disturbance, somewhat as one water-wave depends on another; for no one has yet been able to trace one of our storms so far back as to show it quite independent of previous storms, as seems to be the case with the tropical cyclones. In the irregular blowing of the winds of higher latitudes, for which no full explanation can be given, too much air is accumulated in certain districts, which then appear as regions of high pressure. In seeking a better balanced re-arrangement, surface-currents are established with a rotary deflection, as explained below, toward intermediate areas of lower pressure; and an up-draught is formed at their meeting. This becomes a storm-centre. It might be said that friction would soon cause all these local disturbances to cease, and atmospheric pressure would then remain more uniform. So it might, if the air were dry; but the condensation of vapor, by which the cooling of the ascending current is retarded, brings out a new supply of energy every time an up-current is established; and thus the disturbed condition of the atmosphere is maintained. It cannot settle down into a condition of equilibrium as long as the sun shines, and water evaporates. Some maintain that it is unlikely that the storms of the torrid and temperate zones should have different causes, and that as temperate storms certainly do not, as a rule, arise in a warm calm, tropical storms cannot have such an origin. But as already stated, and as will be further shown, the regions and seasons of tropical cyclones point very conclusively to this origin; and, moreover, it is not necessary that similar results should have identical causes. All the peculiarities of a rotary storm can be satisfactorily explained from either starting-point. And the essential contrast between the two cases is, that in one, differences of temperature precede and bring about differences of pressure, and, in the other, differences of pressure precede and bring about differences of temperature; so that, in both cases, the established storm differs in temperature and pressure from the surrounding atmosphere: and, once established, the motions of rotation and translation, yet to be described, are closely alike in the two cases.

(To be continued.)

THE ELECTRIC LIGHT ON THE U. S. FISH-COMMISSION STEAMER ALBATROSS.[1] — III.

To determine the efficiency of the system of incandescent lamps, I measured, by means of a steam-engine indicator, the power required to run the engine and dynamo, the current being switched off. By the same instrument I measured the indicated power required to run 45, 50, and 70 lamps, respectively. By deducting from these experiments, respectively, the power required to run the engine and dynamo, we obtained the power applied to the shaft; and from this quantity we deducted the friction of the load, leaving, as a remainder, the net powers required to revolve the armature in the magnetic field with 45, 50, and 70 lamps in circuit. The lamps used were each of eight-candle power.

Efficiency of the incandescent lamps.

Horse-power required to run the engine and dynamo	5.36
Indicated horse-power required to run 45 incandescent lamps	5.79
Indicated horse-power required to run 50 incandescent lamps	5.85
Indicated horse-power required to run 70 incandescent lamps	6.92
Net horse-power applied to the revolution of the armature in the magnetic field, using 45 incandescent lamps	1.80
Net horse-power applied to the revolution of the armature in the magnetic field, using 50 incandescent lamps	1.85
Net horse-power applied to the revolution of the armature in the magnetic field, using 70 incandescent lamps	2.84
Mean number of incandescent lamps per indicated H.P., using 45 lamps	7.77
Mean number of incandescent lamps per indicated H.P., using 50 lamps	8.50
Mean number of incandescent lamps per indicated H.P., using 70 lamps	10.11
Mean number of incandescent lamps per net H.P., using 45 lamps	25.
Mean number of incandescent lamps per net H.P., using 50 lamps	27.02
Mean number of incandescent lamps per net H.P., using 70 lamps	24.63

The wires being fixed, their resistance may be considered a constant quantity, and the only variation as existing in the engine and dynamo. The distribution of the power, as above recorded, may, if necessary, be verified by electrical measurements on the wires.

To illuminate the machinery on deck, the derrick-gaff, the lead of the cable, the trawl as it comes on deck, and to afford ample light to the naturalists while culling the contents of the trawl as delivered on deck, an arc-light of great power became indispensable. In the then existing state of electric lighting, an additional dynamo appeared to be imperative, as no arc-light had been run from a tension of 51 volts.

The Edison company, however, was willing to experiment, and in a short time produced a

[1] Concluded from No. 42.

lamp of 750-candle power, which we are now using; and we find, in practice, that a no. 18 copper wire will carry the current without heating. The power of this lamp, to be comparable with other arc-lamps, should be multiplied by four, as the commercial candle-power of the arc-lamp is the aggregate of four measurements, the photometers being placed equidistant from each other in the same circumference. The power required to drive these arc-lamps, though more than necessary for others of equal power, is yet quite small.

Efficiency of the arc-lamps.

Indicated horse-power developed by the engine with two arc-lamps in circuit	6.69
Horse-power required to drive the engine and dynamo	3.56
Net horse-power applied to the shaft	3.13
Horse-power absorbed in the friction of the load	0.23
Net horse-power applied to the revolution of the armature in the magnetic field	2.90
Net horse-power applied to the armature for one lamp (half of the last quantity)	1.45

The number of eight-candle power incandescent lamps per indicated horse-power is taken as a mean between the quantities as determined above, i.e., —

$$\left(\frac{25 + 27.02 + 24.63}{3} = \right) 25.55;$$

and this quantity multiplied into the net horse-power required to drive one arc-lamp gives $(25.55 \times 1.45 =)$ 37.04, which is the power in units, of incandescent lamps, to run one arc-lamp of 750-candle power.

Fishermen in nearly all parts of the world use a light in their boats, when fishing at night, to attract fishes into their nets; and it is a common thing for flying-fish to come on board ship at night if a light be advantageously placed to attract them.

Until incandescent lamps were invented, there were no convenient means of sustaining a light beneath the surface of the waters; and there is consequently opened up to us an unexplored field in fishing.

Just what service our submarine lamps will be, we are as yet unable to say: but, with the small lamp which we use from one to ten feet below the surface, amphipods in great numbers, silver-sides, young bluefish, young lobster, squid, and flying-fish, have been induced into the nets, and dolphins have approached it; but whether the dolphins were attracted by the light, or were pursuing the squid, Professor Benedict, the naturalist of the ship, was unable to say. Squid are especially susceptible to the influence of light. I am informed by the very eminent authority of Professor Verrill, of Yale college, that a heavy sea, breaking upon a lee shore when the full moon is casting its rays across the land into the sea, will throw hundreds of squid upon the beach in a single night, — an evidence of their moving in the direction of the light until caught in the spray and hurled upon the shore.

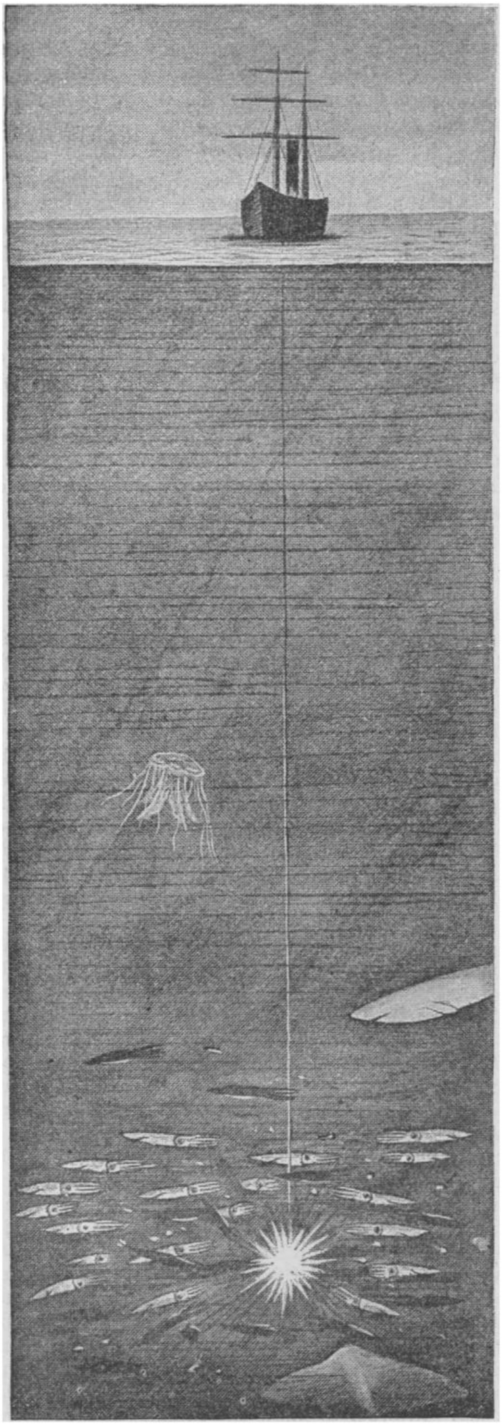
To succeed in producing the light at considerable depths has been by no means easy.

The Edison company first prepared a lantern of two thicknesses of glass, hemispherical in form, with its flat side tightly joined to a bronze disk on which were placed three sixteen-candle power B lamps in multiple arc. At a moderate depth it burned beautifully; but at about a hundred and fifty feet the packing leaked, and the sea-water, entering, short-circuited, and the lamp was extinguished by the destruction of the cut-out plug. A similar lamp was then tried with improved packing; but its glass walls were crushed by the pressure of the water, and it was extinguished.

The next essay was with a single Edison lamp, its glass vessel being cylindrical in form, with hemispherical end, to give it strength; its thin platinum wires extending through one end without any external attachment. To these delicate wires I succeeded in soldering the copper wires of the cable, but broke (or cut) off one of the platinum wires at the point where it enters the glass, while putting on the insulation. When it is remembered that a hundred fathoms depth of water brings a pressure of over two hundred and fifty pounds per square inch on the lamp, it will be understood that great care was required in every procedure.

Our next attempt was with a single Edison lamp exactly the same as the last. I succeeded in soldering and insulating the joints perfectly; but the pressure of the water upon the insulation cut the delicate platinum wire on the glass before it had reached a hundred feet in depth.

The Edison company then produced a lamp in which the platinum wires were soldered to copper wires in a glass cavity, and filled in with rosin, so that copper wires, about no. 30 in size, projected from the lamp for our attachment. I coiled the copper wires spirally, and soldered their ends to the ends of the heavy wires of the cable, separating them by a small block of pine wood: this gave some freedom of motion, without danger of cutting or breaking the wires. A paper mould was placed round the joint, and filled with warm 'gulloot.' When



FISH-COMMISSION STEAMER ALBATROSS.
A SUBMERGED ELECTRIC LIGHT TO ATTRACT FISH, AND ILLUMINATE THE WATER.

this had cooled, it was wrapped with insulation-tape, and served tightly with twine. This was again covered with gulloot, then tape, and finally with melted gutta-percha; and, when the gutta-percha had cooled, its entire surface was seared over with a hot iron to make sure of filling any cracks or holes it might contain. The lamp was then lowered into the sea, about seven hundred and fifty feet of cable being paid out, without any indication of failure. To ascertain if the lamp was lighted at all times, we substituted a lamp for the cut-out plug in the deep-sea circuit. This brought both lamps in the same circuit, which caused them to glow at about a cherry-red instead of a white light; and had any accident happened to break the lamp in the water, or to cause a leak, our upper lamp would have immediately sprung into incandescent whiteness. G. W. BAIRD,

Passed assistant engineer, U.S.N.

CRYSTALS IN THE BARK OF TREES.

IN examining the interior of certain insects and myriapods living in and feeding on the wood and liber of decaying trees, the writer has often had his attention attracted by many beautiful and well-defined crystals mingled with the food-contents of the intestinal canal. The crystals appear to be insoluble in the intestinal juices, as they pass through the entire tract unchanged. Recently, in examining a large lamellicorn larva obtained from beneath the bark of a decaying white oak, I again observed an abundance of the same kind of crystals; and shortly after, numerous others were found in a Polydesmus taken from beneath the bark of a hickory log. Feeling sufficient interest in the matter to learn the source of the crystals, I examined a large white oak, dead and decaying, but still standing, with the bark loosely attached. On the inner side of the bark was a thick, yellowish-white, pulverulent layer, — the decayed liber. This readily crumbled to powder; and a small portion, diffused in water and submitted to the microscope, exhibited a multitude of crystals, forming the greater proportion of the powder, and of the kind previously noticed in insects. The crystals appeared perfectly fresh, and not changed by the surrounding decay, but were isolated, sharply defined, and highly lustrous. They measured from about the two-thousandth to the six-hundredth of an inch. Two forms were common, — simple, as represented in fig. 1; and twinned, as in fig. 2. A portion of the powder was submitted to my friend, Prof. F. A. Genth, for analysis, without informing him