cleaning lamp-chimneys. In this ball a number of roots also emerged from the lower side of the ball, but only to re-enter it again, as in the other cases. In no. 7 stems and roots came out together indiscriminately, and from all sides of the ball; the roots, however, after protruding from half an inch to an inch, re-entering the ball or withering. This experiment was twice repeated. In the first case more stems appeared from the side of the ball away from the face of the clock, and the greater number of roots made their appearance on the opposite side of the ball. It was observed in this case, however, that the spindle slanted about two degrees toward the clock. In the next experiment the spindle was made horizontal, and no difference as to place of emerging of root and stem was observed.

These experiments in combination appear to show with clearness the influence of moisture and gravitation in determining the course of the root, and to suggest that the influence of moisture is the stronger of the two.

The emergence of the sensitive tips of the primary roots from the damp ball into the dry atmosphere I suppose Darwin would have explained as the result of the persistence of the impressions in the root behind. The horizontally extending roots in the damp atmosphere, both dark and light, suggest that the response to gravitation in both cases was *nil*. May it not be true that the diageotropism of roots is such in no other sense than that of direction of growth? that it is in reality simply a growing toward the proper amount of moisture? This would appear to explain the oblique direction of secondary branches, and the largely indifferent direction of tertiary ones. The balls in the jars placed in the horizontal attitudes indicate that the stem does not grow simply in a direction opposite to that of the principal root, for they were turned toward each other through an angle of nearly ninety degrees. The two inverted jars show that the stems did not seek a dry atmosphere, for in both cases they grew up into that which was more moist. The inverted dark jar shows that the effect of the impact or absorption of light on the lower half of the ball, and the absence of these effects upon the upper half, did not produce a sufficient contrast to guide the stem into the light; but since, of the two jars placed in the horizontal attitude, only the ball in the mouth of the glass one sent stems into the jar, it seems possible, since other conditions were alike, that light may exert a small influence in guiding the stems from the ground.

F. H. KING.

River Falls, Wisconsin, May 17, 1883.

## SOME GLACIAL ACTION IN INDIANA.

WITH members of my class in geology, I have been examining the glacial deposits in this vicinity (Montgomery county). Our chief water-course is what is called Sugar Creek, a tributary of the Wabash River, which occupies a valley with a general south-westerly bearing, virtually the same trend which the Wabash has across the state before it makes its sharp bend to the south. Along the valleys of the Wabash and Sugar Creek, there are abundant evidences of a glacier which moved in the direction of the valleys, and is known as the Lake Erie glacier, as it advanced in the direction of the axis of that lake, and so up the Maumee, and across the low divide at Fort Wayne, into the Wabash. Sugar Creek itself has been compelled to bend sharply to the south a few miles to the west of us by the deposits of this old glacier, and has cut its new channel through the soft subcarboniferous sandstone. At one place in this county, where the creek still occupies its preglacial valley, it cuts through what we formerly considered a large terminal moraine, which lies squarely across the valley. Recent floods have swept away some of this moraine, and laid bare the country rock. This rock is found to be smoothly planed, and absolutely covered with glacial scratches all trending N. 20° W., or almost at right angles to the valley of the creek and the course of the former glacier. These scratches of the second glacier are now found in many places throughout the county; and our old terminal moraine proves to be a medial moraine, and bears upon its back a line of huge bowlders with the same north-westerly trend. These facts are recorded here in the hope that they may be of some use in the consideration of a much-vexed question.

JOHN M. COULTER.

Wabash College, Crawfordsville, Ind.

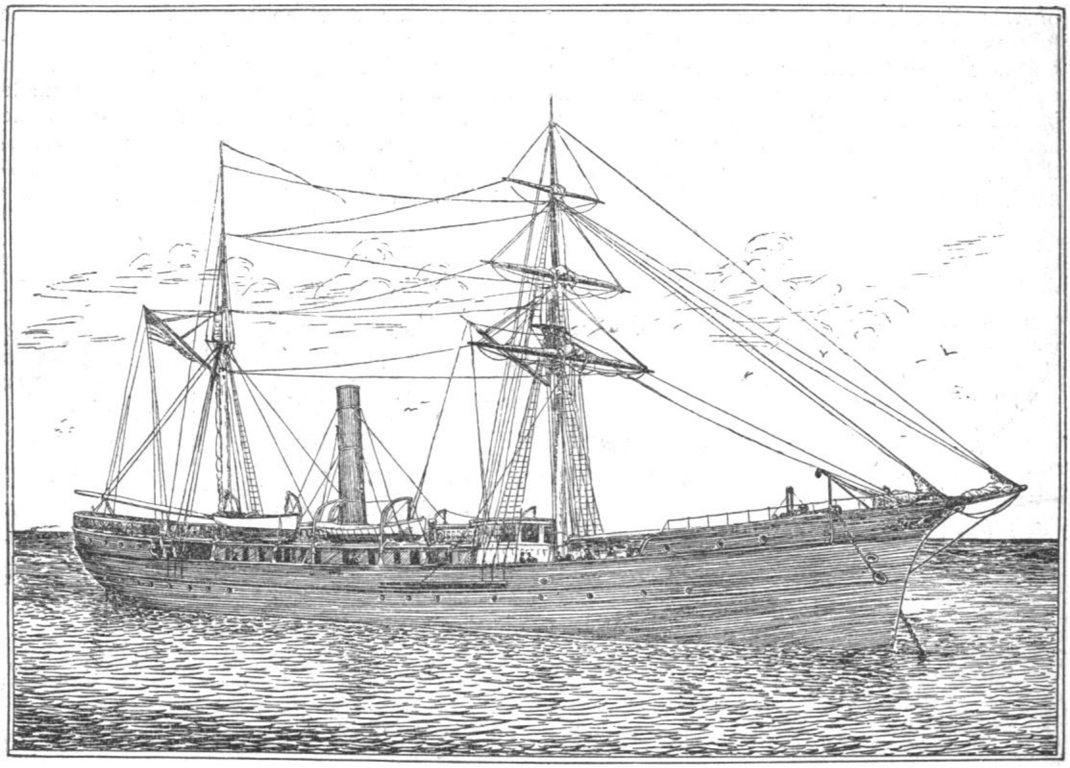
## THE UNITED STATES FISH-COMMISSION STEAMER ALBATROSS.

### I.

PROBABLY no department of scientific investigation has made greater progress in its methods of work during the past ten years than that of deep-sea research. The successful introduction of steel piano-wire for sounding, and of wire rope for dredging purposes, marks a new era in this class of exploration, for which credit is mainly due to American skill and energy. While claiming so much in behalf of our own country, we frankly acknowledge that the only feasible method of using sounding-wire was devised by one of the best known of English physicists, Sir William Thomson; but his efforts were entirely ignored by the mother government, and first bore fruit on this side of the Atlantic, through the liberality of the American navy.

It is needless in this connection to discuss the rapid development of this system of deep-sea sounding, which has been so fully described by its most zealous advocates, Messrs. Belknap and Sigsbee, of the United States navy. We may be pardoned, however, for recalling the fact, that it was early in 1874 that Capt. Belknap made his famous sounding-voyage across the Pacific Ocean in the U. S. S. Tuscarora, while the Challenger was still plodding its way around the world with its cumbersome hempen rope, one of the Thomson machines being carefully stowed below. Since then Commander Sigsbee has so perfected the sounding-machine, on the proper working of which success with wire depends, that further improvements seem impossible.

The use of wire rope for dredging was suggested by Mr. Alexander Agassiz, under whose supervision it was first put to trial on the coast-survey steamer Blake in 1877. To Messrs. Sigsbee and Agassiz, and the officers of the Blake, is due the greater number of improvements in deep-sea dredges, trawls, and accessories to sounding, which are now employed on the American coast; while the U. S. fish-commission claims priority as to the appliances for moderate depths of water, although many of these are yet to be thoroughly tested in the deeper parts of the ocean.

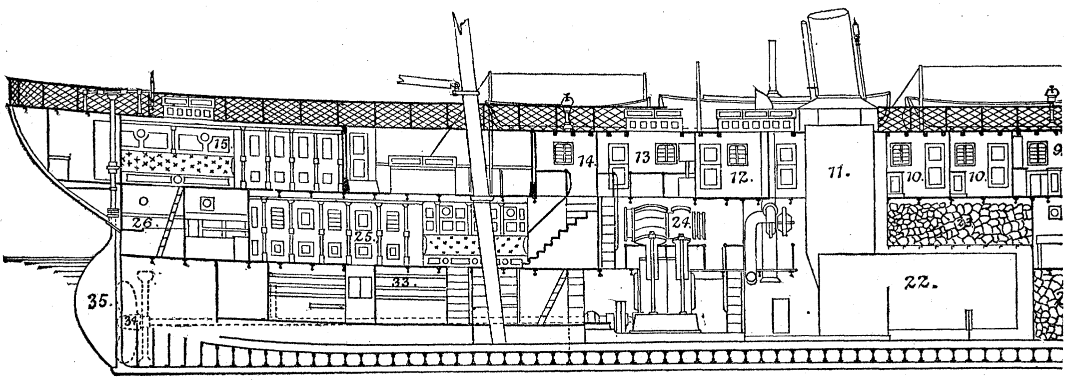


UNITED STATES FISH-COMMISSION STEAMER ALBATROSS.

The great desideratum in marine explorations has always been suitable vessels for properly carrying on the work in all its branches. Our coast-survey, however, is gradually building up a fleet of steamers which are admirably adapted to their special field of surveying and sounding; and several of these, among which we may name the Blake, the Hassler, and the Bache, have already rendered distinguished services in the line of deep-sea dredging and trawling. The latest addition to our exploring-fleet has been the construction of a thoroughly sea-going steamer for the express purpose of investigating our maritime fisheries, in both a scientific and practical manner, by means of every known appliance suited to the work. This new undertaking is but an advance step in the progressive work of the U. S. fish-commission, under the able and judicious management of Professor Baird, and was demanded by the urgent necessity for a more extended knowledge of our off-shore fishing areas. The initiative in this direction was taken some three or four years ago, when Congress sanctioned the building of the steamer Fish Hawk, in the combined interests of fish culture and exploration. Previously, small naval steamers had been adapted to the requirements of the fish-commission as their services were needed; and, considering the pioneer character of their work, they rendered valuable aid.

In associating fish-culture with scientific investigation, some sacrifice had to be made at the expense of one or other of these projects; as no steamer, built to enter the shallow rivers and indentures of our coast-line, could venture with safety to any distance from land. Fish-breeding was at that time considered the more important; and the Fish Hawk, with her shallow draught of water, must confine her operations to the vicinity of the coast; and yet, from a perusal of recent papers in this journal by Professor Verrill, it will be seen that her contributions to biology have been surprisingly great. The Albatross, however, as the new steamer has been christened, will, like her namesake, make her home upon the high seas, chasing schools of fish, or diving beneath the surface with the dredge and trawl.

The Albatross is a twin-screw propeller, rigged as a brigantine, and was built at Wilmington, Del., during 1882, by the Pusey & Jones Company, who were also the builders of the steamer Fish Hawk. She was designed by Mr. Charles W. Copeland, consulting engineer of the U. S. lighthouse board; and her entire construction and subsequent preparation for service have been under the immediate supervision of her present commander, Lieut. Commander Z. L. Tanner, U.S.N. The launch was successfully made Aug. 19; and the work of fitting up the various quarters and of arranging the scientific appliances was rapidly pushed to completion. The trial trip began Feb. 9, 1883; and at the time of writing she is making her first long cruise.




LONGITUDINAL SECTION OF UNITED STATES FISH-COMMISSION STEAMER ALBATROSS.

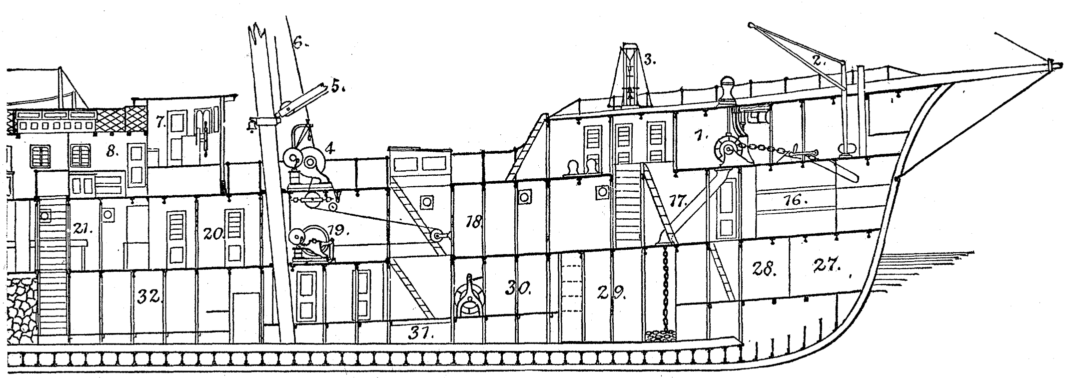
1. Topgallant forecastle; 2. Fish-davit; 3. Sigsbee sounding-machine; 4. Dredging-engine; 5. Lower end of dredging-boom; 6. Dredge-rope; 7. Pilot-house; 8. Chart-room; 9. Upper laboratory; 10. Naturalists' staterooms; 11. Steam-drum; 12. Galley; 13. Upper engine-room; 14. Entrance to wardroom; 15. Poop-cabin; 16. Storerooms; 17. Fore-passage; 18. Berth-deck;

In the construction of the Albatross, several novel features in marine architecture have been introduced; as past experience has proved that the ordinary form of hull is but poorly suited to the work of deep-sea dredging and trawling. The most important modification is at the stern, which has been sharply modelled to enable her to back readily and safely in a seaway, her usual method of propulsion while engaged in this class of work. The rudder and its attachments have also been made of extra strength to withstand the hard service to which they are thereby subjected.

The greatest length of the vessel is two hundred and thirty-four feet; and the length at the ordinary water-line, with a draught of twelve feet, two hundred feet. The breadth of beam moulded is twenty-seven feet and a half. The registered net tonnage is four hundred tons, and the displacement on a twelve-feet draught, a thousand tons. The frame-work and hull are of iron, which also enters largely into the construction of the deck-house. Forward and aft, the iron sides extend to the level of the upper deck to enclose the poop-cabin and top-gallant forecastle, while in the intervening space they form a high protecting rail to the main deck. The deck-house (7–14), which is eighty-three feet long, thirteen feet and a half wide, and seven feet and a quarter high, extends from just forward of the mainmast nearly to the foremast, leaving an ample passageway on either side between it and the rail. The after-part is built of iron, with wooden sheathing; but forward of the funnel it is entirely of wood. followed by the steerage (20), main laboratory (21), engine and boiler compartments (24, 22), which extend into the hold, and the ward-room (25).

The forehold contains the magazine (27), water-tanks, ice-house (29), and a variety of storerooms. Underneath the laboratory is a large room (32) for the stowage of natural history materials; and below the ward-room are the appropriate storerooms for the use of the mess, the navigator, and paymaster.

The poop-cabin (15), on the main deck, is a large, commodious room the entire width of the ship, and extending thirty feet forward from the stern. It contains two state-rooms, a bath-room, pantry, and office, and is conveniently furnished. The ward-room (25) underneath is thirty-eight feet long, and has eight large state-rooms, a bath-room, and pantry. It is




LONGITUDINAL SECTION OF UNITED STATES FISH-COMMISSION STEAMER ALBATROSS.

19. Reeling-engine; 20. Steerage; 21. Lower or main laboratory; 22. Boiler; 23. Coal-bunkers; 24. Engines; 25. Ward-room; 26. Cabin storeroom; 27. Magazine; 28. Magazine passage; 29. Ice-box; 30. Upper hold; 31. Lower hold; 32. Natural history storeroom; 33. Wardroom storerooms; 34. Propeller-wheel; 35. Rudder.

The forward compartment, which is raised about three feet above the general level of the house, is the pilot-house (7), containing a steam quartermaster to aid in steering. Following it in succession are the chart-room (8), upper laboratory (9), four state-rooms (10), steam drum (11), galley (12), upper engine-room (13), and entrance to the ward-room stairway (14).

Below the main deck the vessel is divided into six water-tight compartments by five transverse iron bulkheads, there being also an additional bulkhead which is not closed.

The berth-deck, forward of the collision bulkhead, is cut up into storerooms (16), reached by scuttles from the main deck. Next aft is the berth-deck proper (18), which is forty feet long and the width of the ship, with superior accommodations for a large crew. It is well lighted by a broad skylight overhead in addition to the usual side-ports. These quarters are entirely occupied by the officers of the ship, the civilian scientific staff being accommodated in the four state-rooms (10) of the deck-house abaft the upper laboratory. The latter rooms are better adapted for study than any others on the ship; each having a large, square side-window at the proper height for working with the microscope, should the naturalists desire to conduct their more delicate observations in privacy.

Of most interest to the student are the scientific quarters, which are very capacious, and amply sufficient for all possible needs. They occupy a central position, being thereby removed as far as possible from the extremes of motion caused by rolling and pitching. They extend from just above the keelson to the upper deck, and consist of three rooms on as many levels: the lowest (32) being a storeroom; the central one (21) a general laboratory, or workroom; and the upper one (9) a deck-laboratory for microscopical work and study. These rooms communicate with one another by means of stairways, but are entirely cut off from all the rest of the ship, excepting through the side-doors of the upper laboratory. The two lower rooms are protected fore and aft by water-tight iron bulkheads, reaching to the main deck; and the storeroom, which contains the supply of alcohol, can be made a tight box, and instantly filled with steam, in case of fire.

Light is admitted to the upper laboratory through a skylight, and two windows on each side, and to the general laboratory through three ports on each side, and two deck-lights overhead; but in the storeroom artificial light is necessary. During the day-time, therefore, the working-rooms are sufficiently well lighted for all ordinary purposes; but the system of electric lamps, which pervades the entire ship, reaches its height of development in these quarters, and every few feet of space contains its little glass globe and horseshoe. The effect at night is very brilliant, and work can then go on about as comfortably as in the brightest sunshine.

[*To be continued.*]

## *SURFACE CONDITIONS ON THE OTHER PLANETS.*

IN the *Popular science monthly* for June appeared an article entitled 'Cost of life,' by John Pratt, upon the habitability of the other planets. To his conclusion that most of the larger planets are probably unsuited for habitation by beings like ourselves, I think few astronomers would take exception; but several of his statements as to their surface conditions are apparently at variance with modern observation, and with the results of the application of the principles of mechanics.

As to the light from the planets, he says, "In the first place, as might have been conjectured even before the revelations of the spectroscope, from their great volume of light as compared with their distances from the sun, all of these great bodies [the four exterior planets] are self-luminous." There is some reason to believe that at certain times portions of the surface of Jupiter do shine by their own light, but it is certainly very faint, as otherwise, when his satellites pass into his shadow, they would still reflect some light to the earth. In point of fact, however, even to the most powerful telescopes, they absolutely disappear. As to the three remaining planets, their light is so faint at the best, that any determinations as to their self-luminosity are entirely out of the question. The spectroscope shows us nothing whatever on this subject with regard to any of these bodies.

We are then told, that "the density of Jupiter being about 1.40, and that of the earth 5.48, it follows that the attraction exerted by Jupiter is roughly 300 times that of the earth. A man who weighs 150 pounds on the earth, if transported to Jupiter, would shake the ground with a ponderous tread of 45,000 pounds, or $22\frac{1}{2}$ tons. His own weight would at once crush him into a mere pulp. A hickory-nut, falling from a bough, would crash through him like a minie-ball. Again: water would weigh fifteen times as much as quicksilver. A moderate wave would shiver to atoms the strongest ironclad, etc." Applying the ordinary formula, $W = \frac{M}{D^2}$, — where $M$, the mass of Jupiter, in terms of the earth, is 313, and $D$, its diameter, is 11, — we find the weight, $W$, of an object on the surface of Jupiter, equals $\frac{313}{121}$, or $2\frac{1}{2}$ times what it would weigh here: hence our 150-pound man would weigh just 375 pounds there, and would not be seriously inconvenienced by a whole battery of hickory-nuts, provided he wore his hat. With reference to Mars, he writes, that "the relative mass of Mars being only about $\frac{1}{60}$ that of the earth [it is $\frac{1}{9}$ approximately] . . . our typical man would only weigh about $2\frac{1}{2}$ pounds. . . . An 80-ton locomotive would not propel a train of empty cars. . . . A rifle-ball might be caught in the hand without harm." According to the law of gravitation, the 'typical man' would weigh 66 pounds. Supposing the 80-ton locomotive reduced in weight in the proportion he states, the cars would be so also: therefore, under any such conditions whatever, the 80-ton locomotive would draw precisely as great a quantity of matter there as it would upon the surface of the earth. As to the rifle-ball, its stored energy is proportional to $MV^2$; that is, it is proportional to its mass, and independent of its weight. But the mass of a body is the same throughout the universe: therefore experiments in catching rifle-balls in the hand on the surface of Mars would be dangerous.

Finally, referring to Mars, he says, "Nothing can be more certain than that there is no liquid in Mars, and no life." As seen through the telescope, the poles of Mars appear of a brilliant white color. When one of the poles is turned towards the sun, the size of the white spot diminishes, and, when it is turned away again, it increases. Some astronomers have imagined these white spots to be snow: in that case, it is difficult to account for the disappearance, unless we suppose that it melts. It therefore seems rather a strong way of expressing it to say that "nothing can be more certain than that there is no liquid in Mars." There are several other points raised by our author which would bear mentioning, one or two on the subject of energy, particularly "a large aspect of the question, which seems to have escaped the attention of thinkers;" but I think the points referred to above will be sufficient for the present occasion. W. H. PICKERING.