occupied in common by the two surveys, as given by Hayden and Wheeler, the determinations of the former preceding: —

Stations.	Latitude.	Longitude.
Putnam, Idaho	42° 57′ 10″.6	112° 10′ 9″.4
	42 58 8 .0	112 10 10 .0
Preuss (Meade), Idaho	42 29 42 .6	111 15 11 .0
	42 29 41 .0	111 15 11 .0
Soda (Sherman), Idaho	42 27 53 .7	111 33 11 .4
	42 27 52 .0	111 33 11 .0
Caribou (Pisgah), Idaho	43 5 36 .2	111 18 56 .7
	43 5 34 .0	111 18 58 .0
Willard (North Ogden), Utah	41 21 44 .9	111 57 53 .1
	41 21 45 .0	111 57 53 .0

The following are the differences between the two sets of results: —

Stations.	Differences.	
	Latitude.	Longitude.
Putnam	2″.6	0″.6
Preuss	1 .6	0 .0
Soda	1 .7	0 .4
Caribou	2 .2	1 .3
Willard	0 .1	0 .1

The average differences are respectively 1″.6 and 0″.5.

It is to be regretted that the distances between these points, as determined by the Wheeler survey, are not available, in order that a more direct comparison might be made.

It should be understood that the object of each of these systems of triangulation was simply and solely to furnish adequate control for topographic work, to be published on a scale of four miles to an inch, or about $\frac{1}{250000}$. A greater degree of accuracy than was required for this purpose was not contemplated. In all cases natural points were used as signals until the stations were occupied, when rude cairns of stone, six to eight feet in height, were erected, and used thereafter as signals. The Hayden work was carried on with an eight-inch theodolite, reading to 10″; and the work was adjusted by a graphic method, with foresights only. The area triangulated by this survey aggregated nearly a hundred and twenty thousand square miles; which work, besides the measurement and expansion of four base-lines, was done by one party in six field-seasons, each of four months' duration. As a rule, all the work upon a station was completed in a few hours. The general character of the Wheeler work was very similar to that of the Hayden survey, except that the adjustments were made by least squares.

Henry Gannett.

THE DEEP-SEA DREDGING APPARATUS OF THE TALISMAN.[1]

The first French deep-sea exploring expedition was made in 1880 by the Travailleur, in the Bay of Biscay. The following year the Travailleur was again put at the disposal of the commission over which Mr. Milne-Edwards presided; and the party traversed the Bay of Biscay, visited the coast of Portugal, passed the Strait of Gibraltar, and explored a large part of the Mediterranean. In 1882 the same vessel undertook a third expedition into the Atlantic Ocean, and proceeded as far as the Canary Islands. But the Travailleur, being a despatch-boat for harbor use, did not possess the requirements for making long voyages; and accordingly the Talisman, a cruiser, was equipped for a new dredging expedition, and left the port of Rochefort on the 1st of June, 1883, with Mr. Milne-Edwards and the commission appointed by the minister of public instruction on board. The Talisman explored the coasts of Portugal and Morocco, visited the Canaries and Cape Verde, traversed the Sargasso Sea, and, after remaining some time at the Azores, returned and explored the Bay of Biscay (fig. 1).

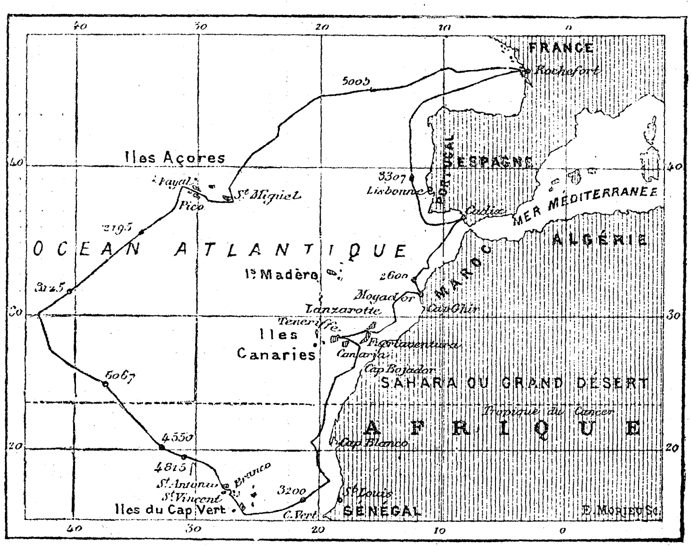

Fig. 1. — Course of the Talisman.

On the bridge of the Talisman there had been

[1] Condensed from an account in *La Nature*. By H. Filhol.

arranged a sounding-machine, worked by engines, and the electric-light apparatus. From the foremast

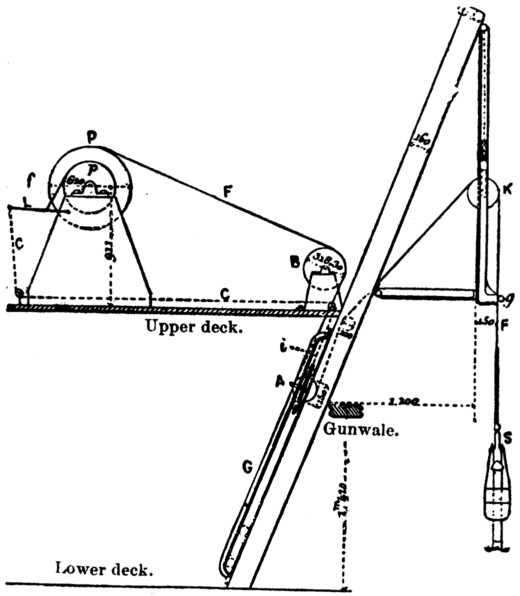

Fig. 2.— Plan of the sounding-apparatus.

a beam or crane projects beyond the vessel to carry the dredges or trawls. The sounding-apparatus used was devised by Mr. Thibaudier, and automatically registers the number of metres of cable run out, and stops when the sounding-cup reaches the bottom. Fig. 3 represents a part of this apparatus, and fig. 2 the plan of another part, in order the better to show its action. It is composed of a reel (*P*, fig. 2) on which were rolled ten thousand metres of steel wire one millimetre in diameter. From the reel the wire passes round a wheel, *B*, exactly one metre in circumference: from there it runs down to a wooden slide, *A*, moving along the sheers, mounts to a fixed block, *K*, and reaches the sounding-cup *S* after having crossed a guide, *g*. The wheel *B* carries at its axis an endless screw, which sets in motion two toothed wheels, showing the number of turns made. One registers the units, the other the hundreds (fig. 4). The latter is graduated to measure ten thousand metres. Each turn of the wheel *B* corresponds to one metre, the number indicated by the register representing the depth. On the axis of the reel there is a brake. Another brake, *f* (fig. 2), is worked by a lever, *L*, at the extremity of which there is a cord, *C*, which is fastened to the slide *A*. When the vessel rolls, and the tension of the steel wire supporting the sounding-cup increases or diminishes, the slide is slightly lowered or raised along the sheers: in this movement it acts more or less on the brake, and consequently regulates the rapidity of unrolling. When the sounding-cup touches the bottom, the running-out of the wire, suddenly relieved of its weights (which sometimes amount to seventy kilograms), instantly stops.

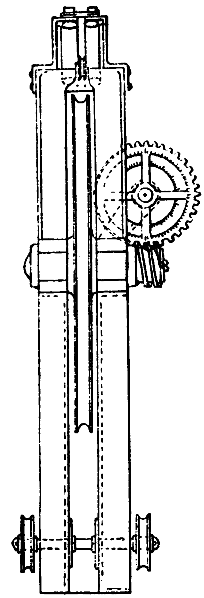

Fig. 4.—Register of sounding-line paid out.

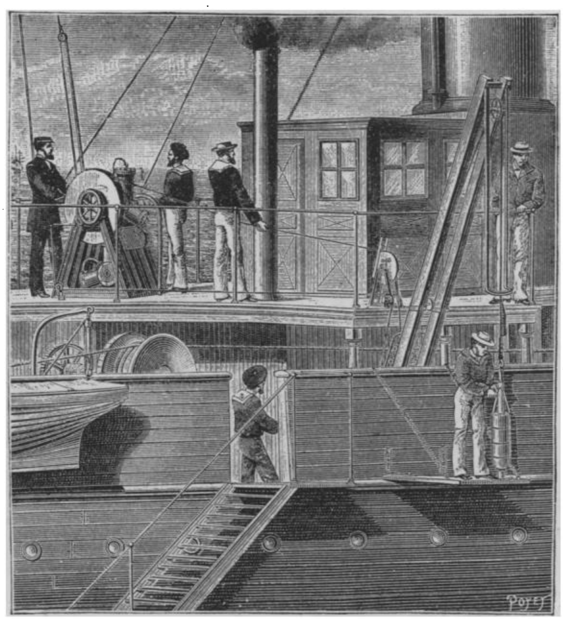

Fig. 3.— General view of the sounding apparatus.

The action of this apparatus is easily understood. The sounding-cup and its weights are arranged within the ship. Some one is stationed at the lever *L* (fig. 2). The register is put at zero. Every thing being thus arranged, the brake is freed, and the unrolling continues until the bottom is reached. While sounding, the vessel is kept motionless by means of its engine, that the wire may remain as vertical as possible. When the bottom is reached, one has only to read the indication on the register to know the depth. Connected with the axis of the drum is a little engine to raise the sounding-cup when relieved of its weights.

The sounding-cup (fig. 5) consists of a long and stout iron tube having two chambers, placed one on the other, and perfectly independent of each other. In the upper compartment there is a metallic rod, at the upper end of which is a ring, and to this is attached the sounding-line. When this is pulled, the rod moves up slightly, a stop controlling its course at a certain point. On the opposite sides of this rod are hooks. To accelerate the descent of the sounder, it is loaded with large cast-iron disks. On the outer surface of these disks are two longitudinal grooves through which pass wires from a ring under the lowest disk, ending in two rings resting on hooks just below the upper end of the sounding-rod. When the lead reaches the bottom, and the pull on the sounding-wire ceases, the rod to which the wire is attached falls in the upper compartment of the sounding-tube, releasing the rings from the hooks, and allowing the iron disks to slide off. Relieved of the extra weight, the lead is easily raised. The lower end of the tube is supplied with valves, which are closed by the falling of the iron disks, and enclose any loose matter on the bottom, the action being assisted by a coating of tallow.

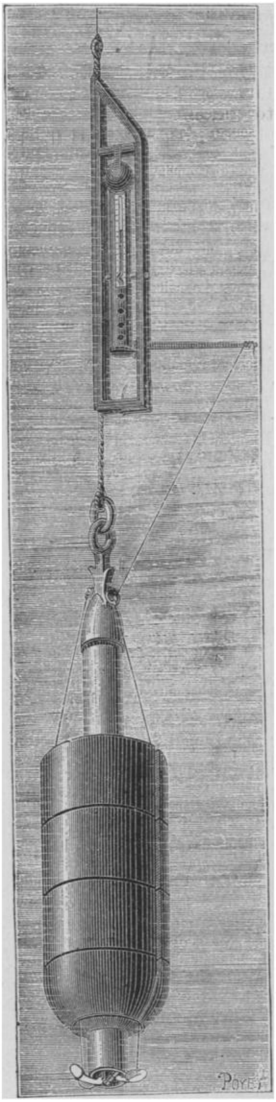

FIG. 5. — Sounding-cup and thermometer.

The thermometers used to determine the temperature of the water at great depths often have to sustain a pressure greater than three hundred atmospheres; that is, more than thirty tons to a square decimetre. Two are used, incased in very thick glass walls. When the lead reaches the bottom, and the extra weights become detached, the catch holding the thermometer-case is released by the breaking of the cord attached to the long lever shown in the upper part of fig. 5, and the thermometers are inverted. The mercury-column is then broken at a point above the bulb where the tube is narrow, and the mercury in the tube falls to the lower end, which is graduated.

On the Travailleur a hemp rope was used for the dredges, of which we give a cut showing its actual size (fig. 8, no. 1), which was not only cumbersome, but had little strength, breaking under a load heavier than two thousand kilograms. On the Talisman a wire rope (fig. 8, no. 2) was employed, composed of six strands of seven steel wires each, twisted around a hempen core. Notwithstanding that it was formed of forty-two wires, its diameter was only one centimetre. Upon trial it bore a weight of forty-five hundred kilograms without breaking.

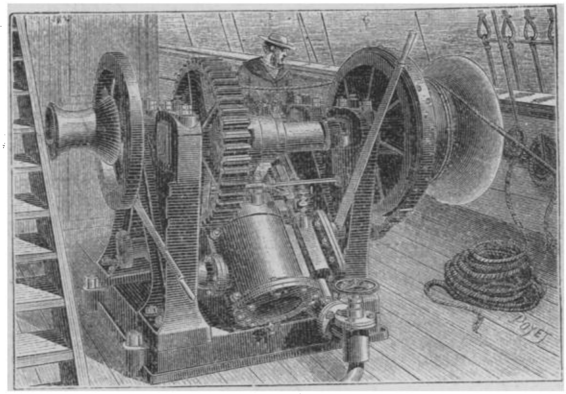

FIG. 6. — Windlass for raising the dredges and trawls.

The collecting-apparatus used on board the Talisman consisted of dredges and trawls. The dredges have an iron frame of rectangular shape, to which is fitted a sack formed of closely-woven cords. The sides of the frame, before reaching the bottom, stand up at right angles, and are provided with scrapers cut and inserted at such an angle that they not only detach clinging objects, but gather the very smallest specimens on the bottom. In speaking of the dredge of Dr. Ball, which for more than ten years (1838–48)

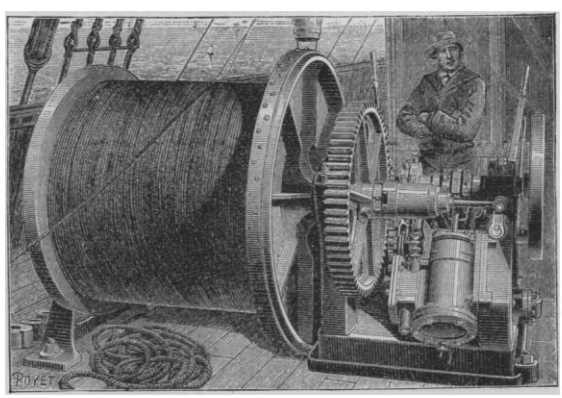

FIG. 7. — Reel for wire rope.

has been in the employ of the English, Wyville Thomson said, that he one day saw the inventor scattering on the floor pieces of money, and raising them again with the greatest ease by means of the

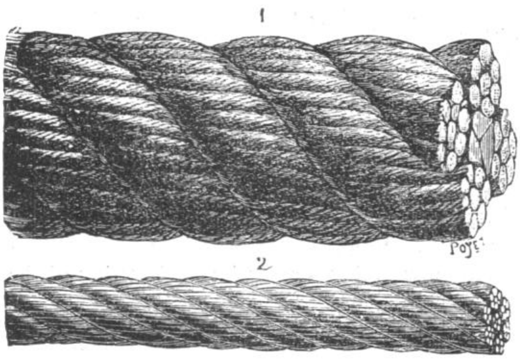

FIG. 8.—Old (1) and new (2) dredging-lines, natural size.

instrument he had contrived. This shows the important use of the teeth with which the sides of the frame are furnished.

To protect the net, which would be torn to shreds by the rocks as it is drawn along, it is enclosed either in another net of iron links, or in a sail-cloth or leather bag. Its lower end acts as a kind of clog, being so arranged that objects, once having entered, cannot escape. The front part of the dredge is sometimes furnished with a rake, to turn the mud or sand of the bottom, and thus to liberate the animals found there. During the explorations of the Travailleur, dredges were sometimes used which, by a special mechanism, descend, closed, to the bottom, and open only when they reach it. But, whatever the plan of the dredge, the results are not valuable; for these machines are almost immediately filled with sand or mud, which, on account of the sail-cloth or leather bag, cannot be released. Generally, when a dredge is raised, a sackful of sediment is all that is brought on board. They are, besides, very inconvenient.

During one of the cruises of the Porcupine, Wyville Thomson noticed, that, while the interior of the dredge enclosed very few interesting specimens, a number of echinoderms, corals, and sponges, caught on the outside of the sack, and sometimes even on the upper part of the chain of the dredge, came to the surface. "This suggested," said he, "many expedients; and finally Capt. Calver sent down half a dozen of the 'swabs' used for washing the decks, attached to the dredge. The result was marvellous. The tangled hemp brought up every thing rough and movable which came in its way, and swept the bottom as it might have swept the deck. Capt. Calver's invention initated a new era in deep-sea dredging." It is certain that the use of tangles gives good results; but they, too, are very inconvenient, as Wyville Thomson was forced to acknowledge.

"The tangles," he says, some pages beyond the passage quoted above, "certainly make a sad mess of the specimens; and the first feeling is one of woe, as we undertake the almost hopeless task of clipping out with a pair of short nail-scissors the mangled remains of sea-pens, the legs of rare crabs, and the dismembered disks and separated arms of delicate crinoids and ophiurids. We must console ourselves with the comparatively few things which come up entire, sticking to the outer fibres, and with the reflection, that, had we not used this somewhat ruthless means of capture, the mutilated specimens would have remained unknown to us at the bottom of the sea." The description is exact; but one must examine the condition of the larger part of the specimens brought up by the tangles, to understand the despair of the naturalists in their search among inextricable confusion of threads, and remains of rare, often unknown, animals. We thus see the necessity of some better method of collecting and bringing up the animals.

During the campaign with the Blake, in the Gulf of Mexico, Mr. Agassiz used trawls, a kind of large net common on our coasts among fishermen, and obtained good results. On board the Talisman, trawls of the same kind, with an opening two or three metrés in extent, were employed. The dredges are very rarely used, these being reserved for the exploration of rocky bottoms, where the sharp edges would cut the net into pieces. In fig. 10 is shown one of the trawls used on the Talisman. By an examination of this cut, one can understand the arrangement of the net, which is such, that, on whatever side the machine reaches the bottom, it is always drawn to some purpose. There are two pockets, one inside the other. At the end of the outer one a large cast-iron ball is tied, while the inner pocket opens at its lower end, preventing objects which have entered from getting free again. During the course of the cruise, Commandant Parfait had one of the tangles

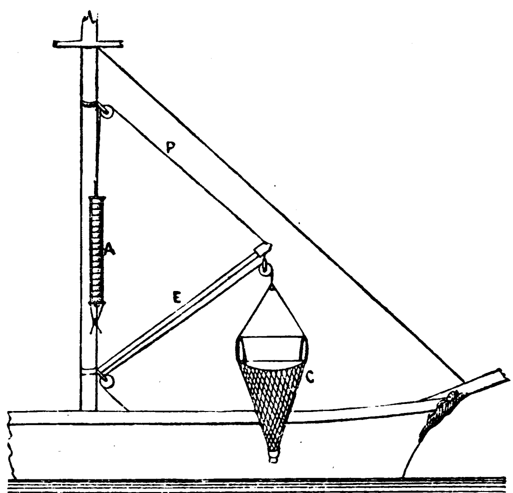

FIG. 9.—Action of the 'accumulator.'

placed at the very bottom of the trawl, with remarkable results. The success was due to the fact that a crowd of all the little animals, crustaceans, mollusks, and ophiurans, which, drawn in with the water into

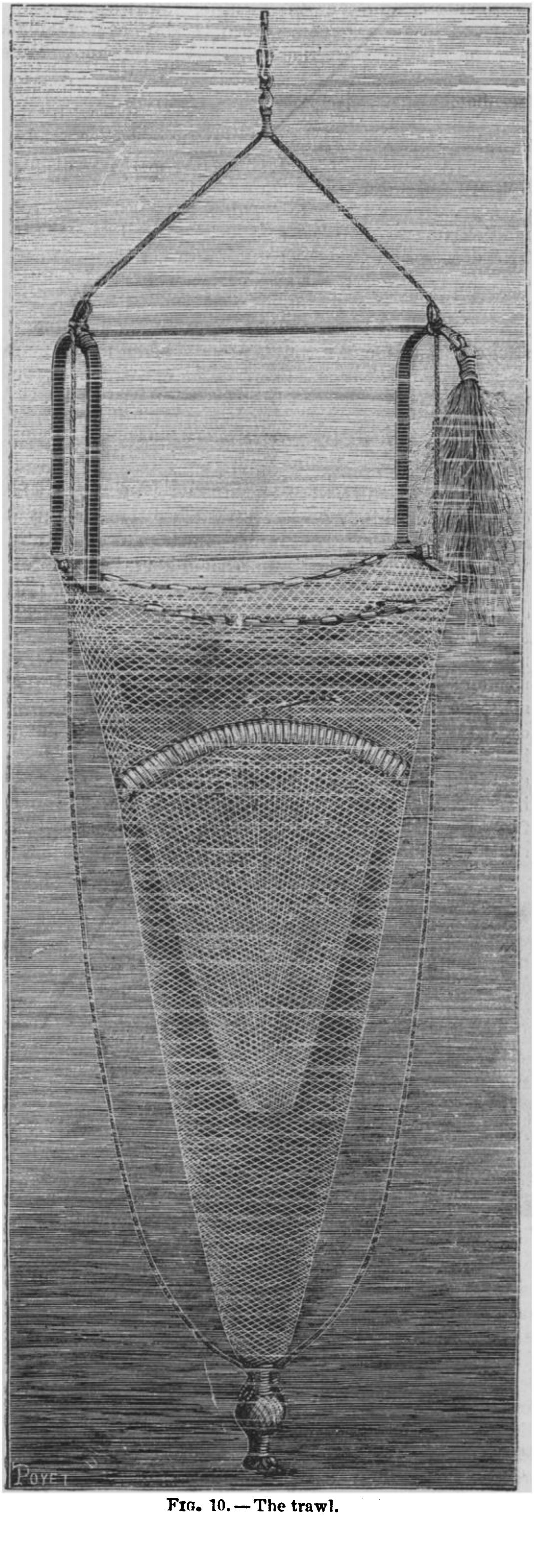

FIG. 10.—The trawl.

the interior of the trawl, would have passed through the meshes of the net, were caught by the long threads of the tangles.

That the strain on the drag-line may be eased, a wire rope (*P*, fig. 9) is made fast to the end of the beam, and, after passing over a block, is connected with a spring balance or 'accumulator,' *A*, made of disks of rubber, and attached to the mast.

The size of the trawl used depends upon the depth to be reached and upon the weather. As a general rule, it may be said that in good weather a trawl of three metres length is used to explore a depth of thirty-six hundred metres. Beyond this depth, a three-metre trawl cannot be used. Lower than three thousand metres, the additional burden is a hundred and eighty-eight kilograms.

When every thing is ready for the lowering of the trawl, the machines are freed, and at first the net is allowed to fall by its own weight and that of the cable which holds it; but after a little time the rapidity becomes too great, and must be regulated by the brakes. During the descent, the ship is held with the wind at the stern, or at least on the side, with its fore and mizen sail set. It must have a speed of at least two knots; and if with the wind alone it cannot make so much, its rate must be increased by steaming. Commandant Parfait discovered that this speed of two or three knots was absolutely necessary, if the cable were to be always taut. If this tension was not maintained, the cable descended more quickly than the trawl, rolled itself up on the bottom, and the net dropped on the bundle thus formed. In this case the cable became tangled, and kinks were formed in great numbers throughout its length. A register on the windlass (fig. 6), around which the cable passes before running into the water, indicates the moment when the net should reach the bottom. When this is reached, the full force of the brakes is applied, and the cable firmly held in place.

To insure the drawing of the trawl along the bottom, it is necessary to unroll a length of the cable greater than the depth of the sea. To a depth of six hundred metres, twice the length is paid out: deeper than this, five or six hundred metres more than sufficient to reach the bottom are run off. While the trawl is dragging, the ship is kept in such a position that it slowly drifts sideways. The time during which the trawl is left on the bottom varies greatly with the depth. In deep dredging it is dragged three-quarters of an hour, at times even several hours. When the trawl rises from the water, it is drawn upon the deck, and placed as seen in fig. 11. In order to obtain the animals enclosed in the thick, sticky mire often brought up in the trawl, the latter must be sifted very carefully. For this purpose a set of metallic frames, placed one upon the other, and raised on balls, is used. By simply giving these frames a backward and forward motion while water is showered into the mud, the smallest animals are obtained without receiving any injury. We have endeavored to show this operation in fig. 11.

Besides the sounding and dredging apparatus, there were, on the Talisman, special instruments for obtaining water at various depths. It is very important to know the composition of the water in which a certain fauna lives, in what proportion (sometimes under great pressure) gases are dissolved in it, and how much salt it contains. This kind of examination had already engaged the attention of the naturalists on the Challenger and on the Blake. During the cruise in 1882, made by the Travailleur in the Bay of Biscay, on the coasts of Spain and Portugal, and in the Mediterranean, water was drawn from very great depths. For this purpose, water-bottles, consisting of strong metal tubes with valves at both ends to allow of a free circulation, were attached to a sounding-line at distances of five hundred metres apart. The valves were kept open by means of brass levers extending out from the line. When a proper length of line had been run out, a ring was slipped over the line, and allowed to descend, knocking the levers and closing the valves as it went down. With each bottle was attached a self-registering thermometer. The gases contained in the water tend very energetically to escape, pressing strongly on the valves, and closing the mouths more effectively. It has often happened, that, upon opening the valves, a jet of water was thrown from the bottle, like Seltzer.

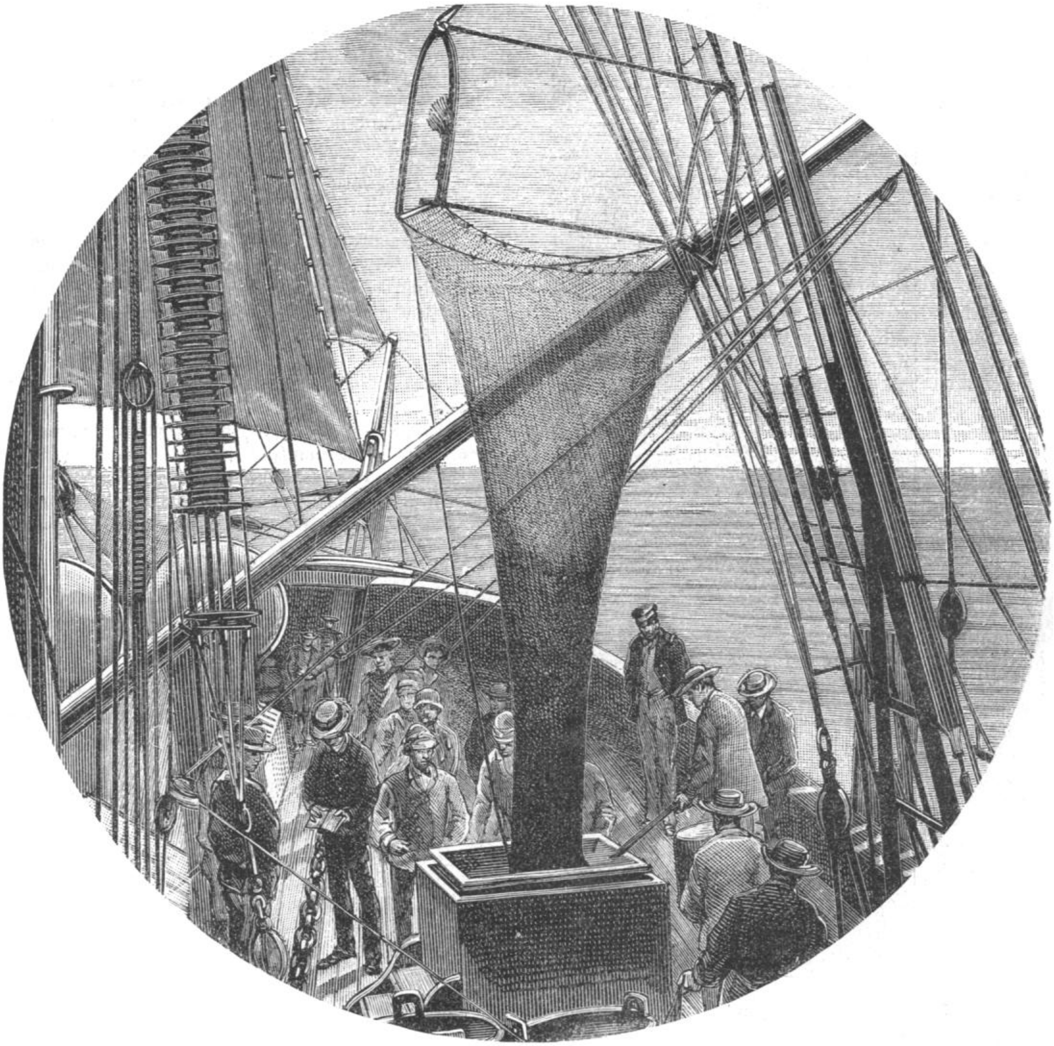

FIG. 11.—Examining the contents of a trawl.

The sampling of water from great depths is, as has been shown, a process which requires considerable time. Accordingly an attempt was made, on board the Talisman, to simplify the work when water was desired, not for the gases which it contained, but in order to investigate the germs which it held. The following plan was adopted. Thick glass tubes, narrowed at the ends, and closed by an enamelling-lamp after a vacuum had been previously formed, were attached to the metallic tube enclosing the thermometers. They were arranged in such a manner, that, when the overthrow of the latter took place, one of their slender ends struck the lower part of the metallic frame bearing the thermometer. Under this shock the point struck broke, and then the water rushed into the interior of the tubes, from which it could not make its escape on account of the small diameter of the entrance. At each sounding, therefore, a specimen of the water at the bottom was brought up; and it was very easy to preserve this by immediately sealing the tube.

FIG. 12.—Effect of expansion on the air-bladder of a fish taken from a depth of fifteen hundred metres.

Dredging at great depths requires considerable time, so that it often happens that the trawl can be brought on board only very late in the day. In the tropics night comes on early, the twilight in these regions being of short duration. To overcome this important difficulty, care was taken, while equipping the Talisman, to arrange electric apparatus capable of furnishing light so bright, that, when the trawl was raised during the night, it was possible to search with great care for the smallest objects brought up. For this purpose, a Gramme machine was placed upon the bridge, and was connected with a set of Edison lamps, lighting either the trawl or the interior of the laboratory. The lamps on the bridge were supplied with a reflector, allowing a bright light to be thrown upon the sea. Thus the approach of the trawl to the surface could be easily watched.

The Edison lamps used to light the ship were also useful, by floating in the water, in attracting fishes into the nets previously arranged. One can imagine the beauty of the scene when these brilliant lights are lowered into the water. The surrounding sea is illuminated with dazzling and constantly changing rays. It seems as if one were watching beautiful medusae, which, like bright disks, rise and fall with the waves, turn and disappear, to rise again a few minutes later more sparkling than ever.

Contrary to expectation, the deep-sea fish brought to the surface are somewhat affected by the expansion they have experienced. Many fishes possess a peculiar organ, consisting of a closed sac situated above the intestine, against the spinal column. The presence of this air-bladder allows a fish to rise and sink with great ease. In the case of a fish taken at a great depth, and brought to the surface, the gases enclosed in this bladder expand to a very considerable extent. As a result, the bladder presses upon the abdominal wall, and, as this expands, it gradually loses by abrasion the scales which cover it. When the expansive limit of the bladder is reached, its lower end pushes against the stomach, on the head of which it rests, enters the mouth, and leaps outside. The pressure which is thus brought to bear on the upper wall of the mouth-cavity is so great that it yields, and the eyes are forced from the sockets. We have endeavored, in fig. 12, from a specimen in the exhibition of the Talisman, to show in what state fishes caught at a great depth are brought to the surface. The same enormous pressure, brought to bear upon the collecting implements, may be understood

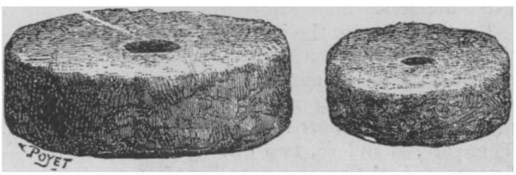

FIG. 13.—Effect of deep-sea pressure on cork.

from the injury to one of their parts. In order to keep the mouth of the trawl-net open, there is arranged within a set of large cork disks strung on a string. These disks, when new, have a rather large diameter, but after a few days' use they shrink to about half their original size. Under the pressure exercised, the tissue of which they are made settles considerably, and at the same time becomes as hard as wood. Fig. 13 shows different sides of two of the disks, — one before use, the other after, — drawn upon the same scale.

THE USE OF NAPHTHALINE AS AN INSECTICIDE.[1]

NAPHTHALINE, in one form or another, has for some time been used by entomologists as a means of preventing injury to their collections from Acari, Psoci, Dermestes, Anthreni, and other museum pests. My own experience is, that it destroys the Acari and Psoci, but not the other pests, though it tends to repel them. Recent investigations would seem to indicate that it may be used to advantage in the field as an underground insecticide. It appears that as early as 1842 a French physician, Rossignon, pointed out the possible use of naphthaline, not only as a remedial agency in medical practice, but also as a substitute for camphor, for the destruction of museum pests. But up to the appearance of the grape Phylloxera in France, no serious experiments were made with it in the field. Among the substances tried against this pest, naphthaline played its part. The efficient ingredient in the 'poudre insectivore' of Peyrat, was, according to Maurice Girard, naphthaline; but the experiments with it did not yield encouraging results.

Baudet recommended it to the French academy in 1872; while in 1874 E. Fallières proposed gypsum saturated with naphthaline, the mixture to be distributed over the soil. It was also among the numerous substances experimented with by Messrs. Maxime Cornu and P. Mouillefert, the results of which were published in the well-known memoir presented by these gentlemen to the French academy in 1877. Naphthaline, up to this time, proved to be of little value in killing the insect, and of no value as a repellant. Nevertheless, Dr. Ernst Fischer of the Strassburg university, encouraged and induced by the most favorable results obtained with naphthaline as an antiseptic and as a destroyer of micro-organisms (moulds, Schizomycetes, Bacteria, etc.), has, since 1881, again experimented with it as a direct remedy for the Phylloxera; and he has given us the results of his experience in an interesting brochure lately received. The first part of Dr. Fischer's work treats of, and strongly recommends, the use of naphthaline for surgical purposes as an antiseptic superior, in most respects, to all other antiseptics now in use. His conclusions are based on extensive experiments showing the effect of the material on the lower organisms, and prove, that, properly used, it not only arrests the growth of these micro-organisms, but eventually destroys them. This part of the work will be of especial interest to those who are experimenting with a view of destroying disease-germs. It is to the second part that I would here call attention. Preliminary to a statement of the results of this part of Dr. Fischer's work, a few facts in regard to the nature of the substance may not be out of place.

Naphthaline, a carbohydrate of the formula $C_{10}H_8$, was first made in 1820, by Garden, from coal-tar. It is volatile at any temperature, melts at 79.2° C., boils at about 214° C., and has a specific gravity of about 1.1. Essentially insoluble in water, alkalies, and diluted acids, it is easily soluble in ether, hot alcohol, hot concentrated sulphuric acid, and in many volatile and rich oils. It is readily carried off with aqueous vapors; so that, in order to quickly disinfect a room, it is only necessary to heat a vessel with water in which naphthaline has been put. The naphthaline gas mixes very readily with atmospheric air, and is also readily taken up by water. It is not poisonous to man or to the higher animals, and, for surgical purposes, should be used chemically pure. The crude material is by far cheaper; and, upon inquiry, Dr. Fischer found that in London it can be obtained, without barrels, at 25 marks ($6) per 1,000 kilograms (about 2,200 pounds), in Paris at 100 francs, and in Cologne at about 45 marks (barrels included). The crude naphthaline contains more or less phenol and creosote, and is a stronger insecticide than the purified article, but also more injurious to plants. Dr. Fischer used the purified naphthaline in his experiments on Phylloxera, but thinks that with some pre-

[1] Das naphtalin in der heilkúnde und in der landwirthschaft. Von Dr. Med. ERNST FISCHER. Strassburg, *Trübner*, 1883.