledger, Calcutta.

Amer. Journ. Sci.—The American Journal of Science, New Haven.

Bull. Comm. de Fin.—Commission Géologique de la Finlande, Bulletin, Helsingsfors.

Bull. Soc. Geol. Fr.—Bulletin de la Société Géologique de France, Paris.

Bull. U. S. Geol. Surv.—Bulletin of the United States Geological Survey, Washington.

Centralblatt F. Min.—Centralblatt für Mineralogie und Palæontologie, Stuttgart.

Denks. K. Akad. Wiss. Wien.—Denkschriften der K. Akademie der Wissenschaften: Mathematisch-Naturwissenschaft-liche Classe, Vienna.

Director's Genl. Rep.—General Report of the Director of the Geological Survey of India, generally published in the *Records, Geological Survey of India*, but the General Reports for the years 1897-9 to 1901-02 were issued separately.

Geog. and Geol. of the Him.—A sketch of the Geography and Geology of the Himalaya Mountains and Tibet by Col. S. G. Burrard and H. H. Hayden, Government Press, Calcutta, 1908.

Geol. Mag.—The Geological Magazine of Monthly Journal of Geology. Numbered in decades and volumes, London.

Geol. Papers.—Geological papers on Western India, including Cutch, Sinde and the South-East Coast of Arabia, to which is appended a Summary of the Geology of India generally, by H. J. Carter, published by the Government of Bombay, Bombay, 1857.

Imper. Gazetteer.—The Imperial Gazetteer of India, New Edition, Oxford, 1907.

Journ. As. Soc. Beng.—The Journal of the Asiatic Society of Bengal, Calcutta.

Journ. Bomb. Br. Roy. As. Soc.—Journal of the Bombay Branch of the Royal Asiatic Society, Bombay.

Journ. Roy. As. Soc.—Journal of the Royal Asiatic Society of Great Britain and Ireland, London.

Journ. Roy. Dub. Soc.—Journal of the Royal Dublin Society, Dublin.

Madras Journ. Lit. Sci.—The Madras Journal of literature and Science.

Man. Geol. Ind.—Manual of the Geology of India published by the Government of India. 1st Edition, Parts I and II, 1879, by H. B. Medlicott and W. T. Blanford; Part III, 1881, by V. Ball, and Part IV, 1887, by F. R. Mallet. 2nd Edition, 1893, by R. D. Oldham, Calcutta.

Mem. du Com. Geol. Russe.—Memoires du Comité Géologique, St. Petersburg.

Mem. Geol. Surv. Ind.—Memoirs of the Geological Survey of India, Calcutta.

Min. Ind.—The Mineral Industry, its statistics, technology and trade, published annually since 1892, New York.

Min. Mag.—The Mineralogical Magazine and Journal of the Mineralogical Society, London.

Neues J. F. Min.—Neues Jahrbuch für Mineralogie, Geologie und Palæontologie, Stuttgart.

Pal. Ind.—Palæontologia Indica, being figures and descriptions of the Organic remains procured during the progress of the Geological Survey of India, Calcutta.

Phil. Mag.—The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science, London.

Phil. Trans.—Philosophical transactions of the Royal Society of London, London.

Proc. Roy. Soc.—Proceedings of the Royal Society of London, London.

Proc. Wash. Acad. Sci.—Proceedings of the Washington Academy of Sciences.

Quart. Journ. Geol. Soc.—The Quarterly Journal of the Geological Society, London.

Rec Geol. Surv. Ind.—Records of the Geological Survey of India, Calcutta.

Report, Brit. Assoc.—Annual Reports of the British Association for the advancement of Science, London.

Réevu crit. Paléozool.—Révue critique de Paléozoologie, Paris.

Sel. Records Govt. Ind.—Selections from the Records of the Government of India, Calcutta.

Sitz. K. Akad., Wien.—Sitzungsberichte der Mathematisch-naturwissenschaftliche classe der kaiserlichen Akademie der Wissenschaften, Vienna.

Trans. Min. and Geol. Inst. Ind.—Transactions of the Mining and Geological Institute of India, Calcutta.

Verhand. K. K. Geol. Reichs.—Verhandlungen der K. K. Geologischen Reichsanstalt, Vienna.

Zeit. Prakt. Geol.—Zeitschrift für praktische Geologie, Berlin.

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MAP OF INDIA
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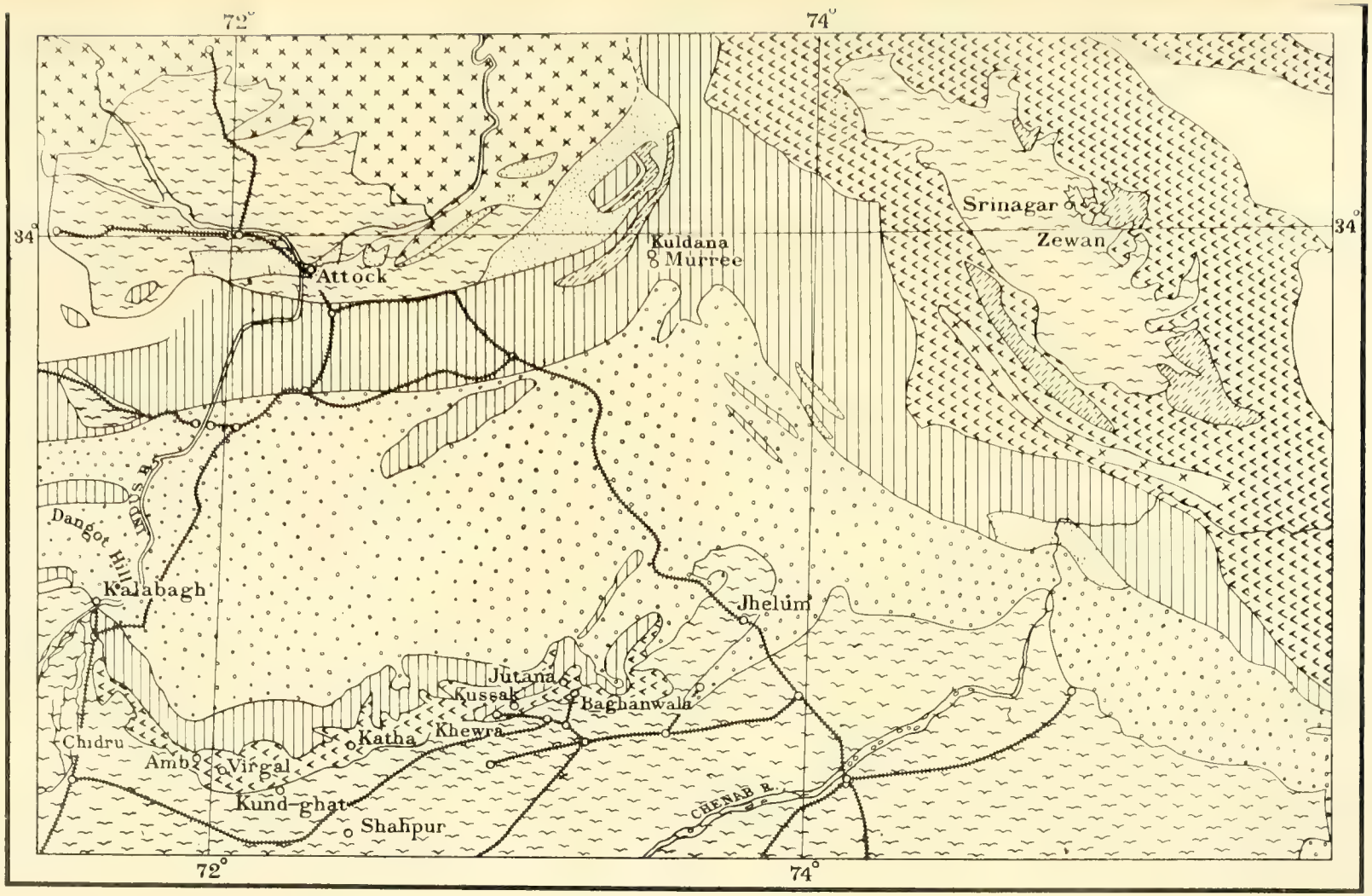
GEOLOGICAL PLACE NAMES

Scale, 1 inch = 128 miles.



INDEX MAP TO THE SALT RANGE.

Scale, 1 inch = 32 miles.

Alluvium

Upper Tertiary

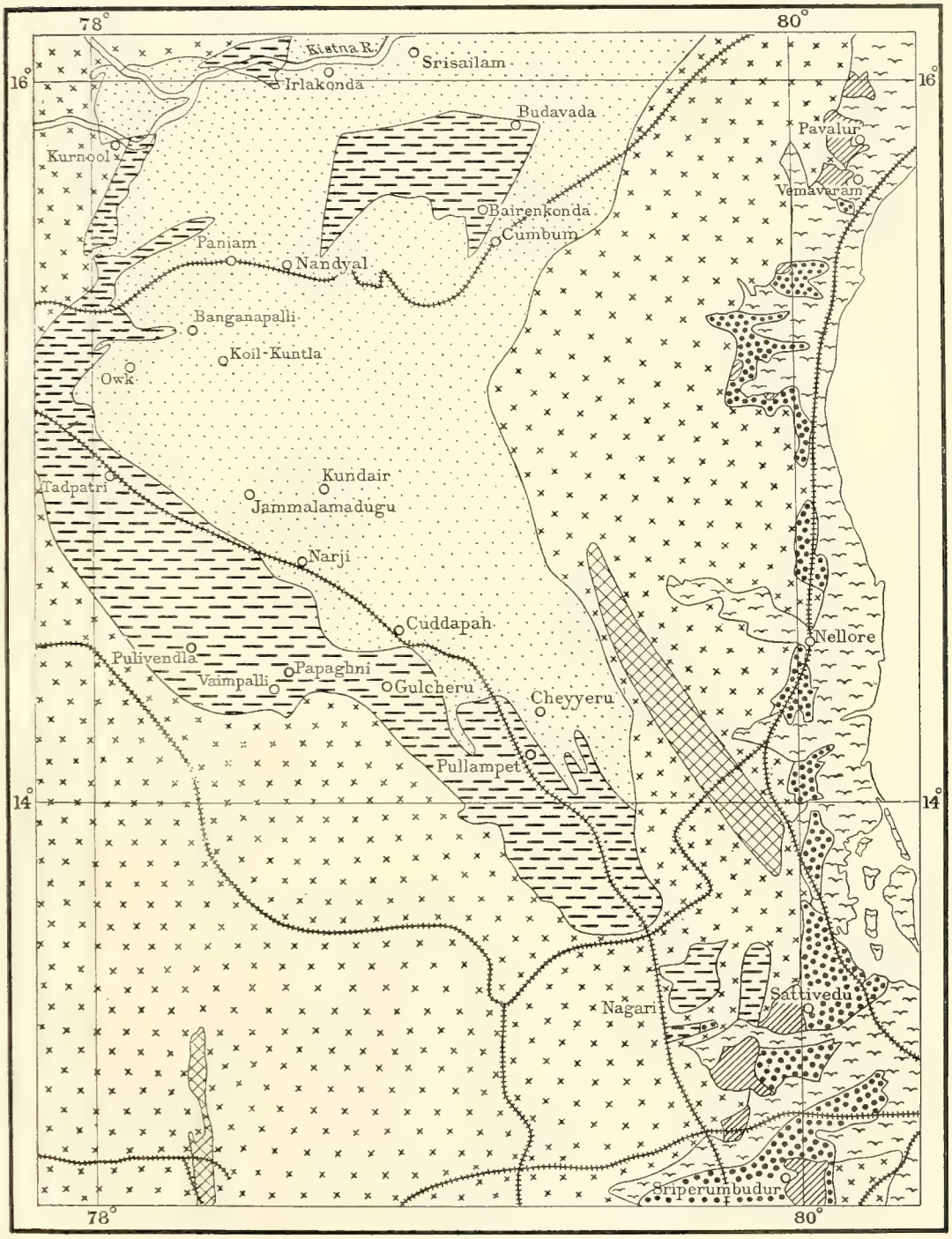
Lower Tertiary

Trias

Palæozoic

Attock slates

Archæan (Gneiss)



INDEX MAP TO THE SYSTEMS OF SOUTHERN INDIA.

Scale, 1 inch = 32 miles

Recent.....

Low level Laterite, and Cuddalore sandstone.....

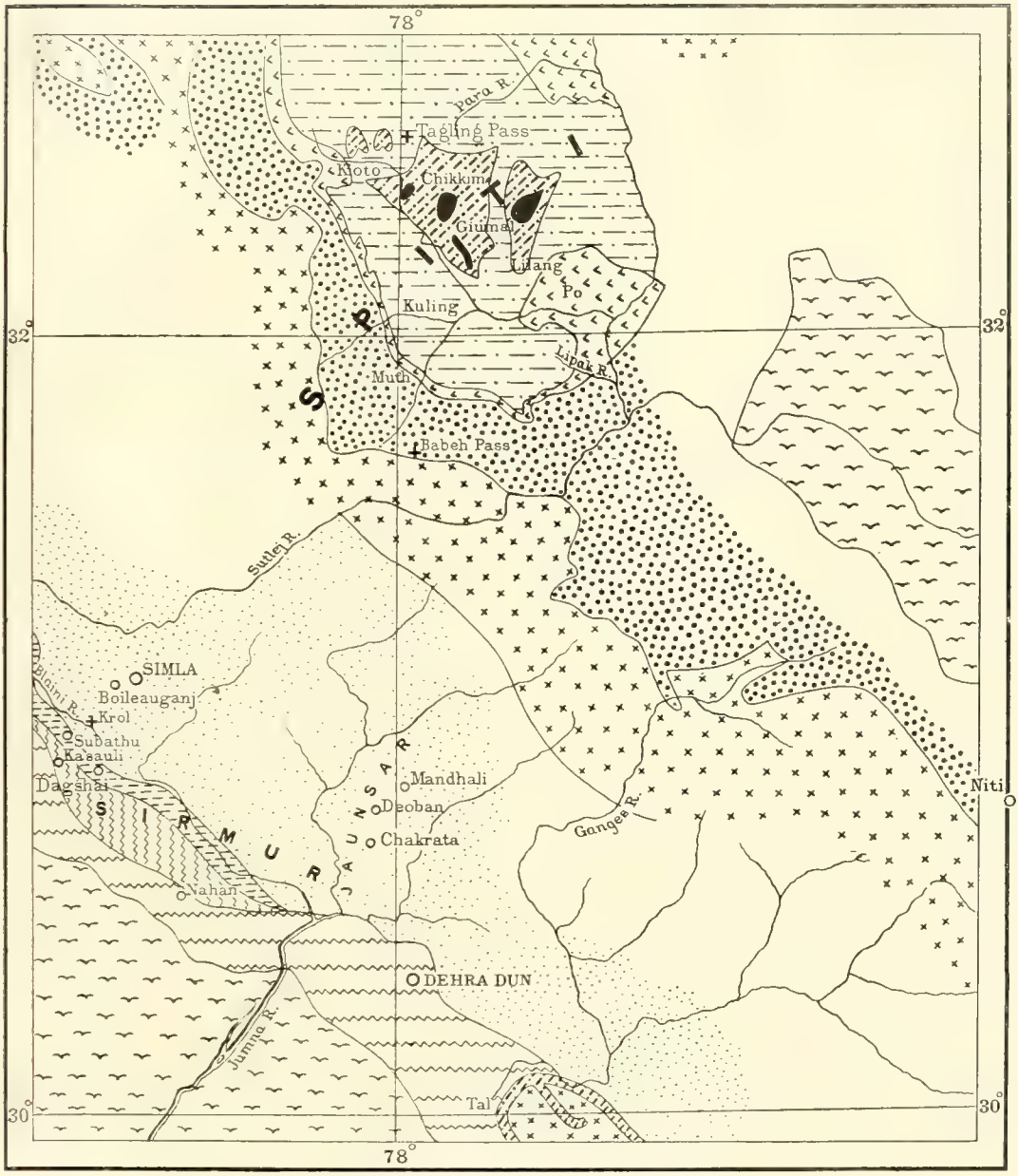
Upper Gondwana.....

Kurnool, and upper Cuddapah series.....

Lower Cuddapah series.

Dharwar system.....

Granite and Gneiss.



INDEX MAP TO THE CENTRAL HIMALAYAN SYSTEMS

Scale, 1 inch = 32 miles.

Recent & Pleistocene

Siwalik series

Dagshai, Kasauli & Murree stages

Subathu stage

Chikkim & Giumal series

Spiti shales, Tagling stage & Tal series

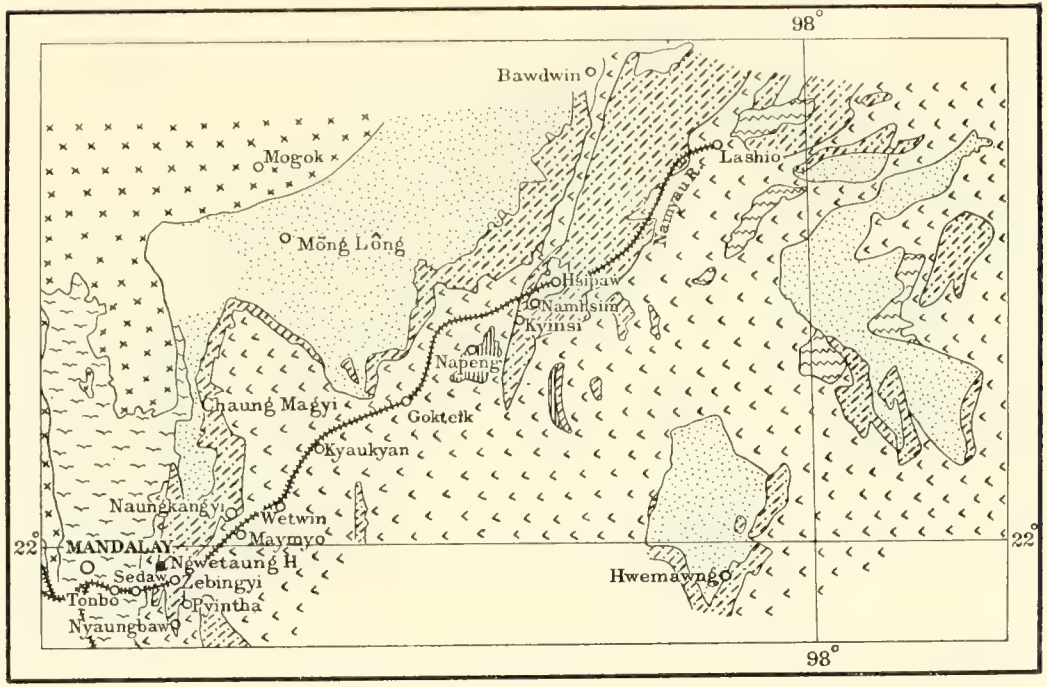
Trias

Kuling & Kanawar series

Muth & Haimanta systems

Purana Group

Granite & Crystalline



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Scale, 1 inch = 32 miles.

Alluvium.....

Tertiary.....

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