

The region of Northern India resolves itself tectonically into two broad belts, the plicated geosyncline of the Himalayas, and the edge of the Indian peninsular massif, that has acted as the foreland, and in the process sagged under the strain of the folding of the northern orogen. The structure of this foreland is revealed in four principal units: (1) The Rajputana plateau, prolonged northwards into the 'Punjab wedge' of Gondwanaland, which has played such an important part in moulding the trend of north-west Himalaya; its main tectonic strike is transverse to the Himalayan strike. (2) The Potwar trough, a tertiary geosyncline containing 25,000 ft. of fluviatile deposits. (3) To the south-east the Potwar geosyncline widens into the great synclinorium of the Gangetic trough, 1200 miles long and 200 miles wide, mostly filled up by late Pleistocene alluviation. (4) The Assam plateau, a tongue of the Gondwana mainland, has played the same part as the Punjab wedge in moulding the Himalayan trend at its eastern extremity. The Assam valley is a 'ramp' valley.

Few parts of the Himalayas have so far been investigated in detail for their structural plan. Areas in which detailed mapping and stratigraphic and tectonic work have been carried out are the Kashmir mountains, the Simla area, a part of Garhwal, and the neighbourhood of Mt. Everest, in Sikkim. In Kashmir the Himalayan system of earth-folds undergoes a deep syntaxial bend round a pivotal point—a narrow promontory of the Punjab foreland hidden under the late Tertiary deposits. The most important tectonic feature of this north-west Himalaya re-entrant are two concurrent thrust-planes delimiting the autochthonous fold-belt at the south foot of the Himalayas against the edge of the foreland, which have been traced around the syntaxis for a distance of 250 miles. The inner of these thrusts marks the front of the Kashmir *nappe* of pre-Cambrian and older Palæozoic rocks, which has moved southwards along a low plane of thrust and encroached upon the

autochthonous belt of Carboniferous-Eocene succession, obliterating it at places. Four overthrusts have been noted in the Simla mountains, representing flat, recumbent folds of great amplitude. The Pre-Cambrian here is piled up on the Carboniferous and Permian sequence. The Simla rocks are totally unfossiliferous and the evidence of the superposition of highly metamorphosed pre-Cambrian, building some of the prominent peaks near Simla (*Klippen*) over the less altered younger rocks, is obtained by a study of relative metamorphism, unconformities, thrusts, etc. In the Garhwal area recent mapping has proved two superposed *nappes*, the Krol and Garhwal *nappes*, composed of the older rock-formations overriding the autochthonous Carboniferous-Eocene sequence of the Outer Himalayas.

Evidence of the extreme youth of Himalayan orogeny has multiplied in recent years; investigations in the Pleistocene, glacial and fluviatile deposits of the Kashmir valley suggest that some 5,000–8,000 ft. of uplift has taken place since the end of the Pliocene. A part of the address dealt with the recently discovered gravity anomalies, both positive and negative, in the Himalayan region, which cannot be explained on the hypothesis of isostasy. On the whole, compensation is in excess in the central Himalayan ranges, while the outer Himalaya is an area of overload and under-compensation.

The arcuate form of the Himalayas, presenting to the south three prominent festoons, is best explained as the result of three crustal pegs arresting the free movement of the plastic folds pressing against the Indian horst under pressures from the north. The Great Himalayan range, built mostly of granite or pre-Cambrian sediments, from the Brahmaputra gorge to Nanga Parbat on the Indus, thus denotes the Himalayan protaxis, the axis of original upwarp of the Tethyan geosyncline. At both its ends it has undergone sharp southward deflections to accommodate itself to the shape of the foreland.

[To be continued.]

Research on Crustacea from the "Discovery" Expedition*

VOL. 14 of the "Discovery" Reports is devoted to Crustacea and includes important memoirs on *Euphausia superba*, on the southern species of the genus *Euphausia*, and on Decapod larvae. The whale krill *Euphausia superba* may be said to be the key animal of antarctic plankton. Its importance as whale food and its enormous abundance make it an ideal subject for research, and the authors of the respective monographs have utilized their unique opportunities to the best advantage. We now definitely know a considerable amount about the development, larval distribution and breeding of one species, the knowledge being based on the examination of a huge number of specimens. There is more to come, for at least another memoir is in progress

* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Title Page and List of Contents: On the Development and Distribution of the Young Stages of Krill (*Euphausia superba*) (published December 7, 1936) by F. C. Fraser. The Southern Species of the Genus *Euphausia* (published December 14, 1936) by D. Dilwyn John: The Reproductive System of *Euphausia superba* (published June 25, 1937) by Helene E. Bargmann: Larvæ of Decapod Crustacea. Part 4. Hippolytidæ (published June 25, 1937) by Robert Gurney. Vol. 14. (Cambridge: University Press, 1937).

which will deal with development and distribution of the adult animal. No member of the group has ever been studied so thoroughly as *Euphausia superba*, and the thorough study of this one species will serve as a basis for all future research.

Dr. Gurney's work on the Hippolytidæ is illuminating in many ways, and it is significant that, in this one family of the Caridea where nine larval stages are frequently present and not known to be exceeded, he should refer to both Fraser's and John's present accounts of the development of the Euphausiæ, noting that they find three *Calyptopsis* stages and six (or rarely seven) *Furcilia* stages (the term *Furcilia* being used to include all stages between *Calyptopsis* and post-larval). Now if we accept the interpreting of stages 1–3 of Caridea as equivalent to the *Protozœa* of Penæidea and the *Calyptopsis* of Euphausiæ, as suggested by Gurney in 1926, the total number of possible stages in Caridea is precisely the same as it is in Euphausiæ—a fact certainly in favour of the placing of the Euphausiæ among the Decapods.

Fraser has established the principle that there are certain important essential *Furcilia* stages, recognized by the number and state of development of the pleopods, and that these stages predominate to such an extent that one must regard any intermediate stages as unessential and as occurring only occasionally. He also shows that breeding takes place in the deep water, and all early stages are found in the deep water of the far south; *Calyptopsis* and early *Furcilia*s in warm deep water and in the intermediate vicinity of antarctic surface water, but that the last *Furcilia*s and adolescents are always found at the surface and at the ice edge. Adolescents remain at the surface but early stages have a well-defined diurnal migration. Miss Bargmann in her account of the reproductive organs of *E. superba* states that it is probable that the process of egg-laying takes place at a depth of 200 metres or more. She has dissected and examined more than 5,000 specimens in order to determine the state of development of the sexual organs. John describes the adult characters of ten species of *Euphausia*, including *Euphausia superba*, and the development of five others, with their distribution, which is exceedingly interesting; the genus in the cold southern waters consists of two groups of species, one reaching to the far south and each of the four

species concerned occupying one of four successive zones of water from north to south, the other, which includes *Euphausia superba*, being circumpolar in range and not so successful in breeding and colonization.

Dr. Gurney is describing group by group the very large collection of decapod larvæ obtained by the *Discovery*. This is the fourth part and in it he has included certain members of the Hippolytidae from the collection of the Great Barrier Reef Expedition and from his own collections from Gardafa in the Red Sea. In so doing he has made a very valuable contribution to our knowledge of the larvæ of this difficult family, the larvæ of which are extremely varied and interesting. Besides describing much new material, he has summarized the larval characters in eight genera, and amongst other things has established the fact that Bate's peculiar larval genus *Eretmocaris* is a composite one, made up of a group of forms, probably mostly, but not all, belonging to the hippolytid genus *Lysmata* or some near relative. In thus summarizing our knowledge of the Hippolytidae, Dr. Gurney shows how much more there is to be done and indicates the essential gaps which should be filled in order to understand the natural relationships of those larvæ.

Irrigation in Egypt

THE Irrigation Services of Lower Egypt, Upper Egypt and the Sudan are the subject of Part II of the annual report of the Egyptian Ministry of Public Works for the year 1929-30, which has only lately been issued (Cairo: The Government Press. P.T. 100). The control and distribution of the Nile waters according to the requirements and crops of the cultivated lands, and the safeguarding of the country from the possible dangers and losses of flooding are regarded as the first and principal duty of the Ministry. In broad terms, this consists in regulating the periodic variations in the river flow to meet the seasonal needs of the agriculturists and in adjusting the authorized croppage to the supplies of water likely to be available. To ensure that an adequate proportion of the plentiful flood waters is retained in storage in order to make up for the natural deficiency during summer, forecasts of the expected state of the river at all seasons are made from time to time, and on these forecasts programmes of distribution are made and progressively adapted as the situation defines itself more clearly. On these and the reports of conditions the Ministry also prepares and executes schemes for the improvement of the system and for the development of cultivable areas to provide for the steadily increasing population.

In the year under review, early forecasts made it necessary, in the first instance, to allot all the supply to the cotton crop, but later forecasts made in April resulted in a modification whereby it was possible, ultimately, to authorize the cultivation of rice areas to the extent of 400,000 feddan. In this year also, the forecasts indicated that the flood would be dangerously high, whereupon the necessary steps were taken to cope with this threat and to carry out such measures of defence and protection as were necessary. In the result, the flood passed safely and without serious accidents or cuts in the banks.

The report is very largely concerned with the day-to-day routine of records of flood, supply, distribution, discharges, allowances, etc., in each of the many areas into which the whole system is divided, and much of this work is illustrated by charts and diagrams. There are also particulars of the buildings, additions, repairs and other constructional and maintenance work undertaken to preserve and extend the facilities and advantages of this vital undertaking.

Closely connected with the work of irrigation in some of its services is the Physical Department, which also comes under the Ministry of Public Works and the report of which is included in this volume. It includes meteorological, hydrological and weights and measures services and a scientific instrument workshop where surveying and other measuring and scientific instruments are repaired, adjusted and calibrated.

The Meteorological Service in 1929-30 with 78 stations, and the Hydrological Service with 345 rainfall stations were very fully occupied in connexion with the needs of the irrigation system, and the report emphasizes the necessity for their enlargement not only in size but also in the scope and development of their work, particularly in research. "New work and new ideas are the life of a scientific department." The growing demand of aviation urges expansion of the meteorological service and the value of instituting research in relation to agriculture and to the climatic causes of the Nile flood are quoted as immediate strong reasons for putting into effect the plans for the extension of its work. Nevertheless, a certain amount of research work is being carried on, including investigations of evaporation at Lake Qaroun and at Gebel Zeraf, and of swamp growths and silting at Aswân, Wadi Halfa and Khaunaq. It is unfortunate that these reports are not available until so long after the period to which they refer.