fearful, and multitudes of fragments were seen to fly off by every one who saw the meteor. In Indiana it was thought that the explosions were heard at Bloomington 150 miles from the nearest point of the path. In New York State the sky was wholly overcast, so that of course nothing was seen. But at many places the people thought there was an earthquake. Was this a solid body? As if to remove this from the class of detonating into that of stone-producing meteors, one single small fragment three-fourths of a pound in weight, was heard to fall and was picked up the next morning on the snow in Indiana. A piece of this is in the Peabody Museum.

In 1860 a meteor went north-west across Georgia and Tennessee and exploded, disappearing nearly over the southern boundary of Kentucky at a height of about twenty-eight miles. There was the same terrific explosion heard, the same scattering of fragments seen. The meteor was seen over all the region from Pittsburgh to New Orleans, and from Savannah to St. Louis. But from this meteor no stone was found, but you cannot doubt for all that that it was a solid body.

So, a few weeks ago a meteor fell in broad daylight in Southern Virginia, the sound of which, over a limited region, seemed like an earthquake. It, too, must have been solid.

In July, 1860, some of you, I presume, saw a meteor cross from the west to the east. It came from over Northern Michigan, and was seen until it had passed at least 200 miles east of us, passing between us and New York City at a height of a little more than forty miles. One pear-shaped ball chased a second and a third across the sky. People listened for the sound to come, and one or two thought that they heard it but would not affirm that it was sound from the meteor. I cannot doubt that that too was solid. It was seen to break in two, and the parts passed on one after the other for hundreds of miles. To be sure no stone was found from it, and perhaps no sound heard, yet that it was solid seems to me almost as sure as if I had a piece of it in my hands.

Again, going one step farther, how can we avoid calling all the meteors solid which are seen to break into pieces, and all those which glance, describing a curved course, or a course having an angle? The number of such cases is large, and often they are very faint shooting-stars. But it is doubtful whether a small gaseous mass could exist permanently as a separate body in the solar system. Its repulsion would keep the parts so far asunder that the sun's unequal attraction would scatter the substance beyond all its own power of recovery. A liquid would probably freeze and become solid. In any case neither a gas nor a liquid could for an instant sustain the resisting pressure which a meteor is subjected to in the air, much less could it travel against it ten, or forty, or a hundred miles. In short, every shooting-star *must be* a solid body.

Second. The large meteors and the small ones are seen at about the same height from the earth's surface. The larger meteors may become visible a little higher than shooting-stars, though that is doubtful; they come down in general a little lower, some of them even come to the ground, but that is due rather to the size of the body. The air is a shield to protect us from an otherwise intolerable bombarding. Some of the larger balls come through that shield, or, at least, are not all melted before their final explosion, when the fragments, their original velocity all gone, fall quietly to the ground. The small ones burn up altogether, or are scattered into dust.

In the *third* place, the velocities of the large and small meteors agree. These velocities are never very exactly measured directly; but we are sure that in general they are more than two and less than forty miles per second. This is true both for small and for large meteors. The average velocities for each class are not widely different.

We sometimes need a name for the small body that will, if it should come into the air, make a shooting-star or larger fireball. We call such a body a meteoroid. Now, velocities of from ten to forty miles a second imply that the meteoroids are bodies that move about the sun as centre, or else move through space. These velocities, as well as other facts, are utterly inconsistent with a permanent motion of the meteoroids about the earth, or with a terrestrial origin, or with a lunar origin.

Fourth. The motions of the large and small meteors, as we see them cross the sky, have no special relations to the ecliptic. If either the one or the other kind had special relations to the planets in their origin or in their motions we should have reason to expect them, if not always, at least in general, to move across the sky *away from* the ecliptic. But the fact is otherwise. We see both small and large meteors move *towards* the ecliptic as often as *from* it. Neither class seem, therefore, to have any relation to the planets.

Again, in general character the two classes are alike. They have like varieties of colour, they have similar luminous trains behind them; in short, we cannot draw any line dividing the stone-producing meteor from the shooting star, at least in their astronomical relations. We cannot say that the Iowa meteor is different from the Georgia meteor of 1860, on the ground that stones were found in one case and not in the other; or that the meteor of December, 1876, was different from that of July, 1860, on the ground that one had a series of terrific explosions and the other was only seen to break into parts; or that the meteor that is seen to break into parts differs from one evidently solid, that burns up without any appearance of explosion. They all are astronomically alike. They differ in bigness; but this has nothing to do with their motion about the sun or in space.

When, therefore, we learn something about the origin and motions of the smaller meteoroids, we can infer like facts about the larger ones. I propose, then, to show that shooting stars were once pieces of comets.

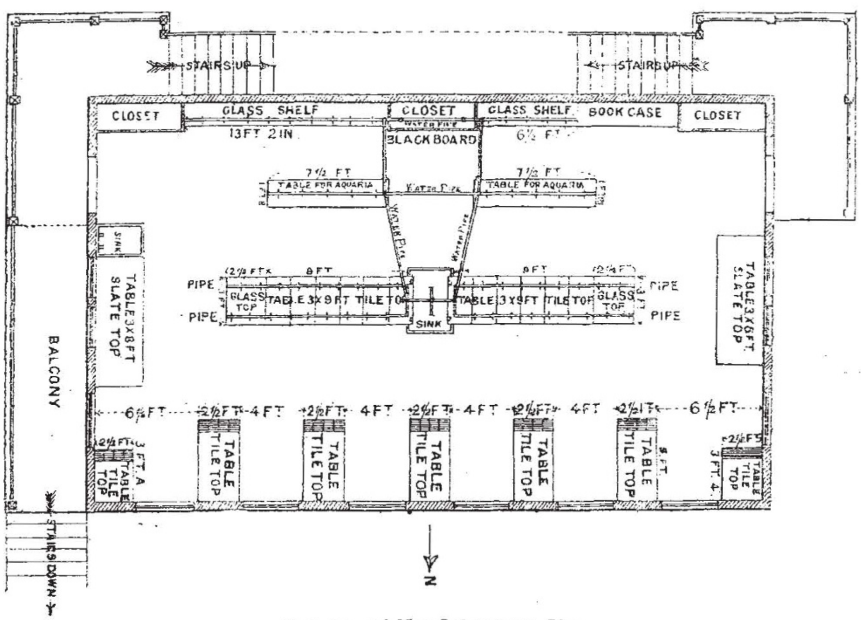
(*To be continued.*)

A ZOOLOGICAL LABORATORY

PROF. ALEXANDER AGASSIZ, in his Report to the President and Fellows of the Harvard College Museum for 1877 and 1878, to September 1, gives an account of his new laboratory at Newport, a plan of which he has been good enough to send us. This is the first report which has been presented since the Museum has come under the care of the President and Fellows of Harvard College, and the description given by Prof. Agassiz sufficiently indicates that the Museum is a model of its kind. During the past eighteen months increased funds have been placed at the disposal of the Museum, and excellent use has been made of them. Not only is the Museum arranged so as to make it of the greatest service to students, but in such a way that the portion thrown open to the public must have an excellent educational effect. Everything has been done to make visitors clearly understand what they see, and evidently this attention is appreciated and is answering its purpose.

The new laboratory, erected by Prof. Agassiz at his own cost, and which is a model of what such a place should be, is described by Prof. Agassiz as follows:—

The new laboratory erected by me at Newport is twenty-five feet by forty-five. The six windows for work are on the north side, and extend from the ceiling to within eighteen inches of the floor. In the spaces between the windows and the corners of the building are eight work-tables, three feet by five, covered with white tiles, one foot of the outer edge being covered, however, with black tiles for greater facility in detecting minute animals on a black background. Between the windows, movable brackets with glass shelves are placed; while similar brackets extend across the windows and between the tables, thus providing a shelf at any desired height. The tables for microscope work are three-legged stands of varying height, adapted to the different kinds of microscopes in use. The whole of the northern side of the floor upon which the work-tables and microscope stands are placed is supported upon brick piers and arches independent of the main brick walls of the building, which form at the same time the basement of the building. The rest of the floor is supported entirely upon the inside walls and upon columns with stretchers extending under the crown of the arches reaching to the northern wall. This gives to the microscopic work the great advantage of complete isolation from all disturbance caused by walking over the floor. This will be duly appreciated by those who have worked in a building with a wooden floor, where every step caused a cessation of work, and was sure to disturb any object just at the most interesting moment. The floor is cemented and covered by a heavy oil-cloth. The centre of the large room is occupied by a sink, on each side of which extend two long tables, three feet by twelve. These are covered with different coloured tiles, imitating mud, sand, gravel, sea-weed, black and white tiles, as well as red, yellow, blue, green, violet, to get all possible variety of background. A space at each end is covered by a glass plate, allowing the light to come from underneath, thus enabling the observer to examine larger specimens from the under-side, without disturbing them when fully expanded. Two shorter and narrower tables, eighteen inches by seven feet, are placed half-way between these central tables and the southern face of the building. These tables are intended for larger aquaria or dishes, and are covered with common marble slabs. There is a blank wall on the south side, the whole of which is occupied by closets and shelves for storing glass jars, reagents, bottles, dishes, and so forth. A space is devoted to books. The open shelves for jars and dishes are of heavy rolled glass, supported upon iron brackets. The basement is used for the storage of alcoholic specimens, dredges, trawls, and other similar appliances. In the attic there is a large tank for salt water and another for fresh: the rest of the attic space will be eventually devoted to photographic rooms and room for an artist. The laboratory is supplied with salt water by a small steam-pump



Prof. Agassiz' New Laboratory: Plan.

driven by a vertical boiler of five-horse power: this is kept going the whole time day and night, the overflow of the tank being carried off by a large pipe. The water is taken some distance from the laboratory, and drawn up at a horizontal distance of sixty feet from the shore in a depth of some four fathoms, the end of the suction pipe standing up vertically from the ground a height of five feet, and terminating in an elbow to prevent its becoming choked. The water is led through iron pipes coated inside with enamel. From the tank the salt water is distributed in pipes extending in a double row over the central tables, over the long narrow tables for aquaria, and along the whole length of the glass shelves on the south wall. Large faucets to draw off salt water are placed at each sink, and by a proper arrangement of valves it is possible to lead fresh water to a part of the pipes, in case it is needed. The pipes leading over the tables and shelves are provided with globe valves and nozzles, to which rubber pipe can be attached and the water led to a vessel below: there are fifty such taps, each of which can supply water or air to at least three or four jars. The overflow runs into gutters laid alongside the tables, leading into the main drain-pipe. To aerate the salt water I use an injector invented by Prof. Richards, of the Institute of Technology. This can be used to supply aerated water directly to the jar by providing it with a siphon overflow, or the aerated water can be kept in a receiver, from which air alone is then led to the jar. This latter course is the only practical one for delicate specimens and for the bulk of the work of raising embryos. The east and west sides have large windows and doors provided with blinds; they always remain open with the blinds closed to keep out sunlight, and serve to ventilate the laboratory thoroughly. Large tables for dissection, covered with slate and adjoining a sink provided with fresh and salt water, are placed across the windows of these sides. Ever since the closing of the school at Penikese it has been my hope to replace, at least in a somewhat different direction, the work which might have been carried on there. It was impossible for me to establish a school on so large a scale, but I hope by giving facilities each year to a few advanced students from the Museum and teachers in our public schools, to prepare, little by little, a small number of teachers who will have had opportunities for pursuing their studies hitherto unattainable. The material to be obtained at Newport is abundant. The dredging is fair and not difficult, as the depth in the immediate neighbourhood does not exceed twenty to thirty fathoms. The pelagic fauna, however, is the most abundant. During the course of each summer, by the use of the dip-net, representatives of all the more interesting marine forms are sure to be found. With my small steam launch a large space can always be traversed any evening and advantage taken of the condition of the wind and tide, the launch being amply large for easy dredging in the moderate depths of the entrance of Narragansett Bay. The laboratory is placed on a point at the entrance of Newport Harbour, past which sweeps the body of water brought by each tide into Narragansett Bay and carrying with it everything which the prevailing southwesterly winds drive before it. Newport Island and the neighbouring shores form the only rocky district in the long stretch of sandy beaches extending southward from Cape Cod—an oasis, as it were, for the abundant development of marine life along its shores.

BIOLOGICAL NOTES

CASPIAN SEA ALGÆ.—Herr A. Grunow has quite recently published a detailed catalogue of a collection of algæ, made by himself at Baku and Krasnowodsk, on the Caspian, and also of some collections made by his friend Czermak in Baku Bay and by Thieme in Krasnowodsk Gulf, in addition some specimens preserved in spirits were given him by Dr. Schneider. Excluding the diatoms only eleven species are alluded to, and but two (Cladophora) appear as new. Of the diatoms there is a goodly list. Many of the species of these diatoms appear to occur everywhere. Go where one will, they are to be found, and what a marvellous geographical distribution!—Baku on the Caspian, St. Paul's Island in the Southern Ocean, and then the Frith of Clyde, or the mouth of the Thames. Two beautiful plates representing the new species of diatoms accompany the paper. Many of the species are marine forms.

NATURAL HISTORY OF THE CAUCASUS.—A very important contribution to the natural history of this region has been made by Dr. Oscar Schneider based on collections made by himself during a summer spent there in 1875. The series of memoirs before us, edited by Dr. O. Schneider, has been reprinted from the *Journal* of the "Isis" Society of Dresden, and consists of an account of the mollusca, by the editor; the arachnoids, by Dr. L. Koch, many new species are figured; the hemiptera, by Dr. G. v. Horvath; the algæ, by Dr. A. Grunow, a memoir we have already noticed; the minerals, by Dr. A. Frenzel; the rocks, by Dr. Moehl; the fossils, by Dr. Geinitz. These reprints form a small volume of 160 pages with five plates.

ON SPROUTING IN ISOETES.—K. Goebel records in some detail and with illustrative figures the fact that he has found buds developed from the base of the leaves below the lingule in *Isoetes lacustris*. The specimens were collected in Longemer Lake in the Vosges, and the discovery was made during an investigation into the embryology of both *I. lacustris* and *I. echinospora*. The examples in question showed neither macro- nor microsporangia, but in their place were found on the leaves little Isoetes plants. The first appearance of the buds was under the lingule in the furrow of the still young leaves. A pretty compact swelling made its appearance on the under half of the glossopodium. This swelling was the commencement of a conical protrusion of the cellular tissue, in which a side cell did not take any leading part; later on this swelling appeared to be more rounded off; the stages between this and that in which one to two leaves were found, was not specially observed. A section through the young bud shows that the median plane of the young leaves is precisely that of the mother leaves, and they lie so tightly packed together that the lingule of the first new leaf is parallel with the surface of the mother leaf. The root formation of these buds appears to be quite normal. Some of the leaves only gave rise to these buds. The author thinks this is an instance of De Bary's apogamy. Interesting and novel as these observations of Goebel are, they yet leave a good deal to be desired (*Bot. Zeitung*, i., 1879).

THE BRITTLE STARS OF THE *Challenger*.—In order that persons who are interested in echinoderms may get early information, and to secure a just priority of discovery to the *Challenger* expedition, Mr. Th. Lyman has just published, as No. 7, vol. v. of the *Bulletin* of the Museum of Comparative Zoology at Harvard College, Cambridge, Mass., a Part I. of a catalogue of the new species found, which contains brief diagnoses, with figures, of the more essential parts of no less than thirteen new genera, and ninety-six new species of Ophiuroids. Part II. will contain some remaining species of the family Ophiuridæ, and those of Astrophytidæ. All matter beyond the mere necessary description is reserved for the volume to be devoted to this group, and which is to be brought out by the British government under the general superintendence of Prof. Sir Wyville Thomson.

SPINES OF ECHINI.—The last published part of the *Transactions* of the Royal Irish Academy (vol. xxvi., Science, part 17) contains a memoir by H. W. Mackintosh on the structure of the spines in the sub-order of the Desmosticha (Hæckel). In indicating four series into which, judging from the structure of the spines, this suborder may be divided, the author expresses his opinion that the characters derived from the spines are just as useful as any other characters drawn from the comparison of individual parts. He finds it just as easy and as certain to recognise a Diadema, an Echinus, or an Arbacia by the structure of its spines as by the arrangement of its pores, or the disposition of its anal or genital plates. The memoir is accompanied by three plates containing twenty-seven figures, all drawn by the author with the assistance of a Wollaston's camera lucida. The figures represent transverse sections of primary inter-ambulacral spines of some twenty-six species, and have been drawn on stone by Tuffen West with great care and accuracy.

THE FOOD OF FISHES.—Mr. S. A. Forbes publishes a very interesting paper on the food of fishes in the *Bulletin*, No. 2, of the Illinois State Laboratory. The importance of the subject to the scientific student and to the practical fish-breeder cannot be doubted. Some valuable fishes are found dependent on food too liable to injury or destruction by man or nature to make it worth while to cultivate them, while others, equally valuable, may subsist on food absolutely indestructible. The contents of the stomachs of some fifty-four species of Illinois fish were carefully examined, and the details of the food found are in each case given. In some instances the enormous quantity of food devoured, especially in insect-feeders, is noteworthy, and much of the food consisted of land-insects which had fallen into the water, thus bringing fish and land birds into competition for food. Some of the species were herbivorous, others carnivorous, and several, such as the cat-fishes, were quite omnivorous; the dog-fish (*Amia calva*) was herbivorous, but only one small specimen was examined. The shovel-fish (*Polyodon folium*), supposed by the fishermen to live on the slime and mud of the river-bottom, was found to feed to an enormous extent on Entomostraca, and fully one-fourth of the entire food was made up of vegetable matter, algæ being largely eaten, and there was very little mud found mixed with the food. The interlacing of the gill-rakers of this species, which are very numerous and fine, and arranged in a double row on each gill arch, doubtless form a strainer which allows the passage of the fine silt of the river out with the water, but arrests everything as large as a cyclops.