

genera allied to Epizoanthus, were obtained, each with a new hermit crab. Other genera of Actinians were rare, owing to the few opportunities for attachment. The most abundant starfish was a new species of Zoroaster named *Z. diomedea*, found in 1200 fathoms. An Archaster-like species was the most interesting, on account of its immense madreporic plate. Several other species of Archaster, and at least one of Solaster, were also taken. Starfishes from these depths belong to the two very opposite genera *Asterias* and *Archaster*, or their near allies. *Ophiomusium lymani* and *armigerum* formed the greater bulk of Ophiurians, but we dredged, in smaller quantities, *Ophioglypha convexa*, several species of Ophiocantha, and a number of other species not yet determined. One species of soft, flat sea-urchin was quite abundant, and another much larger one was taken in smaller numbers. *Echinus norvegicus*, previously found only rarely in the dredgings of the Commission, was obtained in great quantities in 1000 fathoms. Several other species of Echinus and a number of Spatangoids formed the best part of the collection of Echini. Holothurians were represented by many forms. One, resembling *Leptosynapta* in form and in its anchor hooks, another similar to *Molpadia*, and several others having the form of the typical Holothurian, will undoubtedly prove to be new. The most peculiar species of Holothurian were two new forms taken in great numbers from several localities. They are new species belonging to genera described from the *Challenger* Expedition; one will be called *Benthodites gigantea*, the other *Euphronides cornuta*. We can describe them no better than by giving the names applied by the sailors, Benthodites being called the "lump of pork," and "animated boxing-gloves," while Euphronides was christened "Old Boot," and its resemblance to an old, unblackened, low shoe was certainly remarkable. As the specimens of Benthodites tumbled from the trawl-net, they looked very much like pork, and reminded one of boxing-gloves, on account of their size and apparently useless bulk. In the 2950-fathom haul, a specimen of a Tunicate, allied to *Boltenia*, was taken, and a number of shrimps.

Several new and remarkable Cephalopods were dredged during the summer. *Pleurostoma*, *Bela*, and allied genera were taken in great variety and abundance. One species of *Pleurotomella* was very large. A *Dentalium*, differing in no respect from *D. striolatum*, excepting in size, it being often nearly two inches long, was very abundant in from 1000 to 1500 fathoms. *Nucula reticulata*, *Cryptodon ferruginosus*, and several other species had their range extended as deep as 1500 fathoms. *Dolium bairdii* was obtained, and several specimens of a species which differs from *Dolium* only in the fact that it has an operculum, which would lead to the inference that it is a *Buccinum*. The Mollusca probably have more new species than any other group.

In several of the 200 to 400 fathom hauls, *Calliostoma bairdii* was taken. This species is remarkable from the fact that it is one of the few animals which, when taken from the cold bottom waters, will survive and flourish when placed in the aquarium. It is one of the few shells found in our deep water which has a truly tropical appearance. Many Annelids, mostly very minute, were taken at nearly every locality. It is probable that many will prove to be new. *Hyalinæcia artifex*, a worm which secretes a horny quill-like tube, was encountered in some of the shallowest dredgings.

Crustacea were represented by many new and interesting forms, especially of shrimps, including many very curious types. In 2300 fathoms we dredged a shrimp nearly a foot in length, and an Amphipod 3 inches long. Some very odd species of crabs, and hermits furnishing types for entirely new genera, were taken on several occasions. Colossendes, that gigantic Pycnogonid, was dredged many times, and several other large species were also

taken. One specimen measured over 2 feet from the end of one leg to the opposite extremity of the other. Notwithstanding this remarkable length of legs, the body was less than an inch long, and an eighth of an inch in breadth. To support this great length of legs, a branch of the stomach extends into the base of each leg. The fish were perhaps the most remarkable, in point of curious structure, aberrant forms, and marked specialisation. One, *Gastrostomus bairdii*, forms the basis of a new order, and is one of the most remarkable recently-described types of primitive anatomical structure, and, especially as regards the skull and branchial apparatus, it presents a remarkable phase of specialisation. Its nearest ally is a *Eurypharynx*, described by M. Vaillant. It is at present in the hands of Mr. John Ryder and Prof. Theodore Gill, the former studying the anatomy, the latter working out its systematic position. Together they propose to publish a complete monograph of the species. Another remarkable fish has no external traces of eyes. Most animals from the bottom have well developed eyes, although their use is unknown, for, unless some such light as phosphorescence is common, they must live in nearly absolute darkness. Some shrimps and a few other species have no eyes whatever. There are as many as fifteen new species of fish described from the *Albatross* summer collection, most of them belonging to new genera, while one or two families have been added. The field of deep-sea research is as yet just begun, and with what remarkable results. Hundreds of new animals, belonging to entirely new types, have helped to fill up gaps in the animal kingdom which had been left unfilled after a thorough examination of all the shallow waters. Such groups as Crinoids, for a long time supposed to be extinct, are now found quite abundantly and in considerable variety in certain localities. And when the whole ocean bottom has been examined as thoroughly as some portions of the North Atlantic, who can tell what curious forms may be found?

The collections obtained have been placed in the hands of the best American naturalists. Prof. L. A. Lee, of Bowdoin College, Maine, has the Foraminifera, Mr. Jas. E. Benedict and Prof. H. E. Webster the Annelids, Prof. S. I. Smith the Crustacea, who will work up the greater bulk, but will turn a few groups over to other naturalists. Mr. Sanderson Smith and Prof. H. E. Verrill will work up the Mollusca, Alexander Agassiz the more important Echini, and the rest of the Invertebrates will be studied by Prof. Verrill. It is not yet determined who will study the Sponges. The fishes are being worked up systematically by Prof. Theo. Gill, and Mr. Ryder is studying the anatomy of the more interesting forms.

RALPH S. TARR

AFRICAN SPIDERS¹

THE paper above noted forms Part III. of an important and interesting series upon the Arachnida of Africa, and was first published in *Annali del Museo Civico di Storia Naturale di Genova*, vol. xx. pp. 5-105. Its subject-matter comprises the collection of Arachnids formed by Count Orazio Antinori in the kingdom of Scioia in the years 1877-1882. Before entering upon the details of this paper it will be well to notice briefly the two preceding ones of the same series. Part I. (published in the same *Journal* in 1880) states that the object of the series is to bring together all the existing materials in the shape of papers and other works on African Arachnida and present them on one plan and method in accordance with the following five zoological provinces:—(1) *Mediterranean* (extending nearly to the Tropic of Cancer, and in-

¹ *Memoire della Società Geografica Italiana*, vol. ii. parte quarta, pp. 1-103 (Roma, 1883). Spedizione Italiana nell'Africa Equatoriale. Risultati Zoologici. IV. Aracnidi di Scioia, e considerazioni sull'Aracno-fauna d'Abissinia, per il Prof. P. Pavesti.

cluding the Azores, Madeira, Canaries, and Cape de Verde Islands); (2) *Oriental*, or, rather, *Central and Oriental African*; (3) *Western African* (from the Gambia to the Congo); (4) *Southern* (included by a line drawn from Kalabini to Limpopo, and comprising a portion of the eastern coast to the Mozambique); (5) *Malagasic* (i.e. the Lemur country with Madagascar). Various expeditions and other means by which materials have been obtained are mentioned, and a bibliographical list is given, in the introduction, of the numerous published works and papers on African Arachnida from the days of Linnæus to the present time. The Arachnida described and recorded in this first part are from Tunis, while the second part (published *loc. cit.* vol. xvi. 1881) simply contains an account of a collection of Arachnids from Inhambane (in the southern region), with some considerations on the Arachno-fauna of the Mozambique, of which a list of species is also added.

The Tunisian collection described in Part I. numbers 115 species of six orders: *Scorpionidea*, 6 species (Scorpiones, 5; Pseudoscorpiones, 1); *Solpugidea* (Solifugæ), 4; *Phalangiidea* (Opiliones), 4; *Araneidea* (Araneæ), 96; *Acaridea* (Acari), 5. Of the above, two new genera, and eleven new species (all but one of the latter—a pseudo-scorpion of a new genus) belong to the Araneidea. As might be supposed, the essential character of the Tunisian collection is South European or Mediterranean. Very different from these are the arachnids described and recorded in Part II. from Inhambane and the Mozambique. Here we have, though the number of species is very scanty, the true tropical character. Only 54 species are recorded, comprised in 43 genera, 20 families, and 5 orders. The larger part (35 species) belong to the *Araneidea*, of which 1 genus and 4 species are new. Coming now to the Arachnida recorded and described in Part III. from Scioa (in the eastern zoological province) we have 71 species belonging to 49 genera, 18 families, and 4 orders. A general catalogue is also added of Abyssinian Arachnida, which, including those from Scioa, number 124 species. It is noted as remarkable that no scorpions were contained in the collection from Scioa, and that 30 of the Arachnids recorded are new to science; also that only 12 of the Scioan species are common to the rest of Abyssinia.

The author enters into some other considerations on the distribution of the Arachnids of Abyssinia; but the researches and materials on which his observations are based appear as yet to be too scanty to sustain any very general conclusions. At the same time it must be acknowledged that the plan on which the author has worked, of bringing the materials of so large and varied a region as the African peninsula under the geographical divisions announced in the introduction to Part I. is a most useful one, and the work he has done so far is undoubtedly a valuable contribution to arachnological science.

O. P. C.

MR. BURNHAM'S DOUBLE-STAR MEASURES

THE recently published volume of the *Memoirs of the Royal Astronomical Society* contains a further series of measures of double stars by Mr. S. W. Burnham, made with the 18-inch refractor of the Observatory at Chicago. This series comprises measures of 151 double stars discovered by this eminent observer, which brings up the number of such objects discovered by him during the last ten years to no fewer than 1013, amongst which are included some of the most interesting stars of this class; also measures of a selected list of double stars, 770 in number, made chiefly in the years 1879 and 1880, with an appendix, the results of observations of several objects, as late as the middle of the past year. Every one who is interested in this branch of astronomical science will read with much regret one

remark in Mr. Burnham's introduction: he writes:—"The present catalogue will conclude my astronomical work at least so far as any regular or systematic observations are concerned." He expresses himself modestly respecting his own labours—"In a field so infinitely large, one can accomplish but little at the most, and how much, or how little, the astronomers of a few centuries hence can perhaps best decide. . . . At this time I may venture to claim that my work in this field has been prosecuted with some enthusiasm, and for its own sake only, and that my interest has not been divided among several specialities."

But a higher estimate of Mr. Burnham's work in this particular line of observational astronomy to which he has devoted himself may be justly taken. To read of the discovery of upwards of a thousand double stars within a limited period by one observer, we might almost suppose we were living in the days of Sir William Herschel, when the heavens were comparatively an open field, and had not undergone the wide and close exploration which they had done when Mr. Burnham commenced his work. He has had, it is true, the advantage of instruments of the finest class, and we may believe an unusually acute vision; but he must have exercised an extraordinary and most meritorious amount of patience, perseverance, and care in the discovery and accurate measurement of such a list of double stars, and it will be gratifying to the astronomical world that such well-directed exertions have met with so exceptional a success.

Among the more noteworthy stars included in Mr. Burnham's new Catalogue (the fourteenth), which may be considered a continuation of that published in vol. xlv. of the same *Memoirs*, the following may be mentioned:—

1. 126 Tauri (β 1007), "a most remarkably close and difficult pair, one of the closest known"; magnitudes 6.0 and 6.2. With a power of 1400 there was only a slight elongation.

2. B.A.C. 346; Mr. Burnham thinks the principal star may be variable, and he is certainly correct in his surmise. Heis gives it as a naked-eye star 6.7 m., Gould 7.0 m., and it has been several times noted 8 m.; while the writer has recorded it as low as 9 m.

3. β 117; a star with a proper motion, according to Argelander, of 0".438; measures in 1883 show a common motion of the components; their distance is 2".2.

4. ζ Sagittarii; detected by Winlock, probably a retrograde motion of 225° in less than fourteen years; and evidently a change of 48° in less than three years, by Mr. Burnham's measures alone. It is an object for large instruments in the other hemisphere.

5. β Delphini (β 151).—A very rapid binary; since its detection by Mr. Burnham in 1873, there has been an increase in the angle of about 180°, and a diminution in distance from 0".6 to 0".25. He thinks "it may prove to have, with the single exception of δ Equulei, the shortest period known."

Mr. Burnham collects the measures of δ Equulei, and infers a period of revolution of about 10.8 years. Measures should be easy again in 1885.

6. 85 Pegasi (β 733).—The close pair was not measurable in 1882; the angle was about 3.33" at the epoch 1883.75. The mean annual motion is about 12".5, at which rate the period would be less than thirty years.

In the introduction to the Catalogue will be found references to the publications where the thirteen previous ones are to be found.

MEASURING THE AURORA BOREALIS

THE study of the height of the aurora borealis above the earth's surface is, it will be easily conceived, of the greatest importance in understanding the nature of this phenomenon. Unfortunately the height of the aurora has always been, and is to some extent still, a moot point