out a response from one of the 'electrical schools' of England, which shows the result of the trial of such a method of aiding inventors, although a free use of the laboratories could not be offered. In this reply it is stated that the school has for several years openly offered the facilities of its laboratories to any inventor who may come forward, and wish such facilities to aid him in perfecting his work; and that as yet they have received two applications, both of which were withdrawn on account of the remuneration which the school felt called upon to ask. One of the applicants was a cable company, and considered five shillings a day too much for the use of the very extensive apparatus required; and the other looked upon five pounds as excessive for the use of power and a dynamo, with skilled superintendence and advice.

As the most feasible solution, for the present, of the question, how to advance the uses of electricity, many of our large telegraph, telephone, and electric-light companies have established testing-laboratories for the use of their employees, and give regular employment to professional inventors whose researches are directed by the officers of the company; but little is done in these laboratories to promote research by persons not connected with the companies themselves. Our universities and technological schools, in many cases, possess well-equipped physical laboratories, containing electrical testing-apparatus for the use of the students. These laboratories exist for the purpose of promoting research, and might, under suitable restrictions, be thrown open to inventors as well as to students.

However the difficulty is to be met, it is undoubtedly the case, that research looking to the utilization of electricity as a motive power and as a source of light is fettered and hindered by the expense of the apparatus required. If a special laboratory, to be under the direction of suitable persons, could be established in this country for the promotion of electrical research, especially for research in those branches that necessitate the employment of expensive apparatus, invention in these branches would be stimulated, and the whole community would be the gainer. In France the profits of the late International electrical exhibition have been devoted to the establishment of an electrical laboratory. Perhaps the managers of the forthcoming electrical exhibition in Philadelphia may take the hint.

AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION. — TRAWLS AND TANGLES.

Beam-trawls.

THE beam-trawls designed for zoölogical collecting have usually been patterned closely after those employed by the English fishermen, and in this form are well adapted for moderate depths of water. In fact, the only objection to their use in great depths is their liability to capsize while being lowered, often causing them to land upon the bottom wrong side up. They were first employed on this coast by the fish-commission in 1871; and the earliest records of their use by the English, in deep water at least, are given in the Challenger narrative (beginning in 1873), no reference being made to the subject of beam-trawls in the account of the voyages of the Lightning and Porcupine. In all the exploring-work of the fish-commission, the beam-trawls have been used quite as frequently as the dredges; the trawling-results being far richer as to the larger forms of life, and including immense numbers of fishes which could never be obtained by the dredge, and would otherwise have remained undiscovered.

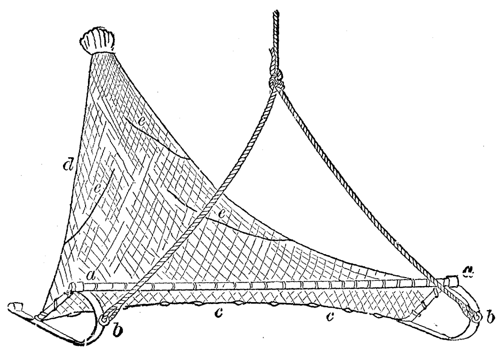

FIG. 1. — THE BEAM-TRAWL.

As is known to most naturalists, the beam-trawl (fig. 1) consists of a large, tapering, bag-like net, which is dragged over the bottom, mouth forwards, to entrap such fish as live close to the ground. The mouth is held open by a long beam, generally of wood, supported upon iron runners; and there are one or more inner, funnel-shaped traps, to prevent the escape of fish after they have entered. The nets are sometimes very large, and the beams often measure forty-five or fifty feet in length. The lower side of the mouth of the net, which is leaded, hangs loose, so as to drag over the ground in a deep backward curve. It does not dig into the bottom, but simply scoops into its capacious mouth every loose object lying in its course. Large quantities of soft sand and mud are, however, often taken up.

In adapting the fishermen's trawl for zoölogical work, a few modifications have been made, mainly as regards size and the materials used in its construction. For small trawls a beam of iron gas-pipe is now preferred by the fish-commission to wood, as being more durable, less bulky, and less liable to injury from pressure in deep water; the defect of wooden beams, in the latter respect, having seriously inconvenienced the deep-sea trawling operations of the Challenger.

The different sizes of trawls employed vary, in the length of beam, from seven and a half to eighteen feet, a wooden beam being used for the latter size only. With an eleven-foot beam, the runners measure twenty-eight inches in height and four feet in length, the beam having a diameter of two inches and a quarter, and screwing into brass strap bands on the tops of the runners. The openings through the runners are closed by netting. In the smaller trawls the net is about eighteen feet long, with a single pocket, and, in the larger, measure from twenty-five to forty feet in length, with either one or two pockets.

For the greater depths of water, the eleven and fifteen feet beams are preferred. The largest size is seldom used, except in moderate depths; and in shallow water, the Otter trawl, another English pattern, is not unfrequently employed.

The common beam-trawl has been used successfully by the fish-commission in all depths down to 2,949 fathoms, the latter indicating the deepest trawling-station on record for the Atlantic Ocean. The Challenger trawled to a depth of 2,650 fathoms in nearly the same locality, but in the Pacific Ocean made several successful casts in more than 3,000 fathoms, the trawl they had having been of about the same size and pattern as the American.

The method of attaching the bridle in the Challenger trawl was similar to that afterwards adopted for the Blake trawl, the bridle ropes being made very long, and extending along the sides of the net to its extremity, with lashings to the runners on each side, and to the hinder end of the bag. The object of this arrangement of the bridle was not stated by Sir Wyville Thomson; but it was presumably to allow the forward fastenings to break, in case of fouling, and permit of the net being hauled up hind-end first.

The Blake trawl.

The objection above raised to the use of the ordinary beam-trawl in deep water suggested to the officers of the Blake dredging-party, in the winter of 1877–78, the construction of a reversible trawl, having in this respect all the advantages of the naturalists' dredge. This pattern, termed the 'Blake trawl,' or 'double beam-trawl,' bears the same relation to the fishermen's beam-trawl as does the naturalists' dredge to the oyster-dredge; the changes in both cases being demanded by the necessity of working with greater precision in deep water, where the loss of time occasioned by the use of ill-suited appliances cannot well be afforded.

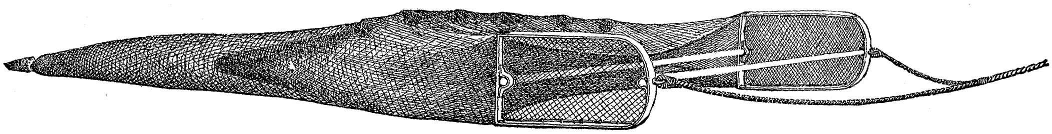

Fig. 2.—The Blake trawl or double beam-trawl. In use (or in position for dragging on the bottom).

The Blake trawl (fig. 2) was the joint invention of Mr. Alexander Agassiz, Commander Sigsbee, U.S.N., and Lieut. Ackly, U.S.N., and was used with great success on the several dredging-cruises of the steamer Blake from 1878 to 1880, undergoing, during this time, a few slight improvements to perfect its working. In 1880 it was adopted by the fish-commission for deep-water work, in connection with the old pattern; and in 1883 it was also copied by the French exploring-steamer Talisman. The following description is made up from one of the trawls belonging to the latter party, and differing but slightly from that of the Blake.

The runner-frames, made of bar-iron half an inch thick by three inches wide, form a very broad D-shaped figure, being equally curved above and below in front, and extending thence straight back to the upright hinder end, beyond which the runners project slightly, the overlapping portions being perforated for the attachment of the net. These frames measure three feet and a half in height by four feet in length, and are rigidly connected by two beams of iron gas-pipe, ten feet and three-quarters long and two inches and a quarter in diameter, which screw into brass collars riveted to the inner sides of the runners, — one in front, and one behind. The net, like the frame, is perfectly symmetrical in shape, and consists of a cylindrical or slightly conical bag of stout twine webbing, open at the lower end. Its length may vary from eighteen to twenty-five feet; and, to give it increased strength, a double thickness of webbing is generally employed. The folds formed in tying the lower end of the net for use serve to retain a certain quantity of the fine bottom-material.

The method of attaching the net to the runner-frame is simple. A two-and-a-quarter-inch rope runs around the entire mouth, and is laced to the hinder ends of the runners, and secured to the four hinder corners of the same. In common with the mouth of the net, this rope is left sufficiently slack between the runners on both sides; so that, whichever side is uppermost, the slack of that side curves down to the level of the beams, and does not obstruct the lower half of the opening: the lower slack line naturally curves backward upon the ground. These slack portions of the line are weighted to serve as lead lines.

There is an inner pocket, or trap, to the net, and a series of four glass or cork floats to assist in keeping it expanded. The runner-openings, and the space between the beams, are also closed in with netting. The bridle for the attachment of the drag-rope may be fastened to the fronts of the runners, or carried back to the hinder end of the net, as before explained. Other methods of arranging the net have been tried, but that above described has proved most satisfactory.

Trawl-wings.

It has long been observed, that enormous quantities of small and delicate free-swimming animals, especially Crustacea of the lower orders, come up completely crushed in the mass of material which frequently fills the trawl; and it was also evident that still larger quantities must escape through the coarse meshes of the net. To collect and preserve these forms, Capt. H. C. Chester arranged in 1880 for the use of the fish-commission, in connection with the beam-trawls, a large towing-net, having a rectangular mouth-frame of iron three feet long by eight inches wide, and a moderately fine mesh bag of netting about three feet in length. Into the lower end of this bag is fitted one of the ordinary silk or linen towing-nets for the purpose of retaining the very smallest objects. Two of these towing-nets are fastened to each trawl of either pattern nearly every time they are used; being attached, one at each end of the beam (as shown in fig. 3), by means of a piece of small

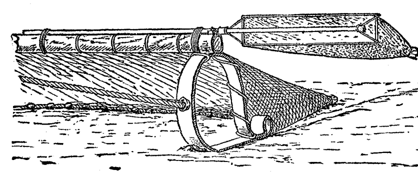

FIG. 3. — THE TRAWL-WINGS ATTACHED TO THE BEAM-TRAWL, IN USE.

gas-pipe lashed by one end to the beam, or extending a short distance into it, if the latter is also of iron. The trawl-wings, as these nets have been christened, give such excellent results, that their appearance at the surface, after a haul, is as anxiously watched for as is that of the trawl proper.

Tangles.

While the use of hempen tangle-swabs attached to the dredge was introduced by the English exploring-steamer Porcupine in 1868 or 1869, the idea that they were worthy of being used separately appears to have originated with Professor Verrill of the fish-commission in 1871; since which time other explorers, both European and American, have employed them to a slight extent in the same way. It has been the experience of this commission, that the combination of tangles with the dredge or trawl is, to say the least, cumbersome; and, following in the wake of either, they generally pick up only the more or less mutilated specimens which have been injured by the iron scrapers or the lead line. By attaching them at the sides, however, as is sometimes done, the latter objection is removed.

The true province of the tangles is a very rocky bottom, where neither the dredge nor trawl can be safely used; and here they perform a real service, notwithstanding the impossibility of extricating the delicate specimens

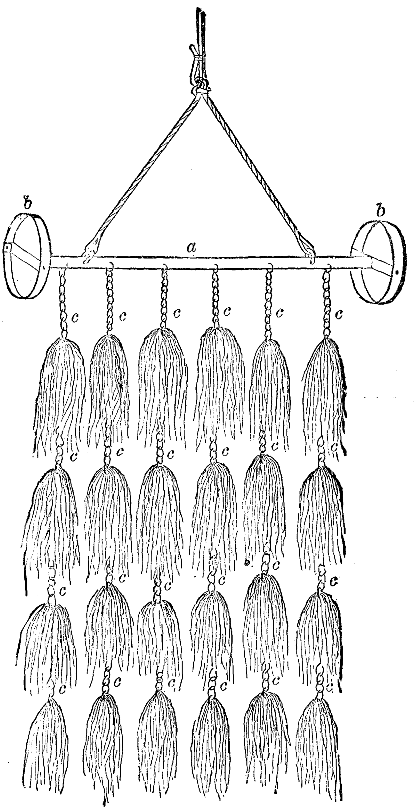

FIG. 4.—THE TANGLES (VERRILL'S PATTERN).

from the hempen swabs without injury. They may also be employed on moderately rough bottoms to supplement the work of the dredge; but, used separately, both have, by actual experience, been proved to obtain far better results. On smooth bottoms, it does not seem rational to suppose that the tangles can in any way add to the results afforded by the beam-trawls, properly managed; and several trials, made on rich ground of this character, have shown such to be the case.

A short distance beyond the coast-line, we generally come upon such uniformly smooth bottom, that the beam-trawl can be trusted nearly everywhere. Working in such a region as this, enormous hauls would be obtained day after day; the trawl delivering its specimens in exceptionally good condition, and affording the full variety of life which existed there. During the earlier part of the explorations, alcohol was used at the rate of two to three barrels a day, and certainly better results could not be asked for. At intervals the tangles would be lowered, but they never furnished any thing new; and the pitiable condition of the specimens they brought up, when compared with those from the trawl, caused their use to be discontinued. And what more could be expected of them, when attached to the runners or net of the trawl?

The tangles devised by Professor Verrill, in 1871, were secured to a triangular iron frame, similar to that of the rake-dredge. In 1873, however, they were altered and improved as represented in fig. 4.

They consist of an iron bar, rigidly attached to two rings or wheels, as a framework, from which extend several small iron chains, each carrying from three to five hempen swabs of medium size. The wheels are not intended to revolve, but merely to keep the bar above the ground, so as to prevent its coming in contact with the specimens; and whatever injury befalls

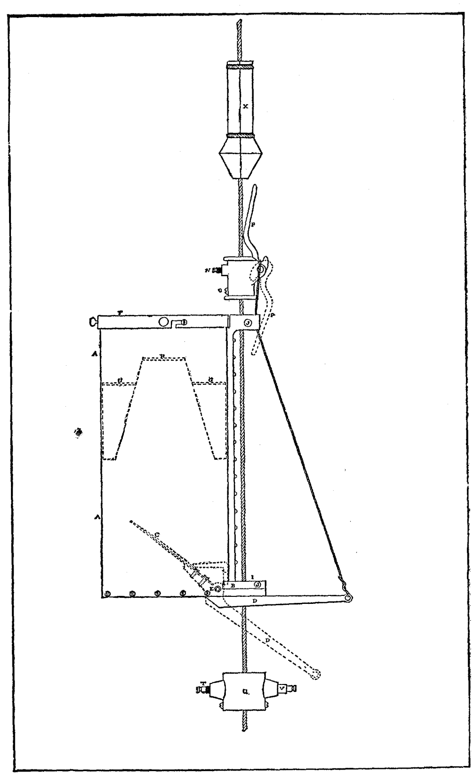

FIG. 5.—SIGSBEE'S GRAVITATING TRAP.

the latter must result from their entanglement among the hempen fibres.

Towing-nets.

As to the towing-nets for collecting at the surface, and at depths intermediate between the surface and the bottom, we have but a single noteworthy improvement to mention, — the gravitating-trap of Commander Sigsbee, which was successfully worked on the last dredging-cruise of the steamer Blake. It is designed to traverse rapidly any given vertical space at any required depth, for the purpose of determining the character and abundance of life at different levels. It does not, however, afford the means of obtaining continuous horizontal towings at intermediate depths, unmixed with the life of higher levels; such a result being still a subject for future investigation.

The gravitating-trap (fig. 5) consists of a brass cylinder, two feet long by forty inches in diameter, riveted to a wrought-iron frame, covered with gauze at the upper end, and having a flap-valve opening inward at the lower. It is suspended to the wire dredge-rope on which it travels, by means of a friction-clamp; while at the point below, to which it is to descend, there is a friction-buffer. The weight of the cylinder and its frame, from the manner in which they are suspended, keeps the valve closed until the apparatus has been lowered to the highest level from which it is desired to take the specimen. Every thing being in readiness, a small weight or messenger is sent down the rope, which, on striking the friction-clamp, disengages it, allowing the cylinder-clamp and messenger to descend by their own weight to the buffer. As the cylinder strikes the buffer, the valve closes, and is held in this position, during the hauling-back, by the weight above it. This implement may be worked at any depth, and the distance traversed by the cylinder may be regulated at will. The many details of construction have been purposely omitted.

For the ordinary towing-nets for surface-collecting, and for use in connection with the trawl-wings, silk bolting-cloth, which can be obtained of any size of mesh, has been substituted for the various other kinds of cloth formerly employed. Bolting-cloth, though moderately expensive, is very strong and durable, and the nets constructed of it have given great satisfaction. The towing-net frames are made of heavy brass wire, and are generally circular in shape, though an elongated rectangular frame is sometimes employed.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE PHILADELPHIA MEETING.

WE have made arrangements for publishing reports and abstracts of so many of the papers presented at Philadelphia, that our readers can soon judge for themselves of the scientific importance of the meeting; and we shall therefore restrict our editorial comments, this week, to some general impressions which were formed during the progress of the session.

The intense heat of the first five days was a serious drawback from the pleasure of attendance, but it was the only drawback. It doubtless deterred from the journey a few who would otherwise have been present; but the arrangements of the Philadelphians were so complete, that those who were in the city encountered the minimum of discomfort, and enjoyed the utmost benefits which a great convention can afford. It was particularly fortunate that Saturday was kept free from all sessions, for many persons were thus enabled to devote two days to refreshment by the seashore or in the mountains in the company of their associates and friends. Every thing which could be done by an enlightened and wealthy community, devoted to hospitality, was done to show an interest in, and respect for, the workers in science, American and foreign. Nothing was forgotten or neglected. The permanent officers of the association did their part with the most satisfactory efficiency. Museums, libraries, and collections were freely opened; and the electrical exhibition, though not complete, was far enough advanced to be an attractive and instructive show. The convention of the mining engineers, and the convention of Agassiz clubs, augmented the number of attendants upon the meetings.

The public interest in the sessions, as usual, reached its height at the delivery of the presidential address. On this occasion, Professor Young, as our readers have already discovered, presented a masterly review of the present condition of astronomical science and of the problems which next invite attack. With many bright flashes, his discourse was as orderly as the solar system; and he balanced this view and that with the skill of a trained physicist. It is rare on such anniversaries for