# Recent Advances in Palæontology in India.*

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NOTABLE contributions to our knowledge of palæontology in India during the last 20 years have been along three main lines: (1) the investigation of the invertebrate palæozoic faunas from the ancient life-provinces of the Salt Range, Kashmir, the Chitral and Pamir region, and the Shan States of Burma; (2) the study of the rich mammalian faunas entombed in the Siwalik and older Tertiary fresh-water deposits of the Himalayan foot-hills and those of the Baluchistan and Burma highlands; (3) the detailed examination of groups of marine Mesozoic and Eocene[1] fossils, *e.g.*, the Jurassic cephalopods of Cutch, the Danian faunas of the *Cardita beaumonti* horizon, the basal Eocene mollusca of the Ranikot series and the Eocene foraminifera from the calcareous mountains of the north-west. To these must be added the revision of the fossil floras of the Gondwana system in accordance with the advances in palæobotany that have been made since Feistmantel carried out his pioneer investigations on the terrestrial fossil vegetation of India between the years 1863-86.

A number of important monographs on the fauna of the older Palæozoic and the "Anthracolithic" formations of the Himalaya, Burma and Salt Range by Dr. F. R. Cowper Reed,[2] have brought the problem of the geographical distribution of the life-provinces in the Palæozoic seas of India nearer satisfactory solution. In the field of invertebrate palæontology in India, Dr. Reed is the successor to Prof. Carl Diener of Vienna, who for many years before the War was a most valued collaborator of the Geological Survey of India in working out its collections of the faunal wealth of the Spiti, Kumaon and Kashmir Himalayas. As a consequence of detailed palæontological study, following closely on systematic mapping and collecting in the field by officers of the Geological Survey, the age of Permo-Carboniferous glaciation of India, a most important datum-line in the geology of the whole of the ancient southern continent of Gondwanaland, is now deduced with considerable precision to belong to a horizon at the base of the Uralian[3] or the top of the Moscovian stage—a horizon which is now accepted by Indian geologists as forming the bottom of the Lower Gondwana system of deposits in all parts of India.

Dr. G. E. Pilgrim[4] (now retired from the Geological Survey of India) has been the chief investigator of the Tertiary mammals of India during the last two decades. His notable contributions are memoirs on the Eocene ungulates from Burma, the Lower Miocene anthracotheroids from the Bugti hills of Baluchistan, the fossil pigs, giraffes and carnivores of India, together with a forthcoming comprehensive review of the hollow-horned ruminants which are so prolific in the Siwaliks. In a very suggestive paper† Pilgrim has discussed the problem of the inter-relations and migrations of the various groups of pre-historic mammals into and out of India during the Siwalik epoch, when India's population of the higher mammals was far greater than it is to-day. An important element in the mammalian fauna of the Siwaliks consists of the remains of creatures belonging to the most highly developed order of the primates, these constituting some 12 genera of anthropoid apes, extending in stratigraphic range from middle Miocene to early Pleistocene. The fossil primates so far discovered are, however, unfortunately very fragmentary and in the present stage of our knowledge no definite conclusions as to the probable lines of descent of these forms and their position with respect to the line of human ancestry in India can be safely drawn, yet the proof of the presence of a vigorous and highly differentiated family of the anthropoid apes (Simiidæ) in an epoch directly anterior to that of man, suggests that the idea of the existence of Upper Siwalik Man in India (the yet undiscovered Sivanthropus) may not be merely a dream.

Since 1920 our knowledge of the Mesozoic reptiles of India, especially of the extraordinarily diversified order Dinosauria, has been greatly increased by the finding of large quantities of vertebræ, skull, limb and

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†Presidential Address, Geology Section, Indian Science Congress, Benares, 1925 (Asiatic Society of Bengal, Calcutta).

girdle bones, armour-plates, and teeth, from the Jubbulpur district, by Dr. C. A. Matley, working in co-operation with the Geological Survey. The systematic description of this material by Prof. Von Heune of Stuttgart, a recognised authority on fossil reptiles, and Dr. Matley,[5] has added 12 new genera and many species to the list of Indian dinosaurs, including the first records of the sub-orders Coelurosauria and Stegosauria in this country. The dinosaurs reached their highest development in India during the Lameta age in the Upper Cretaceous period.

Dr. L. F. Spath of the British Museum has completed his revision of the Jurassic Cephalopoda of Cutch, comprising 556 species of ammonites divided into 114 genera, the majority of these being the author's own creation, in six bulky memoirs of the *Palæontologia Indica*.[6] Dr. Spath has discussed interesting questions of Jurassic zoogeographical provinces, the affinities and comparisons of contemporaneous faunas from other parts of the world and the fascinating problem of ammonite phylogeny, in the investigation of which he finds the Hæckelian theory of Recapitulation, or as it is termed, "Biogenetic law", quite inadequate. The main elements of the Cutch fauna, according to Spath, are more closely linked to the fauna of the Indo-Madagascar province than to the Mediterranean (*i.e.*, Tethyan) area.

Among other noteworthy palæontological work of recent years may be mentioned the establishment of a remarkably well-developed Cambrian system in Kashmir,[7] containing a highly differentiated, but strongly provincial, fauna of trilobites, and of the Neocomian and Albian horizons in the Cretaceous of the Kohat[8] area. The value of Foraminifera as zone fossils in stratigraphic correlations of stages and sub-stages of the extensive Eocene and Oligocene calcareous development of the north-west, is brought out by the work of W. L. F. Nuttall and L. M. Davies. Palæontological research, there appear reasons to believe, may be the deciding factor in settling the much-vexed question of the age of the 'saline series' of the Punjab Salt Range and of the existence of powerful thrust-faults at the foot of the range. In this connection the recent discovery of foraminifera and fish remains by Mr. E. R. Gee of the Geological Survey of India from the Salt Marl associated with the salt deposits of these mountains is a notable event.

The pre-eminent position occupied by the Gondwana system among the stratified formations of the Peninsula has, from the earliest days of Indian geology, enforced attention to palæobotanical studies, not so much for the purpose of establishing chronologies, (for which the value of the evidence of plant fossils is still not fully established) but for the classification and inter-correlation of stages of the various widely scattered Gondwana outcrops of India from Kashmir in the north-west to the mouth of the Godavary in the south-east. In 1920 Seward and Sahni published a memoir on the revision of some Gondwana plants; this paper has drawn attention to the necessity of a comprehensive re-study of the great store of plant petrifactions, impressions, woods, fructifications, etc., belonging to the original material worked out by Feistmantel, as well as that collected by the Geological Survey during the last fifty years. The recognition of the Pteridosperms as a group distinct from the ferns and of the Bennettitales as distinct from the Cycads, along with the improved methods and technique of investigation of fossil plant-tissues that have come into use during recent years, have already caused considerable modifications in the grouping and nomenclature of Gondwana plants. Since 1925 the work of revision has been carried out by Prof. B. Sahni of Lucknow University and two memoirs dealing with the Coniferales,[9] besides several smaller papers on subjects of special interest, have already been published. Prof. Sahni is at present engaged on a comprehensive study of the post-Gondwana fossil Monocotyledons collected from various parts of India.

A magnificent collection of animal and plant fossils, the result of nearly seven decades' collecting by the Geological Survey, is stored in the galleries of the Indian Museum at Calcutta. Free access to these collections is given to both students and specialists and the Museum is indirectly furthering palæontological research by its system of exchange and presentation of duplicate specimens, casts, etc., to Museums of many parts of the world. Last year the Indian Geological Survey co-operated with the Yale University expedition in making large collections of invertebrate and vertebrate fossils from the Permo-Carboniferous of the Salt Range and the Siwalik deposits of the Potwar, Simla and Kangra areas, and with the British Museum Percy Sladen

Trust party in collecting fossil reptilian remains from the Central Provinces.

A welcome sign of the time is the interest taken in palæontological work by some of the younger workers in Indian geology. Considering the serious and often unsurmountable limitations to palæontological research by those beyond the reach of organised departmental centres, *e.g.*, properly equipped libraries and museums, the progress, though yet not great, gives cause for satisfaction. Besides some excellent palæobotanical work produced by Prof. Sahni's students, the Zoology and Geology departments of the Mysore University, the Geology laboratory of the Presidency College, Calcutta, and, lately, that of the Benares Hindu University are making creditable endeavours to start palæontological research on the right lines.

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[2] F. R. C. Reed, *Pal. Ind*, N.S., **2** (1906-08), **6** (1915-25), **10** (1927), **12** (1928), **16** (1930), **17** and **19** (1931).

[3] G. deP. Cotter, Presidential Address, Geology Section, Indian Science Congress, Nagpur (1931).

[4] G. E. Pilgrim, *Pal. Ind.*, N.S., **4** (1911-12), **8** (1925-26), **13** (1928), **14** (1927), **18** (1932).

[5] "*Cretaceous Saurischia* and *Ornithischia* of the Central Provinces," *Pal. Ind.*, N.S., **21** (1933).

[6] L. F. Spath, *Pal. Ind.*, N.S., **9**, Pts. 1-6 (1927-33).

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[8] L. M. Davies, L. R. Cox and others, "Fossil Fauna of the Samana Range, Kohat, N. W. F. Province," *Pal. Ind.*, N.S., **15**, Pts. 1-5 (1930).

[9] B. Sahni, *Pal. Ind.*, N.S., **11** (1928-31).

## The Indian Sugar Committee Meeting at Coimbatore.

THE Sugar Committee of the Imperial Council of Agricultural Research held its sixth meeting at Coimbatore on the 14th, 15th and 16th November 1933, under the Chairmanship of Dewan Bahadur Sir T. Vijayaraghavachariar, Vice-Chairman of the Imperial Council of Agricultural Research. Of all the Committees set up by the Council, the Sugar Committee has been the most active and has contributed materially to the development of the Sugarcane Agriculture and Sugar Industry of India. Within the space of three years, the achievements and the future programme of the Committee have gone far beyond the expectations on a five-year plan. This is evident from the periodical reports of the discussions of the Committee, which having provided adequately for the growth and development of sugarcane agriculture and industry, is applying itself to problems on the equal distribution of profits between the grower and the miller, to the establishment of a central Sugar Research Institute, and to the profitable utilisation of the by-products and waste products of the industry. The grant of protection to the industry and the creation of new and better varieties of sugarcane by Rao Bahadur T. S. Venkataraman, have been responsible for the phenomenal development of the sugar industry in this country. While in 1930-31 only twenty-nine sugar factories were operating in India, fifty-seven factories were in operation in the season 1932-33, and a total of over 120 factories are expected to operate during the coming season.

This being the first time the Committee visited Coimbatore, the several members went round the thick and thin breeding stations and acquainted themselves with the several phases involved in the evolution and distribution of improved varieties of sugarcane. Rao Bahadur T. S. Venkataraman, the Government Sugarcane Expert, and Mr. N. L. Dutt, the Second Cane Breeding Officer, showed the members and visitors round and explained to them the several phases of the science and art of sugarcane breeding, their joys and sorrows in the preliminary selection and rejection of seedlings and their successes and failures and hopes. Mr. Venkataraman also showed the interesting collections of wild sugarcanes and his new creations—the sugarcane x sorghum hybrids—and wound up with a graphic description of how his cane breeding station had already materially contributed to the advancement of the cultivator and the industry and what further improvements could be expected. These morning visits besides enabling the Committee to gain first-hand knowledge of