Surface Life in the Gulf Stream.

The explorations of the U. S. Fish Commission, chiefly within the last two years, have brought to light many wonderful facts connected with the Gulf Stream. The deep water dredgings of 1883, and now more strikingly of 1884, have added multitudes of new types of both vertebrates and invertebrates, illustrating those features of the deep sea fauna which have been becoming so conspicuous and characteristic in the zoological reports of the last year and more. It is not with the individual forms that we have now to deal, but merely with the fact that in those immense depths, 2,000 fathoms and beyond, the bottom of the sea swarms with animal life to a degree that appears almost incredible. The actual bed itself is alive with crustaceans, mollusks, radiates, etc., while the stratum of water so near to it as to be within the depth of a trawl's mouth is filled with fishes prowling about for food. Whether the mass of water between these strata of the bottom and those of the surface is full of living objects, we have as yet no means of knowing.

The trawls pass through all in their descent and their ascent, and part of what they eventually contain may perhaps have been captured in mid-depth, but it is not probable that this can take place to any considerable extent.

At all events, our real explorations have to do chiefly with the surface and the bottom; and the results obtained at the surface are in some respects more wonderful than those from the deep dredgings. The working of the trawls has been freely described and figured, but little has been said of the collections made within a depth of less than two feet, and yet zoologically they are rich beyond all description, and biologically they set before us a problem which is not easy of solution. The means of collecting are exceedingly simple. It is done either with hand nets or drag nets, being in either case a metallic ring to which a deep gauze bag is attached. They can be used to advantage only while the vessel is in very gentle motion; and the first impression made by the use of a drag net in the Gulf Stream for even a very short time is of simple, unbounded astonishment at the apparently limitless profusion of animal life. One is tempted to believe that the vessel is floating, not on water which contains animals, but on a sea of minute living objects with barely sufficient water to give them freedom of motion. The gauze bag speedily becomes so completely clogged with its living load that no water can pass through it until it is cleared. Drawing it in and emptying it into a bucket, perhaps a gallon of "pudding" is secured, which contains probably a greater number of distinct and independent living beings than there are human inhabitants of the earth at this moment.

This is no exaggeration. The numbers are utterly beyond computation. Of course all of these are of extreme minuteness, for the larger species easily escape the slow moving net. The smaller crustacea (oopepods, branchiopods, etc.), the swimming mollusks (pteropods mostly, though not a few cephalopods are among them), various forms of annelids, the tunicates (most especially the salpæ)—these are swept into the net, through whose interstices in the mean time the more minute objects have been escaping; but as the soft and yielding mass gradually thickens the gauze the little things which are really microscopic are detained on its surface, and serve to increase the mass, though hundreds of thousands and even millions are needed before they become fairly appreciable. The larval stage of the echinoderms is represented with an almost infinite richness, and with them come the hydroids and jelly fishes, and then the infusoria, the foraminifera, till we reach absolutely the lowest grades of animal life, including the well known globigerinæ, whose microscopic silicious shells are constantly helping to build up the soft ooze at the greatest ocean depths. These are the objects which the gauze net has collected while dragged slowly along for perhaps one to two hundred yards. And if we have gathered our hundreds of millions of individuals within such an extent, what effort of the imagination can stretch out to numbers which shall even approximately reckon up the surface life in the Gulf Stream, were we to take but even a single square mile of its extent? For it is worthy of note that this richness is not the result of concentration.

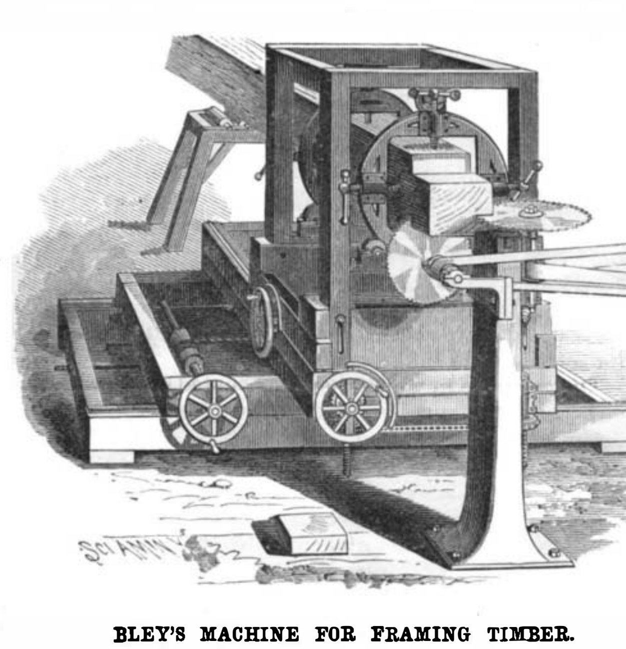
In other places (we have a notable example at Wood's Holl) there are certain occasions when, for a brief period, owing to the run of the tide, and the eddies caused thereby, we may find a state of swarming animal life as remarkable as that which we have specified, but it is only for a very restricted space; whereas in the Gulf Stream, so evenly diffused are the teeming myriads, that out of 150 sweeps of the net only one or two will fail to realize very nearly what we have stated.

Nor is it only in numbers of individuals that the lavish profusion exists; the catalogue of distinct types, reckoned as species, is certainly full of suggestiveness. Without counting the majestic and powerful animals, drawn together in their wide sea rovings by the abundant supply of food—the whales, blackfish, porpoises, etc., and with them the fierce sharks in swarms, together with the fleet and savage dolphins, albicore, bassacudas, and so on—it is safe to count the smaller fishes up to 25 at the very least. Of the crustacea in their various grades, there are certainly 50 species. The mollusca have 60 distinct specific forms, probably more. Of the annelids we find 15; of the tunicates, 8; of the polyzoa, not less than 10; of the echinoderms, 5; of the hydrozoa, certainly as many as 25; while the radiolaria, foraminifera, and other infusoria reckon up 30 as a minimum. These give us 228 species, which total will surely be enlarged by further research.

MACHINE FOR FRAMING TIMBER.

The engraving shows a machine for cutting tenons on the ends of timbers, such as the "square set" for supporting the earth and rock around shaft, drift, and tunnel cuttings, and for use in framing timbers for other purposes. The two saws are mounted upon a fixed frame so as to rotate at right angles to each other, and so as to cut to the same line both ways through the timber. The timber carriage has a forward and backward motion, and is provided with rotatable timber clamps, by which the timber may be turned axially, in order to present all of its faces to the saws. That portion of the carriage which carries the clamps is so mounted as to rotate horizontally, thus permitting both ends of the timber to be presented to the saws. The timber clamp frame is adjustable toward and away from the saws, to govern the length of the framed timbers.

The various devices by which all of these motions are effected are simple in construction, durable, and permit of easy and rapid manipulation, and are so placed as to be within convenient reach of the operator. It will also be seen that when once placed in the machine the timber is under complete control of the operator.



BLEY'S MACHINE FOR FRAMING TIMBER.

Additional information concerning this timber framing machine can be obtained by addressing the inventor, Mr. William J. Bley, of Silver King, Arizona.

An Electric Tram Car.

Experiments have been carried out for a few months past in a quiet and systematic way with a view of determining the value of secondary batteries, in conjunction with electro motors, for the propulsion of tram cars in crowded cities. Mr. A. Reckenzaun has designed, and the Electrical Power Storage Company has constructed, apparatus which, says the *Engineer*, promises a very handy means of locomotion on street rails, and for more than two months past a car has been running on a line put down for experimental purposes in the yard of the Storage Company at Millwall. The line—4 feet 8½ inches gauge—is 400 feet long, forming a right angle of nearly equal sides, so that about half way a curve of 35 feet radius has to be passed. From one end, as far as the commencement of the curve, the road is tolerably level; but with this curve commences an incline of 1 in 40, which rises gradually until it reaches the maximum of 1 in 17 nearly at the end of the up journey; thus it is impossible to make a rush for the hill, on account of the sharp curve intervening. The car itself is an old one procured from one of the metropolitan tramways, and it has done many years' service while drawn by horses on the Greenwich, Westminster line. The body of this vehicle weighs 2½ tons, and it accommodates forty-six passengers. The accumulators furnishing the electric energy are of a special type manufactured by the Storage Company, to the designs of Mr. Reckenzaun. Stowed under the seat on long trays, which run on rollers for their speedy removal, they are out of sight, and the whole car internally and externally has the ordinary appearance. The motor and gearing—Reckenzaun's patent—are placed underneath the car, and occupy so little space that to an ordinary observer they are invisible. The speed may be varied from three miles to ten miles per hour.

Electric tram cars propelled by accumulators have been made and tried on several occasions in London, Paris, and Brussels, but hitherto with little success, and eminent men have pronounced the accumulator system of motive power as impracticable. One of the main reasons assigned was that batteries were much too heavy. The Electrical Power Storage Company has, we are told, reduced the weight without sacrificing either efficiency or durability. The accumulators in the car under notice weigh 1¼ tons, the motor, gearing, and accessories weigh about ½ ton, bringing the total weight of motive power to 1¾ tons for a car which, with its full complement of passengers, weighs itself 5½ tons; while the batteries, motor, and gearing are capable of furnishing at any desired moment a power of sixteen horses if required. Comparing this weight of 1¼ tons, with that of a steam tramway locomotive, or a compressed air locomotive, either of which will weigh some eight or ten tons to do the same amount of useful work, stored electricity has the advantage in proportion of about five to one, so long as the propelling force is directly proportional to the weight moved. It has also been said that there is a great waste of power in the use of accumulators for motive power, as the conversion of energy has to pass through several stages, viz., steam into electric current, current into oxygen and hydrogen, and these again into current and electro-motive power. It can be shown from prolonged experiments and practice that the total loss of energy with all these transformations is 66 per cent between the steam engine and the tram rails. Tramway steam locomotives consume from three to four times as much fuel per horse power as large stationary engines, such as would be used for driving dynamo machines; and bearing this in mind, an efficiency in the electrical tram car far below the one quoted above would still be considered economical. The prime cost of the electrically propelled cars with the charging station is less than steam cars, and the depreciation and repairs of machinery must also be less, on account of the few wearing parts and the complete protection from dirt.

The running cost, including 15 per cent depreciation on machinery and 50 per cent on accumulators, is given as 3·5d. per car mile, which is about one-half of the cost of horsing on tram lines. The car on the line at Millwall runs for two hours with one charge, starting, stopping, and reversing every sixty seconds, and the discharged accumulators can be replaced, it is said, almost as quickly as changing a pair of horses, by means of a trolly, which brings and removes the trays of cells, running on rollers. The whole arrangement has been very carefully worked out in every detail, the mechanical parts being as well arranged. The load is distributed upon two small bogies, so that no objection can be raised on the part of tramway companies using light rails laid for horse car traffic, and the old rolling stock can be readily utilized by putting the bogies which carry the motor under the car, and fitting the space under the seats for the reception of the accumulators. The car is brilliantly lighted by four 20 candle power Swan lamps, and bell pushes inside the vehicle enable the passengers to call the conductor and driver at the same time by the ringing of electric bells.

Rise of the Swedish Coast.

An examination of a series of water marks set in 1750 all round the Swedish coasts, from the mouth of the Tornea to the Naze, in order to settle a dispute between the Swedish astronomer Celsius and some Germans, as to whether the level of the Baltic had been rising or sinking, shows that both parties were right. The gauges were renewed in 1851, and again this year, and have been inspected regularly at short intervals, the observations being carefully recorded. It appears, says *Nature*, that the Swedish coast has been steadily rising, while that on the southern fringe of the Baltic has been as steadily falling. The dividing line, along which no change is perceptible, passes from Sweden to the Schleswig-Holstein coast, over Bornholm and Laland. The results have lately been published by the Swedish Academy of Sciences; and it appears from them that while during this period of 134 years the northern part of Sweden has risen about 7 feet, the rate of elevation gradually declines as we go southward, being only about one foot at the Naze, and nothing at Bornholm, which remains at the same level as in the middle of the last century. The general average result would be that the Swedish coast had risen about 56 inches during the last 134 years.

THE friends of Professor Huxley will be pained to learn that his health is so impaired that he is obliged to spend the winter in southern Europe. From last advices he was staying at Naples, and is already much the better for rest and change. He will pass a month or two at the interesting old city of Amalfi, where it is hoped he will regain perfect health.

Dearborn Observatory, Chicago.

Prof. G. W. Hough gives a very interesting report for 1884.

The instruments in constant use are the great equatorial, the Repsold meridian circle, chronograph, and the various standard clocks. All have been kept in good working order by making the necessary repairs.

Since the date of the last report the gas engine has been placed in the tower for turning the dome. It is connected with the crank shaft by means of bevel gear and one counter shaft, so that but very little of the power is consumed by the belting. It is started instantly, and requires no cleaning or adjusting. A little blacklead on the piston and slide valve once in two or three weeks is all the attention required. It has a working power of 8,000 foot pounds, or about one-fourth horse power.

During recent years a great deal has been said with regard to the construction of large domes, in order to make them readily manageable. From our experience with the Chicago dome, we believe the most satisfactory solution of the problem is the employment of some mechanical motor. There are three forms of force readily accessible to most observatories, viz., water power, gas, and electricity, either of which is readily manageable. Our small engine is capable of turning the dome through 180° in five minutes, so that the time lost in changing from one part of the heavens to another is a matter of no consequence.

As heretofore, standard time has been furnished to the city of Chicago daily. The signal clock has transmitted its beats to the fire alarm office without interruption during the year.

On nearly every clear day or night meridian observations for time have been made with the Repsold meridian circle. Since the date of the last report such observations have been secured on one hundred and fifty-six days, or an average of rather more than two and one-half days in each week. The time signals have generally been correct within two-tenths of a second, and the accumulated error during protracted cloudiness has rarely amounted to one second.

The going of the standard clock has been such that the probable error for one week would fall within one second. At 9 A.M. of each day all the clocks and the chronometer are compared on the chronograph, and the transmitting clock adjusted when necessary.

The standard meantime clock, placed in the city fire alarm office, has been kept as nearly correct as was practicable. Its error has been furnished to me daily by telegraph, and whenever it needed adjustment it has received my personal attention.

The work with the great equatorial has been confined to a few special subjects, viz., such observations as are only possible with the best telescopes.

The following objects were systematically observed:

Pons-Brooks comet.
Difficult double stars.
The planet Jupiter.
The satellites of Uranus.
Miscellaneous observations.

The Pons-Brooks Comet, although it did not attain great brilliancy, yet was an object of interest on account of its periodicity, being identical with the comet of 1812.

The head, or nucleus, was examined whenever the seeing was favorable for change of structure in the surrounding envelopes.

Near the time of greatest brilliancy the envelopes were fan-shaped, similar to the comet of 1861; but the changes in structure were not remarkable.

During the year I discovered thirty-two new double stars, most of which are difficult, and can only be observed when the seeing is good.

The micrometer measurements of double stars for the most part have been confined to those which I discovered in previous years.

The companion to Sirius, a difficult object for most telescopes, was systematically measured by Mr. S. W. Burnham and myself. On nights when the seeing was suitable for micrometer work on other objects, we had no difficulty in measuring it.

The observations of recent years seem to indicate that the period of revolution for the companion will be longer than that indicated by theory. But a few years more of careful observation will probably be necessary to definitely determine the orbit.

The planet Jupiter has been carefully observed on all possible occasions, and micrometer measurements made on the salient spots and markings, for the determination of their latitude and longitude. As the opposition of the planet occurs now at a very unfavorable season of the year, it is somewhat difficult to follow up the minor spots and markings, since they usually require first-class seeing for their observation.

In making physical observations on any celestial object, the quality of the image is an important matter, and unless it is carefully taken into account, may lead the observer to very erroneous conclusions regarding the phenomenon in question. This fact should especially be borne in mind in making physical observations on the disk of a planet.

We believe the erroneous statements regarding sudden changes on the disk of the planet Jupiter, made by both ancient and modern astronomers, are largely due to this cause.

During the past five years of our study of Jupiter we have met with so many instances of alleged phenomena which were not real, that we believe the subject requires very careful consideration on the part of all observers.

This criticism is not merely an opinion on our part, but is based on direct and positive knowledge.

As heretofore, the principal object of interest on the disk of Jupiter was the great red spot first noticed in 1878. During the past opposition it has usually been of a pale brown or pink color. When the seeing was unusually good, the color was unmistakably a pale pink.

This remarkable object has maintained its size, shape, and outline, with very slight change, during the whole five years of its observation here.

During the past opposition it was alleged in foreign journals that the spot had lost its outline, and become merged in a faint belt on the following end. This statement is entirely erroneous, as it was subsequently seen on various occasions with the Chicago telescope entirely separate and distinct from any belt, and presenting the same outline that it did in 1879.

The most marked change has been in its visibility. During the latter portion of the previous opposition it became very faint, and was announced to have disappeared; but observations were made on it at the Dearborn Observatory as long as the planet was visible.

During the present opposition, when the seeing was not good, micrometer observations of the spot were difficult, and hence the measures are subject to greater error than during the earlier years.

White spots, near the equator of the planet, were observed in different longitudes, all of which give essentially the same rotation period.

The observations of the principal spots observed in 1879 and subsequent years indicate a retardation in their motion, as compared with former observations.

The "equatorial white spot," so called, consists of a group of at least three or four distinct spots, lying in nearly the same latitude, and differing from four degrees to twenty-five degrees in longitude. Very often two or three of these objects are visible at the same time, and then again for considerable periods only one can be seen. During the past opposition two were usually observed. These spots were not absolutely fixed with reference to each other, but remained, however, for some months in the same vicinity.

The envelope in which they are situated moves with a velocity of 260 miles per hour, and makes a revolution around the planet in about 44½ days.

The approximate uniformity of this motion during so many years leads us to conclude that the force actuating its motion is of a degree of permanency similar to that of gravity. The problem of the physical constitution of the surface of Jupiter is yet a mystery. We need more exact and continuous observations on the minor details.

Curious Experiment with Sewage.

A curious experiment was shown a year or two ago, in which a long glass tube was filled with earth, and sewage poured in at the upper end. If the tube was long enough, perhaps six or eight feet, the liquid issued from the bottom clear and pure, its dissolved and suspended organic matters having been oxidized by the soil. If, however, before pouring in the sewage, a little dilute chloroform were allowed to filter through the earth, sewage subsequently applied passed through the tube without change, the oxidizing action of the soil being completely suspended. After some hours or days, the soil regained its oxidizing quality. This experiment was believed to show that the oxidation of organic matters in sewage was something more than a chemical reaction, and that it depended, at least to a certain extent, on the presence of small living organisms whose activity could be temporarily suspended by an anæsthetic, and with it the oxidation of the sewage.

This theory has now been confirmed by additional observations, and the little creature which converts into fixed and harmless salts the putrefying impurities of such sewage as it can reach is believed to be a micrococcus somewhat resembling the yeast plant. Many and varied tests have been made to determine the conditions under which the disinfecting microbe lives and acts, and a good deal has been learned about its habits. It is found that it flourishes best, and is most efficient, at a temperature of about ninety-eight degrees Fahrenheit, nearly the temperature of the blood. At higher or lower temperatures its action becomes more feeble, and ceases altogether near the freezing point, or above one hundred and thirty degrees. Experiments to show its distribution in a clay soil show that it is most abundant in the upper six inches, but is found to a depth of a foot and a half. Below that depth it cannot live, and soil taken more than eighteen inches below the surface has hitherto always failed to induce any change in nitrogenous solutions to which it was applied.

These experiments cast a great deal of light upon many questions of sewage disposal by subsoil or surface irrigation, and further tests, made with some reference to this, would be easily made, and extremely valuable. It is found, for instance, that nitrogenous solutions, in order to be acted upon by the oxidizing ferment, must be alkaline, acid liquids remaining unaffected. This observation shows at once that where sewage is to be purified by irrigation, chemical wastes must be kept out of the drains. Normal house sewage is generally slightly alkaline, and in good condition for conversion, but the admission of the acid or poisonous wastes from a dyehouse, metal working shop, or manufactory of any other kind might render the sewage of a whole town incapable of purification.—*Amer. Architect.*

Proposed Employment of Electric Motors on the Elevated Railways, New York City.

According to the calculations of Prof. Moses G. Farmer, it will only cost about one-quarter as much to run the elevated railways by electricity as is now paid for steam locomotives. His calculations are as follows:

A stationary plant can be erected somewhere near the middle of the line, not far from Sixty-third Street, this plant to consist of one or more stationary steam engines of the best type, capable of developing 1 horse power by the combustion of 1¾ pounds of coal per hour per horse power, by the use of such coal as does not cost over $2.50 per ton of 2,240 pounds.

There are in use on this line 20 locomotives of 110 horse power each at the busiest hour of the day, and that each locomotive consumes—per horse power per hour—5 pounds of coal that cost $4 per ton of 2,240 pounds.

The rails now in use are steel and weigh 70 pounds per yard, and that a central steel rail of 70 pounds per yard will be laid for the purpose of conveying the electric current to the motors.

One mile of such steel will offer about 1-20 of an ohm's resistance, and that the aggregate internal resistance of the dynamos concerned in producing the current will not exceed 1-200 of an ohm.

From the central station sufficient current will be supplied to both tracks to energize at the same instant all of the twenty electric locomotives, no matter on what part of the tracks these motors may be situated.

One horse power is the equivalent of 746 ampere-volts, and 20 x 110 x 746 = 1,641,200 ampere-volts, in the aggregate, reach these motors.

Dynamos can be constructed as shall convert 90 per cent of the mechanical power applied to them into current electricity, and I also assume that such electric motors can be constructed and used as shall convert 90 per cent of electricity which they receive into power used to draw the trains which are attached to them.

The Second Avenue Railway is 6½ miles in length.

Invention of Gunpowder.

In a paper recently read before the Shanghai branch of the Royal Asiatic Society, Dr. Macgowan affirms the claims of the Chinese to be the originators of gunpowder and firearms. This claim was examined in an elaborate paper some years ago by the late Mr. Mayers, and decided by him in the negative. Dr. Macgowan admits that gunpowder as now used is a European discovery. Anterior to its granulation by Schwartz it was a crude compound, of little use in propelling missiles; this, says the writer, is the article first used in China. The incendiary materials stated by a Greek historian to have been employed by the Hindoos against Alexander's army are stated to have been merely the naphthous or petroleum mixtures of the ancient Coreans, and in early times used by the Chinese. The "stink pots," so much used by Chinese pirates, are, it appears, a Cambodian invention. Dr. Macgowan states also that as early as the twelfth or thirteenth century the Chinese attempted submarine warfare, contriving rude torpedoes for that purpose. In the year 1000 an inventor exhibited to the then Emperor of China "a fire-gun and a fire-bomb." He says that while the Chinese discovered the explosive nature of niter, sulphur, and charcoal in combination, they were laggards in its application, from inability to perfect its manufacture; so, in the use of firearms, failing to prosecute experiment, they are found behind in the matter of scientific gunnery.

The Ammoniacal Ferment.

By ammoniacal ferment the author means that which transforms urea into ammonium carbonate. It exists in considerable quantities in the soil, in the atmosphere, in the waters on the surface of the earth, in rain, and in many underground waters. It acts as well in a barometric vacuum as at the normal pressure or even under a pressure of three atmospheres. It decomposes urea in presence of air, of oxygen, nitrogen, hydrogen, carbonic oxide, and nitrogen monoxide. With the exception of chloroform, which delays its action, anæsthetics have no effect upon it. Antiseptics do not interfere with its action, except when used in very large quantities.—*A. Ladureau.*