will afford every possible facility to those who may work them.

Not less complete are the arrangements for the collection of specimens and for the observations on depth, surface and bottom temperatures, and other physical features.

Two steamers have been built for the Fish Commission—the *Fish Hawk* in 1880, and the *Albatross* in 1883.

The *Fish Hawk*, a steamer of 484 tons of displacement and 205·71 tons measurement, was built particularly for use in the hatching of shad-eggs. Although unsuitable for long voyages or rough weather, she has proved a valuable boat for short trips and for dredging down to a depth of about 700 fathoms, having been well furnished with modern apparatus. Already much important work has been accomplished in the vessel in her subsidiary capacity, as is proved by the publications of the Fish Commission and Prof. Verrill's articles in *Science*, &c. (*Science*, vol. i. 1883, pp. 443, 531, and vol. ii. 1883, p. 153).

Last year the new steamer *Albatross* was specially constructed for deep-sea trawling. The extreme length of the vessel is 234 feet, the breadth of beam, moulded, is 27½ feet; the registered net tonnage is 400 tons, and the displacement, on a 12-foot draught, 1000 tons. She is most perfectly fitted with all those improvements in collecting and observing tackle which considerable experience has proved to be the best; but improvements and adaptations are continually being suggested. A full and illustrated account of the vessel is given by Mr. R. Rathbun in *Science*, vol. ii. 1883, pp. 6, 66. Suffice it now to mention that the comfort of the staff is as well provided for as their scientific necessities, and a complete system of electric lighting enables the laboratory work to be carried on at all hours. The main laboratory is 20 feet long, 26 feet wide, and 7 feet 10 inches high, and is situated amidships: above this is a well-lighted deck laboratory.

So far we have very briefly detailed the mere appliances for the collection and preservation of specimens. A short sketch of the mode of work might prove interesting.

The steamers are manned by naval officers and crew, a plan which serves the double purposes of lessening the expenses of the Commission and of spreading an interest in marine zoology throughout the navy. The officers have proved themselves to be most zealous in the work, and have cordially assisted the civilian staff in every possible manner; several important improvements in dredging and sounding apparatus have originated from some of them.

The sailors, too, take a personal interest in their occupation, and occasionally bring rare forms to the naturalists, which they have themselves caught in a hand-net.

Before an expedition, Prof. Baird consults with Prof. Verrill on desirable localities to explore, and instructions are given to the Commander, who also has charge of the mechanical portion of the dredging operations.

Mr. Benedict is the naturalist in charge of the vessel, and he is responsible for the specimens directly they arrive on deck; usually one or two naturalists work under his directions, the arrangement being that each is responsible for one or more groups of animals.

The contents of the trawl are subjected, immediately on their arrival on deck, to a process of sifting through a series of sieves of different sized meshes, and most of the animals are forthwith preserved. Numerous methods of conservation have been tried, but it is found that, under the special circumstances, alcohol is the best for general purposes. In some instances the jars have to be kept in ice to preserve the tissues whilst the alcohol is slowly penetrating; picric, chromic, osmic, and other acids and reagents, are used when deemed necessary. As a general rule, pelagic forms are killed by picric acid. All but the largest and smallest animals are put into glass-capped "butter-" and "fruit-jars," which are secured by a screw-down metal cap. Various devices are resorted to for large specimens; the smallest are placed in homœopathic vials.

Each dredging "station" has its serial number, and a full record of the position, depth, bottom and surface temperatures, with other details, is kept, and a label, bearing the number of its station, with certain other information, is put into each bottle of specimens. Mr. Benedict has a small hand-press on board, and he often prints such labels whilst the trawl is out. So far as opportunity presents, the species or groups are roughly sorted on board, and are then ready for identification in the laboratory. Excepting in the case of large quantities of common species, all the specimens from each haul are retained. Surface skimmings are similarly treated.

All the material so obtained passes through Prof. Verrill's hands, and he distributes certain groups to specialists to be worked out after he has described those forms which interest him. The zoological work of the Commission is so well known that it would be superfluous to even enumerate the naturalists on the staff.

After having been duly entered, the specimens, if properly named, are broken up into sets, of which the first naturally goes to the National Museum at Washington, the second to Prof. Verrill, the third to the Museum of Practical Zoology at Harvard University, Cambridge, Mass., and the remaining sets are variously distributed or kept in the stores as duplicates.

The Marine Laboratory is only officially open during the summer months. During the remainder of the year most of the officers are at Washington employing their time in identifying specimens, drawing up reports, and other routine work.

The biological portion of the work of the Commission is not merely restricted to the collection and identification of species; careful drawings are being made of every form collected, with a view to illustrating the entire fauna of that coast. The numerous papers of Prof. Verrill, Dr. Ryder, and others, prove that anatomical and embryological investigations are not neglected; life-histories are studied, and all possible data are collected on the influence of environment on organisms. It is intended, when the new building is completed, that the physiology of marine forms shall receive a due share of attention.

One object of the Commissioner is to thoroughly study the fauna of the American waters, fresh and salt, and encouragement and facilities are given to all the officers to follow their personal bent, of course paying a due regard to routine work. Naturally, at present, the officers are more engaged in the recording of species, since this pioneering work is the necessary precursor to morphological investigation; but the lines of the Commission are laid on too broad a scale to limit the original research of any officer.

ALFRED C. HADDON

ANCIENT AIR-BREATHERS

WHILE the records of the life of the sea have been preserved in abundance from early geological periods down to the present time, the chronicles of the living things of the land are comparatively scanty. The early history of land-animals has therefore a peculiar interest, heightened by the rarity of the evidence from which the history must be compiled. Considerable progress, however, has recently been made in this department of investigation. Within a few years, discoveries of the remains of scorpions and insects have successively been made in older and older strata, till now they have been disentombed almost simultaneously from older Palæozoic rocks in three different countries of the old world. Scorpions, which appear to be the most ancient type of air-breathing arachnids, have been found to be comparatively abundant in the lowest Carboniferous strata. The

first Palæozoic scorpion which came to light was described by Count Sternberg, in 1835, from a specimen obtained by him from the coal-formation of Chomle, near Radnitz, in Bohemia, which, in 1836, was named *Cyclopthalmus senior* by Corda.[1] Three years later Corda gave an account of another scorpion, from the same locality, under the name of *Microlabis*. From that time till 1866 these were the only Palæozoic scorpions known, but in the latter year Messrs. Meek and Worthen described two new genera from the Coal-measures of Mazon Creek, Morris Grundy County, Illinois, under the names of *Eoscorpius* and *Mazonia* respectively.[2] In 1873 Dr. Henry Woodward showed that scorpion remains, referable to the genus *Eoscorpius*, occur both in the Coal-measures of England and in the Carboniferous Limestone series of Scotland.[3] In 1881 the present writer had the privilege of studying and describing a large suite of scorpion remains belonging to the Geological Survey of Scotland, and obtained by their officers from the lowest Carboniferous rocks of the Scottish Border. The results were published in the *Transactions* of the Royal Society of Edinburgh, where several species belonging to the genus *Eoscorpius* were described and figured.[4] In that paper the following conclusion was announced:—"Although there seems to be sufficient reason to separate the genus (*Eoscorpius*) from any recent one, these ancient scorpions appear not to differ in any essential character from those now living. As far as the horny test, the only part now preserved to us, is concerned, they were as highly organised and specialised towards the beginning of the Carboniferous period as their descendants at the present day. It is unfortunate on that account that Messrs. Meek and Worthen should have chosen the name *Eoscorpius*, for the dawn of the scorpion family must have been at a much earlier period, and we may hope that their remains will yet turn up in the Devonian and Silurian plant-beds when these come to be thoroughly searched." The subsequent study of a much

FIG. 1.—Fossil scorpion found in the Silurian rocks of the island of Gothland (Sweden). From the photograph sent by Prof. Lindström to M. Alph. Milne-Edwards (from *La Nature*).

finer collection from the same rocks has fully confirmed the conclusion as to the essential identity of structure between the living and the Palæozoic forms. The hope also expressed in the passage just cited has now been realised by the discovery of scorpions in the Upper Silurian beds of Scotland and Sweden, in the former by Dr. Hunter of Carluke, who obtained one from Lesmahagow in Lanarkshire in June 1883, and in the latter by Prof. Gustav Lindström, of the Swedish Academy of Sciences, Stockholm, who got his last summer (1884) from Wisby in the Swedish Island of Gothland. Prof. Lindström shows that his was a land animal and a true air-breather, and though of a more lowly type than the Carboniferous and recent scorpions, was yet to be placed among the members of that ancient family. Writing to M. Alphonse Milne-Edwards on November 24, 1884, he says:—

"The specimen is in sufficiently good preservation, and shows the chitinous brown or yellowish brown cuticle, very thin, compressed and corrugated by the pressure of the superposed layers. We can distinguish the cephalothorax, the abdomen, with seven dorsal laminæ, and the tail, consisting of six segments or rings, the last narrowing and sharpening into the venomous dart. The sculpture of the surface, consisting of tubercles and longitudinal keels, entirely corresponds with that of recent scorpions. One of the stigmata on the right is visible, and clearly demonstrates that it must have belonged to

[1] Corda, in *Böhmischen Verhandlungen*, 1836, and Wiegmann's *Archiv.*, 1836, vol. ii. p. 360. Figured in the *Transactions* of the Bohemian Museum.
[2] *American Journal of Science*, 2nd series, vol. xlv. p. 25. "Geological Survey of Illinois," vol. iii. pp. 563-565.
[3] *Quart. Journ. Geol. Soc.*, vol. xxxii. p. 57.
[4] *Transactions* of the Royal Society of Edinburgh, vol. xxx. pp. 397-412, Plates XXII., XXIII.

an air-breathing animal, and the whole organisation indicates that it lived an dry land. In this scorpion, then, which we have named the *Palæophoneus nuncius*, we see the most ancient of land-animals. In the conformation of this scorpion there is one feature of great importance, namely, four pairs of thoracic feet, large and pointed, resembling the feet of the embryos of several other tracheates and animals like the Campodea. This form of feet no longer exists in the fossil scorpions of the Carboniferous formation, the appendices belonging to which resemble those found in the scorpions of our own day."

To Prof. Lindström is thus due the honour of first announcing the discovery, and it was not till Dr. Hunter had received a photograph of the Swedish specimen, together with a preliminary notice of his find from Prof. Lindström, that he became fully aware of the importance of his own discovery. On receipt of the photograph and the notice, Dr. Hunter showed the Scottish specimen to the present writer (December 1884), with whom he has agreed to describe the geological and zoological aspects of the find.[1] In the meantime, a short preliminary description for comparison with the Swedish animal may not be out of place here. The rocks from which the Scottish example was obtained are the well-known Upper Silurian beds of Dunside, Logan Water, Lesmahagow, Lanarkshire, which have yielded such a magnificent suite of Eurypterids, and supplied a great part of the materials for Dr. Henry Woodward's work on the Merosomata. The animal in this specimen is about an inch and a half long, and lies on its back on the stone. Its exposed ventral surface shows almost every external organ that can be seen in that position, and in this way serves to supplement the evidence supplied by the Swedish specimen. As in the northern individual, the first and second pair of appendages of the cephalo-thorax in the Scottish example are chelate, but the palpi are not quite so robust. The walking-limbs, though not so dumpy as in *P. nuncius*, also terminate each in a single claw-like spike. The arrangement of the sternum shows a large pentagonal plate (metasternite), against which the wedge-shaped coxæ of the fourth pair of walking-limbs abut. The coxæ of the third pair bound the pentagonal plate along its upper margins, and meet in the mid-line of the body, where they are firmly united. The coxæ of the first two pairs, as well as the bases of the palpi, are drawn aside from the centre line of the body, showing that, as in recent scorpions, these alone were concerned in manducation, or rather the squeezing out of the juices of the prey. From the circumstance of these being drawn aside, the medial eyes are seen pressed up through the cuticle of the gullet, and a fleshy labrum (camerostome) appears between the bases of the cheliceræ.

Behind the pentagonal plate and the coxæ of the hindmost limbs there succeeds a space shaped like an inverted V, where the test is thin and wrinkled in the line of the long axis of the body. It is just along this line that the trunk or abdomen most easily separates from the cephalo-thorax in recent scorpions, and it is at once apparent that the trunk in this case is as far separated from the cephalo-thorax as it can well be without being detached. Similar longitudinally-wrinkled skin is seen to unite the dorsal and ventral scutes up the whole right side of the trunk. At the interior angle of the inverted V there hangs downwards a narrow bifid operculum flanked on each side by the combs, which have each a broad triangular rachis set along its lower edge with the usual tooth-like filaments. The combs almost hide the first of the four ventral sclerites, which bear the breathing apparatus in recent scorpions, notwithstanding which all four of these exhibit on their right side undoubted slit-like stigmata at the usual places. The fifth ventral scute of the trunk suddenly contracts posteriorly, and to its narrow end is articulated a long tail of five joints and a poison-gland with a sting. These joints are all constructed on the same principle as those of recent scorpions, and as the articular surfaces are more highly facetted on the dorsal than on the ventral aspect (a portion of the tail of the specimen lying sideways allowing of these observations), there can be no doubt that the animal was in the habit of carrying the tail over the head (so to speak) and stinging in the same manner as its recent congeners.

The above characters are shown in the accompanying woodcut (Fig. 2) on nearly the same scale as that of the figure of the Swedish example, viz. about twice the natural size, taken from a drawing made by the writer. From it and the description it becomes apparent that the animal was a true air-breather and a land-animal.

The presence of the remains of these ancient murderers in such old strata necessarily suggests the question, What was the nature of their victims? As far as the Carboniferous scorpions are concerned, we are acquainted with several other arachnids, numerous hexapod insects, and chilognathous myriapods, which might have formed their prey. The Middle Devonian rocks of Canada have furnished remains of dragon-flies, which were known as the oldest land animals until the present writer showed, in 1882, that chilognathous myriapods were far from uncommon in the Lower Old Red Sandstone of Forfarshire in Scotland,[1] and the *Gyrichnites* of the Lower Devonian of Gaspé are doubtless the casts of such animals.[2] It is but a short step from the Lower Old Red Sandstone of Scotland to the Upper Silurian. The lowest part of the Lower Old Red Sandstone, which is a lake-formation, may be represented elsewhere by marine strata, which would undoubtedly be called Upper Silurian, and, in fact, high up in the Lower Old Red Sandstone of Lanarkshire, which contains *Cephalaspis*, a band of shale occurs,

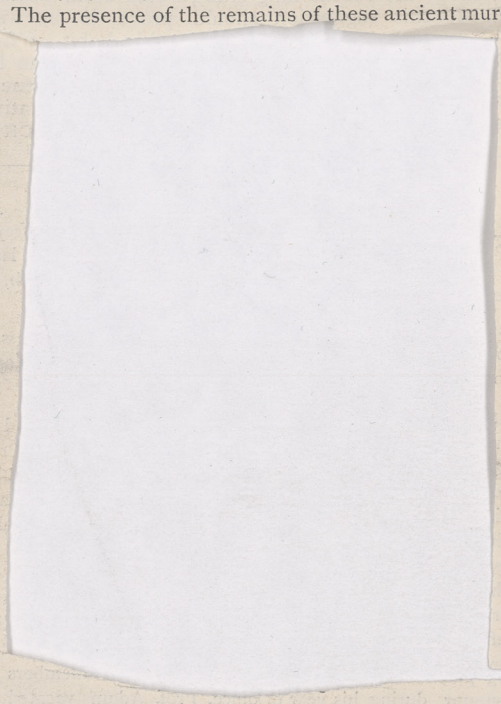

FIG. 2.—Fossil scorpion from the Upper Silurian rocks of Lesmahagow, Lanarkshire, Scotland, found by Dr. Hunter, Carluke; magnified two diameters.

[1] It has been erroneously stated in the *Annals and Magazine of Natural History*, p. 76, and elsewhere, that the specimen was sent to me in 1883. The above statement is the correct one.—BEN. N. PEACH.

[1] *Transactions* of the Royal Physical Society, 1882, vol. vii. pp. 177-188, Pl. II.

[2] *Transactions* of the Royal Society of Canada, vol. i. Pls. xi., xii.

which proves that marine conditions recurred for a short time, and brought again into the lake basin such marine Silurian forms as *Beyrichia*, *Orthoceras*, and even *Graptolites*.[1] We are not left to conjecture the nature of Silurian insect-life, for Mr. Charles Brongniart intimated to the Paris Academy of Sciences (December 29, 1884), through M. Alphonse Milne-Edwards, the discovery of a fossil insect, the rock containing which is the Silurian sandstone of Calvados, and which is even more ancient than the strata containing the Swedish and Scottish scorpions. The specimen consists of the wing, the characteristics of which are those of the wings of Blatta.

It may be that, as recent scorpions feed extensively on the eggs of various Invertebrates, the Silurian species also visited the shores for the eggs of animals left bare by the tides, among which *Parka decipiens*, the eggs of its marine allies, the Eurypterids (if the latter had the habits of their near relation, the recent king-crab), would form a *bonne bouche*. If this suggestion should prove to be well founded, we [illegible] habit of frequenting [illegible] to be imbedded [illegible] eness they [illegible] ative shores [illegible] CH

We [illegible] freys, F.R.S. [illegible] last, at the [illegible] h, in our ne[illegible]

Sir [illegible] ss at the o[illegible] lege, Bango[illegible]

The [illegible] d of Electi[illegible] Prof. Georg[illegible] hich shoulc[illegible] and the di[illegible] hie premi[illegible] for his p[illegible] on health[illegible] ted to Mr [illegible] ing the ef[illegible] ts." Havin[illegible] members for their support during his year of office, Prof. Adams vacated the chair and introduced the president for 1885, Mr. C. E. Spagnoletti.

At the recent meeting of the Government Grant Committee, Prof. Ewing, of Dundee, received a grant of 100*l.* to institute observations of earth movements on Ben Nevis. He was asked to undertake this work by the Directors of the Observatory there, and he intends to look both for minute earth tremors, such as have been observed by Rossi and Bertelli in Italy, and for slow movements of the horizon, such as those observed by Messrs. G. H. and H. Darwin at Cambridge. The isolated position of the Ben Nevis Observatory makes it particularly well suited for observations of this kind.

Sir Joseph Lister, Professor of Clinical Surgery in King's College, London, has been appointed by the German Emperor a Knight of the Order Pour le Mérite for Science and Arts.

We have received from the Fine Art Society a "remark" proof of a very fine etching, by Mr. Flameng, of Mr. Collier's portrait of Prof. Huxley, which attracted so much attention at the Royal Academy Exhibition two years ago. Doubtless many of our readers will remember the leading features of the portrait, the etching of which will form a suitable companion to that of Mr. Darwin by the same engraver, also from a painting by Mr. Collier.

[1] A. Geikie, "Explanation of Sheet 23 of Geological Survey of Scotland," 1873, p. 14.

The first arrangement for supplying private houses with electricity is now in working order in Paris. It has been placed in the Passage des Panoramas, Galerie Vivienne, for the use of all the houses in this extensive block. The motor being a gas-engine, the use of which is legal in cities, the proprietors of this lighting establishment have nothing to do with civic authorities and regulations. Six or seven shops are now lighted by about 100 Woodhouse and Rawson incandescent lamps.

The Russian Government are preparing an expedition to Western Siberia, for the purpose of examining some sulphur deposits recently discovered there. The natives have for many years had knowledge of these deposits, but the Government have only recently been made cognisant thereof, through a report by Lieut. Kalityn. According to the statement of M. Konschin, a mining engineer, one of the deposits contains upwards of five million pood of sulphur, the number of the former being ten. Europe has hitherto been supplied with this article from Sicily, and it is hoped that the Russian deposits may compete with the mines in that island. In Russia sulphur has hitherto only been found at Tchirkota, not far from Petroffsk, in Daghestan, which has chiefly been delivered to the powder-mills. The expedition in question will leave St. Petersburg next month.

Mr. H. Cecil writes to us with reference to our note on the British Museum lectures last week. "To some of us," Mr. Cecil writes, "it is a source of no little astonishment that the materials of these lectures, some of them of such surpassing interest, should not be made accessible to students and the general public in some full, substantial, and permanent form. Besides, it would surely pay. The hunger of men never was keener for every single seed-corn of threshed-out verity; and I am myself constantly asked with reference to the subjects of these very lectures: Where can I find this in accurate form, vouched by the writer's name, and open to the examination and judgment of all men?"

A Michigan paper gives an account of a phenomenon that was witnessed in Orion and vicinity on the evening of December 20:—At Marshall a bright luminous ball of large dimensions, tinged with a deep green, apparently lit up the whole heavens. The light was instantly followed by a loud noise, somewhat resembling distant thunder, which continued for about one minute. The general opinion is that it was an aerolite. At Jackson the vibration was preceded by a vivid flash in the heavens, resembling lightning. The phenomena were noticed in several portions of the city. To the south it was felt quite strong. Near Hanover and Horton the quaking of the earth was observed, while the heavens for an instant were lighted by an instantaneous flash, followed by a loud report. Buildings were slightly jarred, and the people noted the motion of their houses.

The Rev. H. Sumangala, High Priest of Adam's Peak, Ceylon, has recently contributed to the *Orientalist*, a magazine published at Kandy, a short summary of the views of Hindu astronomers on the form and attraction of the earth. The theory of Bhāskara, who flourished in the twelfth century of our era, was that the terrestrial globe, which is composed of earth, air, water, space, and fire, is of a spherical shape, and being surrounded by planets, such as the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, and by the orbits of stars, stands firm in the midst of space by its own power, without any other aid. This, he says, is a well-ascertained fact. Like the pollen in the Kadamba flower, on its surface are countries, mountains, gardens, and buildings, where Rāksasas, men, Devas, and Asuras dwell. He refutes the theory that the earth cannot stand of itself without any support by arguing that, if there be