Discovery of Marine Beds at the Base of the Gondwana System in Central India.

MOST of the papers recently published in the Records of the Geological Survey of India naturally take the form of shading with details the general outline previously known. Some of the results published in the last general report of the director (Records, Geological Survey of India, vol. 54, Part 1) are, however, of special interest as showing that some of the previously accepted outlines need reconsideration. We have space to notice only one of them at this stage, and that because the director's announcement may not be superseded for some time by a more detailed description.

Among the results hitherto regarded as final has been the conclusion that the Peninsula of India has never been submerged beneath the sea since early Palæozoic times, except for narrow strips extending not far from the present coast lines. Towards the end of 1921, however, the discovery by Mr. K. P. Sinor of a very thin marine bed at the base of the Lower Gondwana system, on the small coalfield at Umaria in the Rewah State of Central India, suggested a review of the previously accepted view regarding the stability of the peninsular *Horst*. Early last year, after this discovery had been reported to the director of the Geological Survey of India, a field collector was deputed to obtain further specimens, and these included, besides Productus, a species of Spiriferina related to and probably identical with *Spiriferina cristata* var. *octoplicata*.

This discovery thus unexpectedly provides evidence of the fact that the sea in Carboniferous times trespassed on to the continent of Gondwanaland farther than was previously suspected; for the Umaria coalfield is some 500 miles from the present west coast, 400 miles from the east coast, and 400 miles from the marine formations which lie away to the north of the crystalline axis of the Himalayan range. In view of the fact that portions of the western States of Central India and the northern parts of the Bombay Presidency were invaded by the sea just before the outflow of the great Deccan trap early in Cretaceous times, one is tempted naturally to regard marine trespass from the west as the most natural line of advance and subsequent retreat; but there is a possibility also that this Productus bed in Rewah records the spread southward of the Permo-Carboniferous sea which left thick masses of Productus limestone in the Punjab, Kashmir, and Tibetan plateau.

The discovery is thus one of very great interest to students of geomorphology; but though doubtless the basal (Talchir) rocks of the Gondwana system will now be searched afresh with renewed hope, the chances of finding further evidence are remote. The coal seams of peninsular India all lie above the Talchirs, and mining operations naturally are not carried below the coal beds for purely scientific objects, while it is only around the edges of the coal basins that narrow strips of the underlying Talchirs occasionally peep out. The surface is fairly flat—a soil-covered peneplain which is lapped over on its northern margin by the mantle of Gangetic alluvium of unknown thickness.

Some years ago this discovery would have had a double interest; for the problem of correlating the great freshwater Gondwana system with the standard stratigraphical scale was the occasion of some controversy due to differences of opinion which naturally follow indirect inferences from homotaxis. But twenty years ago characteristic members of the Lower Gondwana Glossopteris flora were found associated with Productus beds in Kashmir, whither presumably they were carried by one of the rivers then running from Gondwanaland into the great Eurasian ocean known to geomorphologists as Tethys. The base-line thus became definitely established and at a level in the vertical scale near that which W. T. Blanford and others had advocated from indirect evidence many years before. Blanford lived long enough to hear of the Kashmir discovery, which proved that in the Indian region the Productus marine fauna and Glossopteris land flora were contemporaneous. What polemics would have been saved, probably, if he had surveyed the Central Indian instead of the economically more important eastern coalfields, and had thus been able to start from a recognisable stratigraphical base line on the Peninsula itself.

The Calcutta School of Tropical Medicine and Hygiene.

THIS teaching and research institution was opened two years ago, and an account of its work is given in a paper by one of the staff, Major Knowles. The laboratory has four floors with 220 feet of north light and a shorter wing at right angles to the main front, while the special hospital for tropical diseases has more than 100 beds, both having been constructed and partially endowed at a cost of about 120,000*l*., nearly two-thirds of which were raised by the founder, Sir Leonard Rogers, and by Major Knowles. The staff of whole-time professors and research workers now numbers thirty-three, special laboratories and investigators being provided for kala-azar, dysenteries, ankylostomiasis, leprosy (for which a separate institute is to be built opposite the school at a cost of another 20,000*l*.), diabetes and filariasis, all in addition to the teaching staff of the school. The departments now number seventeen, three or four sections commonly combining on one research under the director, Col. J. W. D. Megaw, thus furnishing the team work so essential to success.

The teaching is purely post-graduate, the number admitted being limited to 50 by strict selection. The course for the diploma in hygiene lasts nine months and that in tropical medicine six months, against four in the Liverpool and three in the London School of Tropical Medicine. After an hour's clinical work in the hospital, a lecture is given illustrated by numerous lantern slides, epidiascope pictures, and cinematograph films. This is followed by practical work in the class-rooms for the rest of the day illustrating the same subject, after which that lecturer is free for the rest of the week for research and preparation for his next class.

In the short time the Institution has been open, important work has been published, or is in the press, on the pathology and treatment of leprosy by Muir; on the diagnosis by a new test and the treatment of kala-azar by Napier; on the differentiation of chronic dysenteries by the reactions of the stools by Knowles and Napier; on the poisonous amines of dysentery and cholera bacilli, and also in lathyrism and epidemic dropsy by Acton, Chopra (professor of pharmacology), and S. Ghosh (chemist). Tropical skin diseases are being closely studied with the help of the full-time artist and the photographer of the school. Every case admitted is worked out clinically and microscopically by all the sections concerned, and careful records are kept. This cannot fail in due time to result in important additions to our knowledge of tropical diseases in view of the unrivalled clinical

material available in the special hospital and in the 600 additional beds of the adjacent Medical College group of hospitals.

The new Institution is evidently destined to take a leading place in scientific medical research and teaching in the British Empire.

Virus Diseases of Plants.

HUMAN pathology has naturally had first claim upon the services of the investigator of disease, but a study of plant diseases is probably equally essential to human progress, and the timely review in *Science Progress* (No. 67, January 1923), by Dr. E. J. Butler, director of the Imperial Bureau of Mycology, bears eloquent witness to the great activity with which the special problems of plant pathology are now being attacked. It was only towards the close of the last century that the propagation of disease in plants was shown to be effected in some cases by a filterable virus, but since then facts and theories as to virus transmission have followed in rapid succession from various Continental and American laboratories. Very few observations have so far come from British laboratories, and it may be hoped that the very comprehensive and critical review presented by Dr. Butler will direct more attention to this fascinating field of work.

Many obscure conditions prevailing among growing plants should receive elucidation as a result of investigation into this problem, while the facilities the plant provides for experimental work may enable the whole mechanism of transmission by a virus to be submitted to a very critical analysis. For more than a century it has been known that in certain cases of variegation, if a branch bearing variegated green and white foliage be grafted upon a plant of the same species with normal green foliage, the variegated habit will slowly extend to the branches formerly bearing normal green leaves. This type of "infectious chlorosis" is still of obscure origin, and in this case, as with the curious "peach yellows," investigated in the United States, and in the "spike" disease of the sandalwood tree in India, grafting appears to be the only artificial method of transmission. All these puzzling abnormalities, varying from innocuous variegation to serious diseases such as the "spike" disease, which threaten to extinguish a profitable crop, may receive elucidation through the study of virus diseases more amenable to experimental treatment.

Among the diseases suitable for investigation, perhaps the best known are the "mosaic" diseases, so called from the patchy discoloration they usually produce upon the plant surface. Tobacco mosaic provides a remarkable case of transmission by a highly infectious virus which has been very thoroughly examined by H. A. Allard in the United States. In this case, if the hairs upon an infected plant are carefully cut with a sterile scissors, infection may follow if the hairs upon a healthy plant are then cut with the contaminated scissors. Originally considerable support was given to a theory that the infectious principle in tobacco mosaic was enzymic in nature, but Allard showed that, although ultramicroscopic, the infectious substance could be removed from the expressed plant juice by filters that left the oxidase activity of the juice practically unimpaired. However, the strongest argument in favour of an organism is furnished by dilution experiments in which the expressed juice, diluted to 1 in 10,000, still retains infectious properties. One of the most puzzling properties of the tobacco virus is its extraordinary stability to chemical reagents usually very toxic to living protoplasm and its resistance to relatively high temperatures. In the absence of any information as to the life-history of the invisible parasite it is impossible to correlate this resistance with any special growth form.

The invisibility of the organism sets an upper limit to its size in accordance with the resolving powers of the microscope; experiments with bacterial filters, in view of their tendency to clog, do not permit a lower limit of size to be assigned with confidence, while, on the other hand, the way in which a mycetozoan plasmodium will filter through a cotton-wool plug, cleaning itself from ingested food particles in the process, suggests caution in considering passage through a filter a proof that the natural diameter of the organism is smaller than that of the pore of the filter.

Although a filterable virus was first demonstrated as a cause of disease in the case of the tobacco mosaic, plant pathology is not so far advanced in its study of the organism as human pathology.

One great difficulty is that the culture of the organism outside the plant has so far proved impossible; in this respect these are as confirmed pathogens as the well-known group of rust fungi. Some of the virus diseases, as potato leaf-roll, net necrosis of the tuber, etc., seem to propagate only within a special tissue, the phlœm. This is worthy of consideration when attempts are made to cultivate the organism on artificial media, as the phlœm is relatively alkaline in reaction and both cell walls and contents are probably very distinctive in chemical composition.

Many of these virus diseases are propagated by insects, and Dr. Butler discusses critically the evidence which has been brought forward to explain the greater success of transmission when the plant cuticle is pierced by the insect rather than by needle or knife. One interesting possibility is the need for a necessary part of the life cycle of the pathogen to be completed in the insect carrier, but more work is also required upon the natural healing of punctures caused by insects and by instruments. The manner in which some aphids are also alleged to puncture always in the neighbourhood of the phlœm also provides a very interesting problem for further observation and experiment.

One interesting result of this work is the considerable significance it gives to the aphis as a carrier of plant diseases. At the International Potato Conference held under the auspices of the Royal Horticultural Society in November 1921, Mr. A. D. Cotton pointed out how the recent work of Quanjer in Holland and Schultz and Folsom in the States emphasised the importance of the relative intensity of aphides and possibly other insects in the propagation of leaf-roll. This disease, which is of very great economic importance, seems to spread from plant to plant chiefly in districts where the aphis-attack is general early in the season. As a result, the disease is transmitted very extensively in the warmer English counties, while in the Northern Scottish counties its spread may be little or nil, coincident apparently with the relative absence or late development of aphis infestation. This is very suggestive in relation to the proved value of Scotch seed-potatoes, and this important problem alone, with the new light it throws upon the principles to follow in seed-selection, would justify the extensive exploitation of this comparatively new field of scientific investigation.