

another on Mr. Darwin's work on Earthworms; and a third on Dr. Günther's work on Fishes.

THE Austrian naturalist, Dr. Karl Helmes, has discovered a new viper in a valley of the Makattan Mountains in Central Egypt. He has named it *Ammodytes-azyptiaca Helmesii*. It has nothing in common with *Cerastes cornutus*, the yellow horned viper. The principal difference is that the horn-points are not above the eyes but about 4 mm. behind them. The animal does not hiss like other serpents, but makes a rattling noise as when water is thrown upon red-hot iron. The discovery will be all the more interesting to zoologists as this is the first new species discovered for many years.

THE Budget Commission of the German Reichstag has again granted 75,000 marks (3750*l.*) for the investigation of Central Africa. The Berlin African Society intends to send out two expeditions during 1882, one to start from the west and another from the south-west. It is further expected that the German station at Hakoma (Lake Tanganyika) will soon be able to pay its own expenses by establishing plantations and opening commercial relations with the neighbouring tribes.

THE Academy of Meteorological Aërostation of France has sent to M. Paul Bert a report which was adopted at its last session, and which suggests that an international exhibition of "Aërial arts" should be held in Paris in 1883, to commemorate the invention of balloons by the two Montgolfiers in 1783. The first public experiment having taken place at Annonay on June 5, 1783, a local commemoration is to take place in that town. The "Aërial arts" are to include every industry, science or art, relating to gas or the atmosphere, which is supposed to have any connection directly or indirectly with aërostatic experiments.

A SUBMARINE eruption took place recently in the Gulf of Missolonghi, not far from Anatolikon. For five days a strong odour of sulphuretted hydrogen was noticed in the neighbourhood, and whole ships' cargoes of dead fish were washed ashore.

A SMART shock of earthquake occurred at Iquique on November 13, and the master of the German barque *Shakespeare*, from Liverpool, reports that he felt it when about eight miles to the westward of Punta Arenas with such severity that he imagined the vessel had struck on a rock until the lead showed that he was in deep water. On Saturday night an earthquake shock was felt at Agram, lasting three seconds, and accompanied by a rumbling noise. Intelligence reached Plymouth on Monday from Yokohama of a destructive earthquake in China. The news, which was despatched from Yokohama on December 25, coming by way of San Francisco and New York, is exceedingly meagre. It simply announces the fact that a severe earthquake had occurred in the district of "Kantcheou," and that more than 250 people had been killed.

THE additions to the Zoological Society's Gardens during the past week include a Markhoor (*Capra megaceros* ♀) from Afghanistan, presented by Lieut.-Col. St. John; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Miss Morson; a Common Raven (*Corvus corax*), British, presented by Mr. S. J. Elyard; a Spanish Terrapin (*Clemmys leprosa*), South European, presented by Mr. H. Balfour; a collection of Sea Anemones, British Seas, presented by Mr. A. D. Bartlett; a Malayan Bear (*Ursus malayanus*) from Malacca, purchased; and a Cashmere Shawl Goat (*Capra hircus*, var.), born in the Gardens.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society last week, Sir John Kirk read a paper by Mr. Joseph Thomson, on his examination of the Rovuma basin, East Africa, during his recent

trip in search of the long-talked-of coal-beds. These were supposed to be situated at the Mavitu village of Itule on the banks of the Lujende, some three days' march from its confluence with the Rovuma, but on investigation proved to be only some irregular layers of bituminous shale, which are of no practical use. Though disappointed in the primary object of his journey, Mr. Thomson has been able to add much to our knowledge of the geography of the Rovuma region, having traversed between 600 and 700 miles of country, besides furnishing many interesting particulars respecting the seven tribes, or remnants of tribes, which are found there. A paper by the Rev. Channey Maples, of the Universities' Mission, was afterwards read, on Makua Land between the Rivers Rovuma and Luli, a tract of country hitherto entirely unknown. Mr. Maples had hoped to have gone right through from Masasi to Mozambique, but on his arrival at Mvalixa's, the capital of the Meto Makuas, he was unable to induce his followers to proceed further. He had, therefore, to abandon his projected visit to the fierce branch of the Makua tribe, called the Walomwe; but what was more annoying, his hopes of verifying the existence of a snowy mountain, named Irati by the natives, and said to be about half way between Meto and Mozambique. In the discussion which followed the reading of these papers, Sir John Kirk made some interesting remarks on the great expansion of the india-rubber trade in East Africa during recent years, the value of the annual export having risen from *nil* to about a quarter of a million sterling.

AFTER his recent discovery of the source of the River Lujende in what he supposes to be the unexplored northern portion of Lake Shirwa, the Rev. W. P. Johnson, of the Universities' Mission, followed the course of the river with a view to returning to his station at Mataka's town, but he was met outside and informed by the chief that his house had been utterly wrecked and his very books torn to pieces and scattered to the four winds of heaven. The outrage appears to have been committed by the owners of a slave-caravan, who believed that Mr. Johnson had contrived to send down information which had enabled Capt. Foot, R.N., to stop them some fifteen miles from the coast. Mr. Johnson had consequently been obliged to go to Zanzibar to refit, and as it would be impossible to settle again at his old station for the present, he intends to establish himself at Losewa, on the eastern shore of Lake Nyassa, in about S. lat. 13°. Thence he hopes to work Mataka's town, and he ought to be able to obtain useful information about this almost unknown side of the lake.

A TELEGRAM from St. Petersburg states that a scientific expedition, consisting of members of the Russian Geographical Society, the Imperial Academy of Sciences, and others, is being equipped for the purpose of making historical and ethnographical researches in Bulgaria and Roumelia. Prince Alexander of Bulgaria has contributed 4000*l.* towards the expenses of the expedition, in the work of which it is hoped Prince Vogo-ides will join.

MR. CUTHBERT PEEK is to read a paper on his journey in Iceland last summer, at the Geographical Society's meeting on January 30.

MR. BARHAM, an experienced surveyor, is to start this week for West Africa, for the purpose, it is said, of surveying a line for a light railway from the Gold Coast littoral through the little-known gold-mining region of Wassaw, which will pass the property of several mining companies. The country which will be opened up by this railway, if it be constructed, is rich in palm-oil, india-rubber, &c., in addition to the precious metal.

THE first number of *Petermann's Mittheilungen* for this year contains a letter from Mr. Schuver, giving details of his journey on the Upper Nile, to which we have already referred. There is a good summary of the Arctic work of the year, with special reference to Wrangel Land, of which island an excellent map is given from recent surveys. An interesting sketch is given of convict life in Siberia, and a summary of recent work in the Congo basin. A brief but valuable sketch of the Karachis of the Caucasus, followed by the monthly notes, concludes the number. A valuable geological map of West Africa, after data furnished by Dr. Lenz accompanies the number.

THE new part (Heft i. band iii.) of the *Mittheilungen* of the German African Society contains several communications. Dr. Buchner has reached Loanda on his return journey. There is a series of interesting letters from the members of the German

station at Kakoma, in 32° 29' E., and 5° 47' S., in the plateau which begins at the boundary of Ugogo with the Mpwapa heights. The letters contain a good deal of information on the country and the people, the fauna, flora, and climate. Dr. Stecker gives an account of his Abyssinian journey, to which we have already referred. Herr Flegel gives a long account of his journey from Rubba, on the Niger, north to Sokoto and back, between October 1880 and April 1881. His map contains much new and useful information on the country traversed. Finally there are some letters from Herren Pogge and Wissmann, who had reached Malange in May, and hoped to be at Kimbundo in June.

FURTHER RESEARCHES ON ANIMALS CONTAINING CHLOROPHYLL¹

IT is now nearly forty years since the presence of chlorophyll in certain species of Planarian worms was recognised by Schultze. Later observers concluded that the green colour of certain infusorians, of the common fresh-water hydra, and of the fresh water sponge was due to the same pigment, but little more attention was paid to the subject until 1870, when Ray Lankester applied the spectroscope to its investigation. He thus considerably extended the list of chlorophyll-containing animals, and his results are summarised in Sachs' Botany (Eng. ed.). His list includes, besides the animals already mentioned, two species of Radiolarians, the common green sea-anemone (*Anthea cereus*, var. *smaragdina*), the remarkable Gephyrean, *Bonellia viridis*, a Polychæte worm, *Chatoperus*, and even a Cru. tacean, *Idotea viridis*.

The main interest of the question of course lies in its bearing on the long-disputed relations between plants and animals; for, since neither locomotion nor irritability are peculiar to animals, since many insectivorous plants habitually digest solid food, since cellulose, that most characteristic of vegetable products, is practically identical with the tunicin of Ascidians, it becomes of the greatest interest to know whether the chlorophyll of animals preserves its ordinary vegetable function of effecting or aiding the decomposition of carbonic anhydride and the synthetic production of starch. For although it had long been known that *Euglena* evolved oxygen in sunlight, the animal nature of such an organism was merely thereby rendered more doubtful than ever. In 1878 I had the good fortune to find at Roscoff the material for the solution of the problem in the grass-green planarian, *Cowvoluta Schultzei*, of which multitudes are to be found in certain localities on the coast, lying on the sand, covered only by an inch or two of water, and apparently basking in the sun. It was only necessary to expose a quantity of these animals to direct sunlight to observe the rapid evolution of bubbles of gas, which, when collected and analysed, yielded from 45 to 55 per cent. of oxygen. Both chemical and histological observations showed the abundant presence of starch in the green cells, and thus these planarians, and presumably also *Hydra*, *Spongilla*, &c., were proved to be truly "vegetating animals."

Being at Naples early in the spring of 1879, I exposed to sunlight some of the reputedly chlorophyll-containing animals to be obtained there, namely, *Bonellia viridis* and *Idotea viridis*, while Krukenberg had meanwhile been making the same experiment with *Bonellia* and *Anthea* at Trieste. Our results were totally negative, but so far as *Bonellia* was concerned this was not to be wondered at, since the later spectroscopic investigations of Sorby and Schenk had fully confirmed the opinion of Lacaze-Duthiers as to the complete distinctness of its pigment from chlorophyll. Krukenberg, too, who follows these investigators in terming it *bonellin*, has recently figured the spectra of *Anthea*-green, and this also seems to differ considerably from chlorophyll, while I am strongly of the opinion that the pigment of the green crustaceans is, if possible, even more distinct, having not improbably a merely protective resemblance.

It is now necessary to pass to the discussion of a widely distinct subject—the long-outstanding enigma of the nature and functions of the "yellow cells" of Radiolarians. These bodies were first so called by Huxley in his description of *Thalassicolla*, and are small bodies of distinctly cellular nature, with a cell wall, well-defined nucleus, and protoplasmic contents saturated by a yellow

pigment. They multiply rapidly by transverse division, and are present in almost all Radiolarians, but in very variable number. Johannes Muller at first supposed them to be concerned with reproduction, but afterwards gave up this view. In his famous monograph of the Radiolarians, Haeckel suggests that they are probably secreting-cells or digestive glands in the simplest form, and compares them to the liver-cells of Amphioxus, and the "liver-cells" described by Vogt in *Verella* and *Porpita*. Later he made the remarkable discovery that starch was present in notable quantity in these yellow cells, and considered this as confirming his view that these cells were in some way related to the function of nutrition. In 1871 a very remarkable contribution to our knowledge of the Radiolarians was published by Cienkowski, who strongly expressed the opinion that these yellow cells were parasitic algæ, pointing out that our only evidence of their Radiolarian nature was furnished by their constant occurrence in most members of the group. He showed that they were capable not only of surviving the death of the Radiolarian, but even of multiplying, and of passing through an encysted and an amoeboid state, and urged their mode of development and the great variability of their numbers within the same species as further evidence of his view.

The next important work was that of Richard Hertwig, who inclined to think that these cells sometimes developed from the protoplasm of the Radiolarian, and failing to verify the observations of Cienkowski, maintained the opinion of Haeckel that the yellow cells "für den Stoffwechsel der Radiolarien von Bedeutung sind." In a later publication (1879) he, however, hesitates to decide as to the nature of the yellow cells, but suggests two considerations as favouring the view of their parasitic nature—first, that yellow cells are to be found in Radiolarians which possess only a single nucleus, and secondly, that they are absent in a good many species altogether.

A later investigator, Dr. Brandt of Berlin, although failing to confirm Haeckel's observations as to the presence of starch, has completely corroborated the main discovery of Cienkowski, since he finds the yellow cells to survive for no less than two months after the death of the Radiolarian, and even to continue to live in the gelatinous investment from which the protoplasm had long departed in the form of swarm-spores. He sums up the evidence strongly in favour of their parasitic nature.

Meanwhile similar bodies were being described by the investigators of other groups. Haeckel had already compared the yellow cells of Radiolarians to the so-called liver-cells of *Verella*; but the brothers Hertwig first recalled attention to the subject in 1879 by expressing their opinion that the well-known "pigment bodies" which occur in the endoderm cells of the tentacles of many sea-anemones were also parasitic algæ. This opinion was founded on their occasional occurrence outside the body of the anemone, on their irregular distribution in various species, and on their resemblance to the yellow cells of Radiolarians. But they did not succeed in demonstrating the presence of starch, cellulose, or chlorophyll. The last of this long series of researches is that of Hamann (1881), who investigates the similar structures which occur in the oral region of the Rhizostome jelly-fishes. While agreeing with Cienkowski as to the parasitic nature of the yellow cells of Radiolarians, he holds strongly that those of anemones and jelly-fishes are unicellular glands.

In the hope of clearing up these contradictions, I returned to Naples in October last, and first convinced myself of the accuracy of the observations of Cienkowski and Brandt as to the survival of the yellow cells in the bodies of dead Radiolarians, and their assumption of the encysted and the amoeboid states. Their mode of division, too, is thoroughly algaic. One finds, not unfrequently, groups of three and four closely resembling *Protococcus*. Starch is invariably present; the wall is true plant-cellulose, yielding a magnificent blue with iodine and sulphuric acid, and the yellow colouring-matter is identical with that of diatoms, and yields the same greenish residue after treatment with alcohol. So, too, in *Verella*, in sea-anemones, and in medusæ; in all cases the protoplasm and nucleus, the cellulose, starch, and chlorophyll, can be made out in the most perfectly distinct way. The failure of former observers with these reactions, in which I at first also shared, has been simply due to neglect of the ordinary botanical precautions. Such reactions will not succeed until the animal tissue has been treated with alcohol and macerated for some hours in a weak solution of caustic potash. Then, after neutralising the alkali by means of dilute acetic acid, and adding a weak solution of iodine, followed by strong sulphuric acid, the

¹ Abstract of a paper "On the Nature and Functions of the 'Yellow Cells' of Radiolarians and Cœlenterates," read to the Royal Society of Edinburgh on January 14, 1882, and published by permission of the Council.