separated from those of the living ones; not only separated in different rooms or parts of the building, but separated in different departments. The bones of the living animals we generally find with the skins or near them. The bones of the fossil forms we find either in a special department or in the geological department. It is absolutely necessary to exhibit the bones of fossil and living animals together in one section.

The morphologist will not waste his time and that of others in giving new names to every miserable fragment of a skull, or a vertebra, or a limb-bone: he will study the fossil forms exactly as the living ones, with the greatest detail. He will take the utmost care to work the bones out of the rock, not leave them to show people how nicely they were embedded in the matrix. How can a man study the bones of living forms if he does not remove the muscles? By treating the fossil bones exactly as the living ones, it is possible to make a direct comparison with the greatest minuteness; and thus alone can we get satisfactory results. How many important extinct forms exist, of the osteology of which we know but little, simply because they have not been worked out sufficiently! I may mention, that, of the triassic *Aetosauria*, a group of two dozen specimens is preserved in a splendid condition; but about this very remarkable order of reptiles we know very little, simply because it has not been worked sufficiently out of the rock.

I stated above, that a man, if he should study all forms of living animals, would get no clear results without paleontology; but very often we find living forms for which we receive no help even through paleontology, the ancestors of which are not yet found. In this case the third branch of osteology comes in,—embryology, or evolution of the skeleton. Of course, in very rare cases only, we can study the evolution of the skeleton of an extinct form; such a rare case is offered, for instance, by the Permian batrachian *Branchiosaurus*, of which Professor Credner has given the development. The evolution of the skeleton of living forms is of the greatest importance for comparative osteology, and I will demonstrate it by a few examples.

We know little about the ancestors of the *Bovidæ;* but by studying the evolution of their limbs we find that the earliest embryos show four well-developed metapodials, distinct from each other. Gradually the side metapodials become reduced, and the median ones unite. We can safely say that the ancestors of the *Bovidæ* had at a former period four distinct metapodials, which became modified from time to time until the conditions were reached which we see to-day. Another very instructive example is offered by the *Carnivora*, dogs, cats, and so on. In the carpus of the living animals we find that the radial, intermedial, and central are represented by a single bone, but in the embryo we find three distinct cartilages which unite later to form this one bone. This we knew long ago, before we had any idea of these parts in the ancestors of the *Carnivora;* and we could say with confidence that these ancestors must have three distinct bones in the carpus, in the place of one. The limb-bones of some of the *Creodonta*, the ancestors of the *Carnivora*, were discovered subsequently, and showed the three bones.

We know the whole paleontological history of the horse, down to the pentadactyl *Phenacodus* from the lower eocene, but we hardly know any thing about the embryological history of this animal. This, when known, will show the gradual evolution of the peculiar monodactyl foot. Of course, it will not represent the early *Phenacodus* in the earliest embryo (too many generations have gone since the lower eocene, and the embryological history is obscured), but it will doubtless show three well and more equally developed metapodials, and possibly the representative of a fourth one. Here a man could do great service to science by collecting the necessary material in one of the places where the horse has become wild.

But the embryologist has to be sceptical with his conclusions also in osteology. He must never forget that the embryological history is very much abbreviated, and that only the later stages will be indicated in the skeleton of the embryo. But this study is very rewarding, and, in connection with osteology of living and fossil forms, gives splendid views of the origin and evolution of vertebrates. This branch of osteology, I am sorry to say, has not been treated with the interest it deserves. Embryologists generally stop after they have found out about the formation of the germ-layers. Very seldom an animal is studied up to its adult stage. It is true, the late Professor W. K. Parker has published numerous works on the evolution of the skull of different vertebrates, and these we find cited very often as examples of such a kind of study; but these researches suffer very much from the lack of paleontological knowledge, a number of the statements brought forward are unreliable, and the general conclusions are usually too vague. In these numerous papers we miss the true phylogenetic sense, which alone can lead to true results. Had he, with his great diligence, considered more the results of paleontology and taxonomy, he would have done very much more for the phylogeny of vertebrates.

I can only repeat here, what I said eight years ago in my paper on the "Tarsus of Birds and Dinosaurs:" "Palaeontologie und Entwicklungsgeschichte des Skeletsystems müssen Hand in Hand gehen. Wenn wir palaeontologische Reste studiren wollen, so müssen wir die Skeletogenese des Thieres, welches ihm am nächsten verwandt ist, zuvor kennen. Ich halte daher die Genese des Skeletsystems der Wirbelthiere von eben so hoher Bedeutung, wie die ersten Vorgänge am Ei und die Entstehung der Keimblätter."

Osteology of living forms, osteology of fossil forms, evolution of the skeleton, must go hand in hand. No one of these branches is sufficient in itself: it becomes complete only by the assistance of the two others. So osteology of living forms is deficient without paleontology and embryology of the skeleton; so paleontology is deficient without osteology and embryology of the living forms; so embryology is deficient without osteology of living and fossil forms. All three equally and harmoniously united are able to explain and to unriddle that complicated genealogical tree of vertebrates, with its numerous branches and branchlets, and to conceive the origin of man.

REPORT OF THE MARINE BIOLOGICAL LABORATORY AT WOOD'S HOLL.

The trustees have the pleasure of reporting to the corporation another year of prosperity to the laboratory.

During the last summer those working in the laboratory numbered no less than forty-five, and the tuition-fees amounted to $959, as against $845 during 1889, and $363 during 1888.

During the last summer the laboratory offered greater advantages for study and collecting than ever before, and it may be confidently expected that in the future the receipts from tuition-fees will be even larger. The trustees learn with pleasure that the gentlemen in charge of the department of instruction report that the quality of the elementary students and the work done by them is decidedly better than in previous years.

The two Lucretia Crocker scholarships, of fifty dollars each, were held by Miss A. F. Armes and Miss Nellie L Shaw, both teachers in the Boston public schools.

During the summer of 1889 the need of a lecture-room was keenly felt. Every available place in the laboratory being occupied by a work-table, it was impossible for students to gather around the lecturer without completely disarranging the laboratory. Experience had also shown that some more advanced students did not need to attend every lecture given, but could spend the time allotted to certain lectures to greater advantage if allowed to continue their laboratory work. This could not be done conveniently while lectures were in progress. Further, in accordance with the plan adopted by the director, evening lectures of a more advanced character were given from time to time. These were attended by both students and investigators, an aggregate of over forty persons. The interest in and instructiveness of these lectures were much marred by the discomforts of the surroundings. The library had also outgrown the quarters to which it was originally assigned, and during the summer of 1889 the number of rooms for investigators was less than the number of applicants.

In view of remedying these defects, the trustees have added an L to the present building. This addition contains a comfortable and convenient lecture-room, a pleasant library, and six investi-

gators' rooms, which, like those in the main building, are fitted with aquaria and supplied with running sea-water. All workers at the laboratory during last summer fully appreciate the advantages gained by this addition.

The library has been considerably enlarged by gifts from numerous friends. Although we were unable to purchase any books, the current subscriptions to journals have been maintained. The following list gives the donations received as far as catalogued: G. Baur, 12 pamphlets; J. N. Coulter, 2 volumes and 2 pamphlets; Stanley Coulter, 2 pamphlets; W. G. Farlow, 2 volumes and 3 pamphlets; C. P. Barnes, J. W. Fewkes, W. F. Ganong, J. S. Kingsley, each 1 pamphlet; Dice McLaren and W. S. Miller, each 1 volume and 1 pamphlet; T. Wesley Mills, 16 pamphlets; C. S. Minot, 15 volumes and 6 pamphlets; Francis Minot, 20 volumes; H. F. Osborn, 7 volumes and 8 pamphlets; A. S. Packard, 9 volumes and 116 pamphlets; Peabody Academy of Sciences, Salem, 5 volumes; Samuel H. Scudder, 1 volume,—a total of 62 volumes and 171 pamphlets. Other gifts were received from A. Agassiz, California Academy of Science, R. Ellsworth Call, C. and R. S. Eigenmann, E. G. Gardiner, Mrs. Gifford, J. E. Ivers, T. H. Morgan, E. S. Morse, W. A. Satchell; but, as these have not returned from Wood's Holl, they have not been catalogued. The most important gift was from Dr. Francis Minot, and included Agassiz's "Contributions" and a series of the publications of the American Academy. The additions go far towards completing our sets of the *American Naturalist* and of the *Botanical Gazette*.

During the former seasons both students and investigators have felt the need of better collecting facilities than the laboratory could offer. Although well supplied with row-boats, the strong tides which prevail in the neighboring waters rendered it imperative for the laboratory to have the use of a steam-launch. Many of the localities where the richest fauna and flora were to be found were beyond the reach of either sail or row boats.

Last spring the trustees supplied this deficiency in the equipment by the purchase of the "Wyandotte," a most excellent launch, designed by Edward Burgess, and in every way suitable to the work. During last summer the "Wyandotte" fully demonstrated her usefulness, dredging and collecting excursions being made every day when the weather was suitable.

Last August the Gifford homestead, which consists of upward of half an acre of land, closely adjoining the lot on which the laboratory stands, and a substantial old house, was advertised at forced sale. The trustees have long believed that in the near future the land and house would be of great value to the laboratory, but have been deterred from purchasing by lack of funds. Appreciating that the amount for which this property could be purchased (thirty-five hundred dollars) was small considering its real value, J. S. Fay, Esq , advanced the money for the purchase, holding a mortgage on the property for three thousand dollars. This generous act secures the property to the laboratory, and at the same time presents the trustees with the sum of five hundred dollars. Since the laboratory was first opened, Mr. Fay has shown by his liberality great interest in its success, and the trustees have once again to thank him most cordially. Their thanks are also due to Professor McDonald, United States commissioner of fisheries, for many courtesies extended by him and his staff to our officers and students.

We are again, as in past years, under obligations to Miss Fay for the use of Gardiner cottage for a mess-room for those working in the laboratory. This last summer the mess was under the immediate charge of one of the officers of the laboratory, and if not in every way satisfactory, yet was on the whole as good as circumstances would allow.

It is hoped that the experience gained will be of service in whatever arrangement may be made another year. The laboratory now owns a complete mess outfit, including tables, chairs, stove, cooking utensils, and table furniture; and it is believed that the house of the newly acquired property can be adapted to a permanent mess-room at small expense.

The trustees believe that the laboratory is now fully equipped; and, until an effort is made to establish a permanent laboratory, but little outlay on improvements will be necessary.

They would, however, again remind the corporation that the success of the laboratory is largely due to the voluntary efforts of the director and his corps of assistants. They have worked faithfully and without further remuneration than their personal expenses while at Wood's Holl. In many cases the work was very arduous, allowing little or no time for study or investigation. It is to be hoped that at least those who give their whole time to the laboratory will in the future receive some compensation.

As the success of the laboratory has greatly exceeded expectation, and warrants the largest hopes for the future, your trustees consider it imperative that an effort be made at once to place the laboratory upon a permanent footing; and they have accordingly voted to take immediate steps to raise sixty thousand dollars, which, when the indebtedness incurred the past season is removed, will yield an annual income sufficient not only to carry it on as heretofore, but to pay a small stipend to those on whose voluntary assistance in direction and instruction we have been dependent for success. The trustees invite your earnest co-operation in securing this amount. The proved usefulness of the laboratory, the great demand for the privileges it offers, and its present far-reaching influence, demonstrate the need for a permanent establishment, and enable us to make our appeal to the public with pride in our brief past, and confidence in our future.

AID TO ASTRONOMICAL RESEARCH.

PROFESSOR EDWARD C. PICKERING of Harvard College Observatory has issued a circular (No. II.) on the above subject. A circular was issued last summer, announcing the gift by Miss Bruce of six thousand dollars for aiding astronomical research. No restrictions were made upon its expenditure which seemed likely to limit its usefulness, and astronomers of all countries were invited to make application for portions of it, and suggestions as to the best method of using it.

Eighty-four replies have been received, says Professor Pickering, and with the advice of the donor the entire sum has been divided so as to aid the following undertakings: Professor W. W. Payne, director of the Carleton College Observatory, for illustrations of the *Sidereal Messenger;* Professor Simon Newcomb, superintendent of the American "Nautical Almanac," for discussion of contact observations of Venus during its transits in 1874 and 1882; Dr. J. Plassmann, Warendorf, for printing observations of meteors and variable stars; Professor H. Bruns, treasurer of the *Astronomische Gesellschaft*, to the *Astronomische Gesellschaft* for the preparation of tables according to Gyldén's method for computing the elements of the asteroids; Professor J. J. Astrand, director of the Observatory, Bergen, Norway, for tables for solving Kepler's problem; Professor J. C. Adams, director of the Cambridge Observatory, England, for a spectroscope for the 27-inch telescope of the Cambridge Observatory; Professor A. Hirsch, secretary of the International Geodetic Association, to send an expedition to the Sandwich Islands to study the annual variation, if any, in latitude; H. H. Turner, Esq , assistant in Greenwich Observatory, for preparing tables for computing star corrections; Professor Edward S. Holden, director of the Lick Observatory, for reduction of meridian observations of Struve stars; Professor Lewis Swift, director of the Warner Observatory, for photographic apparatus for 15-inch telescope; Professor Norman Pogson, director of Madras Observatory, for publication of old observations of variable stars, planets, and asteroids; Dr. Ludwig Struve, astronomer at Dorpat Observatory, for reduction of observations of occultations during the lunar eclipse of Jan. 28, 1888, collected by the Pulkowa Observatory; Dr. David Gill, director of the Observatory of the Cape of Good Hope, (1) for reduction of heliometer observations of asteroids, (2) for apparatus for engraving star-charts of the "Southern Durchmusterung;" Professor A. Safarik, Prague, for a photometer for measuring variable stars; Professor Henry A. Rowland, Johns Hopkins University, for identification of metals in the solar spectrum.

Of the remaining replies, many describe wants no less urgent than those named above. Some relate to meteorology or physics rather than to astronomy, some to work already completed, and others were received too late to be included. Two important