

10-13, are in open communication, forming a wide continuous longitudinal tube extending from somite 6 to somite 13. Openings to the exterior from this tube were found in somites 6-9 inclusive, corresponding to the four large looped nephridia: each of these openings was close behind the upper end of an uncingerous torus. The internal openings of the same four nephridia could be traced with ease and certainty: they are attached to the body-wall close behind the notopodial fascicles of somites 5-8. These openings are wide, and are overhung dorsally by a longitudinal lip furnished with a series of small ciliated digitate processes: lower down, the anterior and posterior lips of the opening are simple, thick-walled, and ciliated. The aperture leads into a thin tube, which passes inwards and backwards, curving round the inner end of the fascicle of bristles behind the aperture, and then, crossing the continuous tube, passes up on the inner or medial side of the loop, at the apex of which it is continued into the efferent wider limb of the loop, which passes down on the outer side to open into the longitudinal tube. Neither internal nor external openings could be found in that part of the longitudinal tube which is behind the loops: it seems evident that this part of the tube represents four somewhat reduced nephridia which have coalesced, but whose openings have disappeared. Anteriorly to the four looped nephridia are traces of three others: the longitudinal tube extends forwards into somite 5 as if it included a nephridium belonging to that somite, but I could find no external opening in this somite: at the angle between the septum behind somite 4 and the body-wall is a very obvious nephrostome, which ought to lead into the longitudinal tube, into that part of it corresponding to somite 5, but the connexion could not be traced. Nephrostomes were also present attached to the anterior face of the septa behind somites 2 and 3 (the first and second branchiferous), and leading into tubes seen in somites 3 and 4, but I could find no external openings in these somites. I could find no nephrostome in somite 1 (the buccal) nor any trace of a tube in somite 2. Gonads are present in the form of clumps of deeply-staining small indifferent cells attached to the exterior of all the nephrostomata mentioned, seven in all. The germinal cells, when still quite undifferentiated, separate from the gonads, and undergo further development in the coelome. But I found no reproductive elements in the cavity of the nephridial system, though the body-cavity contained them in quantity, and it is probable that at the right season they are expelled through the nephridial system. The body-cavity contains, besides the reproductive elements, a large number of spherical, vacuolated, nucleated cells. This is the first case in which a communication between successive nephridia has ever been discovered in any adult invertebrate. It is true that in the development of *Polygordius*, according to Hatschek, each nephridium gives off backwards a prolongation of itself, from which the next nephridium is formed, and the two remain in communication for a time; but the connexion is soon severed, and in the adult the successive nephridia are isolated and independent. In *Lanice conchilega* the nephridia have coalesced together after coming in contact from before backwards, the separating membranes having disappeared. The case is extremely interesting in the fact that we have in it an approximation to the condition of the excretory system in Vertebrata: the presence of a metameric series of nephrostomata in vertebrate embryos has long ago been seen to constitute a resemblance between them and Chaetopoda, but hitherto no Chaetopod was known which resembled the vertebrate in having a number of nephridia coalesced to form a continuous longitudinal tube.

It is surprising to find that, as far as I have been able to discover, no resemblance to the condition seen in *Lanice conchilega* occurs in any of its near allies. The only species of the genus *Terebella* as defined by Malmgren that occurs in the Firth of Forth is *Terebella Danielsseni*, but of this I have only one specimen, and have not examined its nephridia. Of Amphitrite there are two species in the Firth: *Amphitrite cirrata* I have not examined anatomically; in *Amphitrite Johnstoni* there are a large number (15-17) of nephridia forming long loops projecting dorsalwards into the body-cavity, in the anterior region: each has its own internal and external openings, and is isolated and independent. In *Terebellides Stromii* there is one pair of large dark-coloured nephridia in the anterior end, and three pairs of small rudimentary ones posterior to this. In *Pectinaria belgica* there are three pairs: they are all independent. In *Melinna cristata* there are several pairs, all separate. Figures showing the interesting relations which exist in *Lanice conchilega*,

together with a more complete description of the nephridia in other forms of Polychæta, will I hope shortly be published in a paper on the anatomy of Polychæta.

#### NOTES ON THE GEOLOGY OF PART OF THE EASTERN COAST OF CHINA AND THE ADJACENT ISLANDS.

SURGEON P. W. BASSETT-SMITH, R.N., has forwarded to the Hydrographical Department of the Admiralty a brief Report on this area, embodying the results of observations made in the course of last summer during the cruise of H.M.S. *Rambler*. Specimens of rocks were collected at certain points on the mainland and on the neighbouring islands, stretching from Chusan on the north to Ockseu Island, south of Hai-tan Strait, opposite the northern part of Formosa.

All the islands, with a single exception, appear to consist of crystalline rocks. They usually present sharp rugged outlines, with bold cliffs—more or less fissured and veined—rising, in many cases, vertically from moderately deep water. In the following notes, the stations from which the specimens were collected are described in succession from north southwards.

Tou-wah Island, the most northerly station, consists of an irregular range of hills trending in a north-west and south-east direction, and reaching an elevation of 1600 feet. A gray granitic rock was obtained from the summit. Thornton Peak, on the mainland in the province of Chi-kiang, separated from the Chusan group by a narrow sea, is composed of a pink granite. From Ta-fou Island, in San-moon Bay, a fine-grained purplish quartz-felsite was obtained. The group of Hae-shan Isles seems to be composed of a dark gray quartz-felsite, and a similar rock forms the Tai-chow Islands.

Another group of stations visited by the *Rambler* lies off the coast of the province of Fu-kien. Fuh-yan Island consists of hills reaching a height of 1700 feet, and yielding a fine-grained greenish rock, apparently a diabase. Coney Island is composed for the most part of a coarse pinkish granite, with veins of quartz, and dykes which appear to consist of diabase and hornblende-porphyrity. The two islands known as Tung Yung are formed mainly of quartz-felsite; the specimens obtained from the larger of the two isles containing much opaque white feldspar, porphyritically distributed through the rock. In a cove at the south-west end of the latter island, the rocks split up into irregular columns, and in certain parts these columns exhibit considerable curvature.

The third group of stations is situated on the River Min, and in the neighbourhood of its mouth. Chang-chi is a large irregular-shaped island of red porphyry. The island known as Matsou is particularly interesting, the principal rock being a white quartz-felsite, with a complicated network of basaltic dykes. In a small sandy bay, a deep water-course exposes a layer of dark earth, about a foot in thickness, crowded with land shells. Two small neighbouring islands known as White Dog consist of dark gray quartz-felsite.

On the north side of the mouth of the River Min is an island, termed Sharp Peak, about three miles in length, which culminates in a rocky peak 1500 feet high. The island is formed, for the most part, of a hard conglomerate, associated with slates and shales, and with a talcose schist penetrated by veins of quartz. A cliff at the north-east point of the island displayed a clear section, in which this schist was seen to alternate with beds of slate and conglomerate, inclined at about 45°.

A small low island off the south point at the entrance to the River Min, consists of granite, gneiss, and mica-schist. A specimen of red granite, with crystals of iron pyrites, was obtained from the rugged mountains of the neighbouring mainland. Temple Point, on the north side of the Min, a few miles from its mouth, yielded a greenish-yellow steatitic rock, with dendritic markings. At Pagoda Anchorage, up the river, a fine-grained pink gneiss was obtained, and this locality also yielded a fragment of a large crystal of smoky quartz. About twelve miles further up the Yuen Fu branch of the Min River are some hot springs having a maximum temperature, in November, of 114° F. The rock is here a quartz-felsite. An orthoclase porphyry occurs about five miles further up the river, and quartz-felsite again occurred ten miles higher. Here, in a curious recess in the hill-side, in which a temple has been built, are numerous stalactites, some of large size. The mountains all up

the Yuen Fu are very fine, presenting a succession of bold outlines and rocky peaks. A dark-gray quartz-felsite was obtained from a high peak in a range of hills bounding the water-shed of the Min on the south. From the base of the hills a stretch of low flat reclaimed land extends to the coast. The soil of the hills is of a bright red colour, contrasting with the dark tints of the felsitic rocks.

The fourth group of stations includes a number of localities around Hai-tan Strait. Here the hills present vivid colouring, which contrasts very markedly with the white sands of the shore, especially on Hai-tan Island itself. This consists of three ranges of hills, with intermediate barren plains. Near the north point is a group of reddish sand-cliffs, from 20 to 30 feet high, horizontally stratified, and presenting flat summits, which form a miniature plateau deeply trenched by numerous gullies. At the mouth of the strait is a small barren island—Tessara Island—composed of gneissose rocks, which carry iron pyrites. Slut Island, about 400 feet high, yielded a dark porphyritic felsite, and a weathered surface of the rock displayed evidence of fluxion structure. Syang Point, at Hai-tan, shows granitic rocks running up into high hills. Kiang-shan, on Hai-tan Island, is a hill 1800 feet high, composed of dark-gray quartz-felsite. Mount Bernie, on the mainland, at the south end of the strait, about 1400 feet in height, is composed of a similar rock, weathering to a reddish earth; and in Hungwah Sound the hills are of similar character. In Ockseu, a small rocky island, about twenty miles south of Hai-tan, is a dark-coloured rock, apparently dioritic, and certain masses of this rock when struck, emit a ringing sound, like that of a phonolite. There are here numerous veins of quartz, some showing rather bold crystals, and a good deal of schorl, or black tourmaline. It is notable that the island of Ockseu is especially subject to seismic disturbances.

### THE METEOROLOGY OF INDIA<sup>1</sup>

IT is perhaps inseparable from the mode of issue of the "Indian Meteorological Memoirs" that their titles (*e.g.* Vol. III., Part I., I.—Rainfall, Part I.) are rather complex. It is stated that this memoir is to be in three parts, whereof the present part treats only of the normal rainfall of India; Part II. is to treat of its variations in past years; Part III. is to contain the tabular data: the whole to form Vol. III. of the series.

As India depends chiefly on agriculture, the investigation of the conditions affecting its rainfall is of the highest practical importance to it. The registers of rainfall available are, except a few private ones, all official work done under Government orders. Some few extend from 1844, but the most of those accepted as trustworthy, after a critical examination, date from about 1862; the discussion includes the data only down to 1883, *i.e.* covers pretty nearly a complete record for twenty-two years. Altogether, the registers of 424 stations are reviewed; for purposes of discussion these are grouped into twenty-five "rainfall districts," *i.e.* districts with similar rainfall.

From all these it appears that the average rainfall of the whole of India, excluding Burmah and the Himálya, is about 42 inches. The range of rainfall over this wide area is one of the most wonderful in the world, viz. from about 500 or 600 inches in Cherra Púnji to from 1 to 5 inches in Sindh. The average annual range over the whole of India (as above) is about 13 in the whole 42 inches. The rainfall is discussed under four heads:—

- (1) Summer Monsoons.      (2) Autumn Rains in South-East.
- (3) Winter Rains.          (4) Spring Storms.

The local distribution of 1, 3, and 4 is well shown by tints of various shades on three maps. For the connection with the state of air-pressure, twelve maps are given, showing the isobars for the mean pressure of each month; the discussion of this connection is complicated, and difficult to summarise.

(1) *Summer (South-West) Monsoon.*—By some, the south-west monsoon is considered to be an extension of the south-east trade-winds, but the author considers their connection to be very

<sup>1</sup> "Indian Meteorological Memoirs," Vol. III., Part I. I.—The Rainfall of India, Part I. Pp. 116, and 9 Plates. A Monograph by H. F. Blanford, F.R.S. (Calcutta: Government Printing Press, 1886.)

"Indian Meteorological Memoirs," Vol. IV., Part I. Pp. 57, and 4 Plates. Edited by H. F. Blanford, F.R.S. (Calcutta: Government Printing Press, 1886.)

"Report on the Meteorology of India in 1884," by H. F. Blanford, F.R.S. Pp. 305 and 3 Plates. (Calcutta: Government Printing Press, 1886.)

doubtful, and gives a rough calculation, showing that the evaporation from the Northern Indian Ocean, land of India, and Bay of Bengal is enough to account for the whole of this season's rain. This rainfall is far the heaviest of the four seasons, and the most important for agriculture for most part of India, being, in fact, popularly styled "the rains." On its sufficiency depend the lives of millions. The distribution is at once seen by the tinted map. The west coasts of India and Arakhan catch the first and heaviest fall of over 100 inches: this does not top the coast range of mountains. The next heaviest is from the head of the Bay of Bengal to the Himálya, thence all along the lower Himálya, of from 50 to 70 inches. The amount decreases thence steadily with distance from the head of the Bay of Bengal, and from the Himálya, dwindling to almost nothing on the south-east coast and north-west border.

The effect of a mountain-range in intercepting rain is clearly brought out, *e.g.* in the Western Gháts this rainfall, coming from the south-west, decreases from 250 inches on the coast to 40 inches at 30 miles inland, and to 20 inches at 60 miles from the coast. Again, very little rain crosses the outer snowy range of the Himálya. In fact, it seems to be an established law that the precipitation of rain from damp air is greatest in an ascending current from the chill produced in the ascent, and only moderate in a horizontal current.

(2) *Autumn Rains in South-East.*—The author shows that these are not (as often stated) a part of the north-east monsoon, but are, in fact, a late part of the south-west monsoon, corresponding to the late and heaviest part of the same on the Arakhan coast.

(3) *Winter Rains.*—These are popularly styled the north-east monsoon, and are popularly said to be due to a reversal of the conditions of the south-west monsoon. Their distribution is, roughly speaking, the opposite of that of the south-west monsoon, and is well shown on the map given. The south-east coasts, which scarcely feel the south-west monsoon, catch the maximum of over 10 inches of this season, the North-West Himálya catch from 5 to 10 inches, the head of the Bay of Bengal from 3 to 5 inches, and the rest of the country less and less with increased distance from these places.

Small as these quantities are (compared to those of the south-west monsoon), they are of the greatest importance to some of the localities named, especially to North-West India, as on them depends the growth of the valuable crops of temperate climates, *e.g.* wheat, the staple of North-West India; indeed, in the extreme north-west the winter is the dampest season.

(4) *Spring Storms.*—This rainfall is distinguished by increasing with the advance of the season, *i.e.* with the rising temperature, and mainly restricted to the south and east provinces. It is often accompanied by hail and thunderstorms, and is common in the evenings. This rain is usually very local, of short duration, heavy, and frequently repeated.

Altogether, this is a most elaborate and valuable monograph on its subject—the normal rainfall of India.

Part I. of Vol. IV. of "Indian Meteorological Memoirs" contains three memoirs, each a short monograph on its own subject, by different authors: these will be dealt with separately.

I.—"Account of the South-West Monsoon Storm of May 12–17 in the Bay of Bengal and at Akyab," by J. Eliot (pp. 38, and 2 plates). The history of this storm has been worked out from the meteorological reports of fourteen coast stations, and the logs of fourteen vessels passing through the Bay of Bengal. The states of the barometer and wind are shown for four days on four charts, and the track of the storm-centre on another. The meteorological conditions seem to have been remarkably uniform over the Bay of Bengal for a fortnight preceding the storm; indeed, this seems to be the normal state of things before a cyclone. The south-east trade-winds seem to have extended north of the equator on May 10 and 11, and gradually advanced into the Bay of Bengal, as strong south and south-west squalls, with rain, increasing in violence within the Bay. In front of these, a barometric depression was formed about the 12th, round which, as a vortex, the wind became cyclonic. This cyclone advanced in a curved path north and east (whereas most cyclones advance north and west up the Bay), increasing from 6 miles per hour on the 15th to 15 miles per hour on the 17th, and broke up on the Arakhan Hills close over Akyab on the 17th, doing great damage to property.

II.—"On the Diurnal Variation of the Rainfall at Calcutta," by H. F. Blanford, F.R.S. (pp. 8, and 1 plate). This is a