sneezing. Shivering is a less effective convulsion to restore the paralyzed nervous energy, but in a lower degree it may answer the same purpose. The shivering that results from the effect of a poison on the nervous centers is a totally different matter. We speak only of the quick muscular agitation and teeth chattering which occur whenever the body is exposed to cold and evil results do not ensue. It follows from what we have said that the natural indication to ward off the effects of a chill is to restore the vital energy of the nerve centers, and there is no more potent influence by which to attain this object than a strong and sustained effort of the will. The man who resolves not to take cold seldom does."

THE TELEPHONE CENTRAL OFFICE SYSTEM.

[*Continued from first page.*]

is represented in the larger view in the engraving. Each person having the use of a telephone connected with the central office is called a subscriber, and his wire entering the office is connected with a small switch—a jack-knife switch; just below his name, and by this switch an electrical communication between the line and one of the annunciators above the switch is established or broken.

The arrangement of a telephone line in its normal condition is as follows: One wire from the subscriber's local battery is grounded; the other connects with the push button seen at the side of the desk. When this button is pressed the current from the local battery passes through the line wire, through the switch at the central office, through the magnet of the annunciator to the ground. The effect of the passage of the current through the annunciator is to release the little cover concealing the number of the subscriber's wire, permitting it to drop and expose the number. On seeing the number, the switchman connects his portable telephone with the subscriber's line, by inserting the plug at the end of the flexible telephone cord in the jack-knife switch. This operation not only connects the switchman with the line, but it also breaks the connection between the subscriber's line and the annunciator. The switchman's telephone being already connected with a battery and induction coil, and in condition to talk over the subscriber's line, he says to the subscriber, whom we will call A: "Well, A; what will you have?" A then says: "Connect me with B (say) at 25 Wall street."

The switchman then connects A's jack-knife switch with one of the long horizontal bars seen below; switches and turns the bar slightly, to indicate that it is occupied. He then goes to B's jack-knife switch; inserts one end of a flexible cord in the switch, and taps on a long brass strip connected with the central office battery, thus sending electrical impulses through B's line wire, ringing B's bell, when B removes his receiving telephone from its switch, and listens while the switchman connects B's jack-knife switch with the same horizontal rod that is connected with A. He then removes A's connection from the rod, and tells A "All right; go ahead," when the conversation between A and B proceeds. It takes only seconds to do what has required minutes to describe.

The boys attending the switches become expert and rarely make mistakes, although it is difficult to see how anything could be done correctly amid the din and clamor of twenty or thirty strong voices crying, "Hello! hel-l-o, A!" "Hello, B!" "What will you have?" "Who?" "Which?" "What?" "A-l-l right," and so on. It seems anything but orderly and systematic; but, nevertheless, it is the very embodiment of order and system. There are no less than six thousand calls per day; yet there is no delay, no mistakes, no trouble, save from the occasional breaking of a wire or the crossing and interference of one wire with another.

An idea of the activity of a telephone central office may be obtained from the larger view. The actual condition of things is far from being exaggerated.

It doubtless will be asked, How is it known at the central office when A and B have finished talking? The clearing out relays shown in one of the lower views, and at the farther end of the office in the upper view, indicate this. These relays, which are of comparatively high resistance, are each arranged to work a local circuit in which there is an annunciator representing one of the switch rods.

Each horizontal switch rod is connected with one of the relays, and all of the relays are grounded. Now A, having begun the conversation through the telephone, must indicate when it is ended; therefore, upon hanging up his receiving telephone, he pushes the button four or five times, working the relay, and consequently the annunciator connected with it, indicating that whatever is connected with the horizontal switch rod whose number corresponds with that of the annunciator, may be removed, and the switch rod may be used for C and D, or any one else.

One desk, seen at the right of the larger engraving, is the chief operator's desk, and the line-men, whose business it is to rectify troubles, get their orders at this desk.

There are upwards of 600 wires entering this office alone, and it requires over a thousand cells of battery to work this maze of wires.

Persons desiring to avail themselves of this means of communication subscribe to certain conditions, which require, among other things, the payment of a monthly rental, and the observance of the rules of the company. Men are then sent from the central office to place the telephone and battery, and to run from the subscriber's telephone to the central office a wire, supporting it at intervals by poles and fixtures as in the case of telegraph lines. The line and the instrument are kept in order by the company. Any imperfection in the action of either reported to the chief operator's desk at the central office receives immediate attention, men being sent out at once to find and remedy the trouble.

An alphabetically arranged list of subscribers is furnished with each telephone, and as new subscriptions are made, supplementary lists are furnished to all subscribers.

Among the recent improvements in telephone exchanges is the portable switchman's telephone, which is clearly shown in the lower left-hand view in the engraving, and the switch rods, shown in the same view, and also in the larger one. The latter are the invention of Mr. T. G. Ellsworth, the manager of the central office. They certainly save a great amount of labor, and prevent confusion and trouble.

The telephone, like many other modern inventions, needs to be used to be appreciated. It is wonderful enough that we are enabled to talk to persons in all parts of this great city, but when we can talk without difficulty with persons in neighboring cities, it becomes even more wonderful and interesting. The lines which connect New York with Newark run under the North River. Those that connect New York and Brooklyn are suspended from the East River bridge towers. The wires may run underground, under water, or high in air.

The large and rapidly-increasing number of telephone lines indicate the growing popularity of this means of communication, and we confidently expect at no distant day to see it almost universally adopted for business and even domestic purposes. Already the wires extend in every possible direction from the central office, and fairly darken the sky in some localities. The Gold and Stock Telegraph Company have in this city three exchanges similar to the one we have described, connected with each other, and, with the central office systems, several of the adjoining cities. Jersey City, Newark, and Orange, N. J., and Brooklyn, N. Y., are so connected. Yonkers, and, in fact, all of the other important cities surrounding New York, will undoubtedly be telephonically connected with the metropolis before the beginning of another year. We understand New York and Philadelphia are soon to be connected in this way. The convenience of such means of communication is thoroughly appreciated by business men, whose operations are confined to a few hours, and whose time is valuable. The SCIENTIFIC AMERICAN has constant proof of the utility of this invention, as there is scarcely an hour in the day that the telephone in the office is not used in communicating with some one, either in this or one of the adjacent cities.

ON THE DEPHOSPHORIZATION OF IRON.

BY PROF. MAURICE KEIL.

Science has of late years made fast strides, and one scientific fact after the other has been forced to yield the point which it is the business of our utilitarian age to force from facts. In the chemical metallurgy lately the perfection of the process for the dephosphorization of iron has caused quite a sensation, and has set scientists to work for further investigation. Not long ago the convenient and economical use of our most reliable metal—iron—was hampered by the facility with which it rusted and decayed. Once attacked by rust, the rust point was a center from which proceeded further corrosion with fatal rapidity; but also in this instance, true to the exacting spirit of the age, nature has been made to yield up her secret, and iron is to wear in future a protecting coat of oxide of iron, to the perfection of which centuries testify.

In the new dephosphorization processes of Krupp and Bell, and of Thomas and Gilchrist, a problem has been solved which has baffled the scientific world for years. And it must be admitted as a great invention, the importance of which it is scarcely possible to exaggerate. In the light of the past history of inventions, it is not surprising to find that the development of this important process is not the work and thought of one man. The same end certainly has been accomplished, independently, but by different means. The importance of the invention lies in the fact that, while up to the present districts which had only at their disposal iron ore of a phosphoric nature exclusively, were not able to produce any forged iron or steel, will now be able by means of this process to work iron up to any imaginable form or shape or manufacture steel. This process will certainly also revolutionize a complete alteration in the relative iron production for the future.

As remarked above, both processes are alike in principle but different in execution. The process of Krupp and Bell is divided into two stages. First, elimination of the phosphor (100 parts of iron melted in a cupola oven to 15 of oxide of iron, or 25 per cent consumption of ore if worked in a Siemens-Martin furnace) in a rotating oven attained a reduction of the phosphor from 0·6 to 1·2 up to 0·13 to 0·3, therefore a refining, and afterward conversion of the refined iron in the converter. Silicium iron must be added to the product, as this is taken away in the first stage.

In the Thomas and Gilchrist process both stages are united in the converter, as by means of a basic lining and basic flux the elimination of the phosphor is produced, as shown further on.

Taking particularly this process the last experiments that have lately taken place in an eight ton converter fully demonstrate the complete success of the invention, which is as follows:

The converter used for the experiment was lined with basic bricks, of the following chemical composition: SiO_3 = 9·50, CaO = 50·21, MgO = 21·50, Al_2O_3 = 10·00, Fe_2O_3 = 4·46 NaO = 4·00, and it had a perforated bottom of dolomite, for want of the exchangeable pipes, which could not be obtained, as they had not been manufactured.

The gray Cleveland pig iron, which had been remelted in a cupola oven, contained: Si = 3·030, C = 3·200, P = 1·800, S = 0·030, Mn = 0·450, of which 5 tons 18 cwt. were poured into the converter.

Directly afterward there were poured in (about 20 per cent against the above in-put) 21 to 24 cwt. of flux of a mixture of limestone and oxide of iron (20 to 27 per cent of blue billy), which before had been melted together into firm pieces of the following chemical composition: SiO_3 = 1·000, CaO = 60·000, Fe_2O_3 = 31·890, CO_2 = 6·400. After which the converter was raised upright and blown with 120 cm. column of quicksilver.

By the first charge, after four minutes the line of natron appeared in the spectrum, while during the period of boiling a large quantity of iron was thrown out; after 17 minutes the green lines had disappeared, and by usual hematite melting the process would have been finished with this charge. But the blowing was continued for another 1½ minutes, the converter tilted, and a proof taken in the usual manner, which still showed a luminous grain proceeding from considerable alloy of phosphor. The process was therefore continued for another minute and 22 seconds, after which no trace of phosphor was perceptible. Now followed the addition of spiegel iron in a liquid state, containing 22 per cent of manganese, in proportion of 9½ per cent to the pig iron put in, which created a violent reaction, and the slag was thrown out in powerful columns of flame. On the pouring out in the casting pans the steel appeared agitated and of soft quality, but rose in the pans and was uncovered in the usual manner. The converter, after running quite empty, did not show the least trace of injury, the borders of the bottom perforators were strongly marked, the joints of the bricks were regular, somewhat darker as the glowing brick matured, but perfectly uninjured. The finished steel showed the following composition: C = 0·171, Mn = 0·160, P = 0·223, S = 0·037, Si = traces.

The blocks were afterward transferred to the gas furnace and rolled in quadruple lengths for rails. The experiments were highly satisfactory, and a special advance to the Bessemer process.

MECHANICAL INVENTION.

An improvement in windmills, patented by Mr. Thomas Dewees, of San Antonio, Texas, consists in arranging three stationary sails between arms on central shaft, so as to obtain double or increased power from the air passing through the wheel.

MIASM AND FEVERS.

Abundant experience has already established the following facts regarding the appearance of intermittent fevers and the causes which are designated as *malaria:* First, that the real cause is to be sought for in the soil, where it is developed in greater intensity under favorable conditions of heat and warmth; second, that this poisonous substance, when the surface is dry, is lifted up a little above the surface by ascending currents, and can then be carried further or raised to a greater height by stronger draughts of air; third, that this substance, the cause of the malaria, is not developed in every soil of the same composition and the same degree of moisture, a circumstance which has repeatedly led to the assumption that it possesses the nature of a specific organism, which requires for its development not only the most favorable conditions, but first of all a *germ* from which it is developed.

From time immemorial the Roman campagna has been known as one of the poisoned plague spots of the earth, hence the interest that naturally attaches to the investigations made there last spring by Klebs and Tommasi-Crudeli.

The malarial powers of different kinds of soil, of water, and of air, were tested. The solid and liquid portions of the former were tested separately. Under the supposition that the germs of the disease were organism, substances rich in infective matter were exposed to those conditions which have been found by experience most favorable to the development of the disease (30° to 40° C., or 86° to 104° F.; plenty of moisture deeper in the soil and rapid evaporation on the surface). Small particles of substances thus prepared were transferred to different liquids for cultivation, and then experiments were made to determine whether, after frequent successive fractional cultivation, the same activity was present as in the substance first employed. Finally, the liquid was mechanically separated from the solid microscopic particles in the cultivated liquids, as in the original, by filtration through gypsum and other filters, and the relative activity of filtrate and residue separately examined. To test the activity of these different substances they were injected hypodermically into rabbits; the temperature was measured every two hours, and the dead body examined. The regular intermission of the fever and the swelling of the spleen and want of other changes were employed as guides and measurements.

The results may be briefly summarized as follows.

1. The malarial poison is found in large quantities and largely disseminated through the soil of malarial districts at a season when people are not yet attacked by disease.

2. At these times it may also be obtained, in especially

favorable places, from the strata of air nearest the surface. To test this, 300 liters of air were thrown with great force and velocity against a glass plate covered with glue solution, to which the solid particles in the air adhered.

3. Stagnant water in malarial districts seemed not to contain the disease, although it may be, like the lake of Caprolace, extraordinarily rich in lower organisms. Their experiments indicate that a large quantity of water hinders the development of malarial poison and renders the germs which are present inactive.

4. By infection with the above fluids, some directly from the soil and others prepared by cultivation and filtration, a fever was produced in the animal of the regular type, with intermissions, which lasted up to 60 hours, and an increase of temperature up to 40° C. (104° Fah).

5. The filtered liquids caused but very slight increase of temperature even when five times the quantity was injected. Even filtering through a double paper filter seems to remove the malarial poison.

6. Animals infected with malarial liquids all showed a swelling of the spleen, and in many of them was found a black pigment.

7. The organisms which were the real cause of the malaria belong to the genus *Bacillus*. They are present in the soil of malarial regions in the form of numerous movable brilliant spores of long oval shape, with a greater diameter of of 0·95 micrometer. They grow, both in animals and in cultivating apparatus, into long threads, which are at first homogeneous, but afterward divide and develop again within the limbs. These spores first form on the walls, but finally the whole interior of the member becomes filled with these little bodies. Owing to their peculiar morphological action they must be looked on as a new kind of bacilli, and have been named *Bacillus malariæ*.

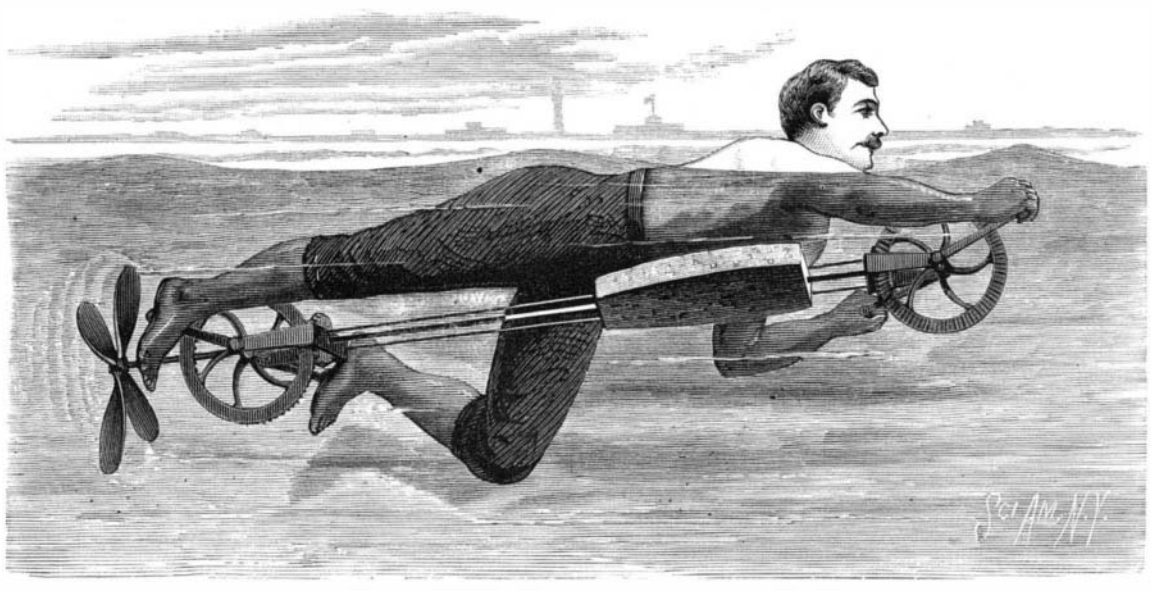
8. These organisms will not develop if atmospheric oxygen is excluded, and hence belong to the class of Aerobii. They do not develop in water, but will in nitrogenous liquids, like solutions of glue, albumen, and the fluids of the body. Sometimes the fibers reach the length of 0·06 to 0·084 mm.

ANOTHER EXTINCT RACE THAT NEVER EXISTED.

One of Mark Twain's best points was made when he described the Indians of Cooper's novels as an extinct race that never existed. Now Professor Stephenson, of the Hayden surveying party in New Mexico, is charged by a Chicago paper with giving a similar report of the Aztecs. He says they are a myth, and that the tribes known as the Cliff-dwellers are to be credited with all the romance attached to the Aztec name. New Mexico is full of their buried towns and cities. During his summer's work in New Mexico, Professor Stephenson made a number of valuable collections, including skeletons and remains of extinct animals. Among his trophies are two gods of Egyptian character, with finely cut features, outstretched wings, and traces of paint on their faces. The Professor brought away specimens of pottery bearing a close resemblance to that unearthed in the ruins of the Old World, and also secured the secret of its manufacture from the Indians, who still make it in New Mexico.

NOVEL SWIMMING DEVICE.

We illustrate herewith one of the most novel applications of machinery that has come under our notice. It is a singular craft without hull or engine, but nevertheless apparently correct in principle and capable of practical application. This swimming apparatus, recently patented by Mr. William H. Richardson, of Mobile, Ala., consists essentially of a light frame carrying a float and a longitudinal shaft, having at one end a small screw propeller and provided with gearing for running the propeller.



RICHARDSON'S SWIMMING APPARATUS.

The swimmer reclines on the float, and, grasping one of the hand cranks in each hand and placing his feet on the two foot cranks, proceeds rapidly and easily, with the head far enough above the surface of the water to be comfortable without extra exertion.

The inventor asserts that a swimmer with one of these machines can, under favorable circumstances, make from four to five miles an hour without undue exertion.

Further information in regard to this novel device may be obtained from the inventor.

Substitute for Cod Liver Oil.

According to the New York *Medical Journal*, Dr Thomas A. Emmet, of this city, in his recent work on the "Principles and Practice of Gynecology," recommends the fat of pork, properly prepared, as an excellent substitute for cod liver oil. A portion of a rib, free from lean, is selected and soaked in water thirty-six hours to get rid of the salt. It is then boiled slowly, the water being often changed, until the meat is thoroughly cooked. It is to be eaten cold in the form of sandwiches, cut very thin. Thus prepared, it forms, according to the author, a very nutritious and concentrated article of diet, and one which can often be retained by irritable stomachs.

JUVET'S TIME GLOBE.

For many years it has been the ambition of horologists to apply by some mechanical device a motor to a terrestrial

JUVET'S TIME GLOBE.

globe, that, while it should show the exact diurnal revolution, should also be so constructed as to have utility as a timepiece. Various and ingenious methods have been devised, putting a clock in a case and projecting above its base a rod with a gear coupled into another on the equatorial portion of the globe. A French inventor made a globe in the shape of a dome, exhibiting only the northern part of the earth, and by an impelling mechanism turned it on its axis. These and other crude and cumbersome mechanical devices prevent any other than a rigid position, and one that could not accurately illustrate the earth's polar position. A sphere that shows but a half globe, or one that necessitates a fixed horizontal or perpendicular polar projection, is calculated to mislead and not instruct. The requirements for a perfect scientific instrument of this kind are excellence as a time-keeper, accuracy, clearness, and completeness of map surface. It must admit of being easily examined, and should be capable of any inclination necessary for terrestrial or other planetary illustrations.

Any exterior mechanism precludes these essential requirements.

Mr. Louis Paul Juvet, a native of Neufchatel, Switzerland, but for some time a citizen of the United States, after years of patient effort, has devised a time globe which avoids the imperfections of its predecessors. This globe, which is shown in the accompanying illustration, has a chronometer movement in its interior. The shell that envelops the works and protects them against accident or dust is very light and uniform in thickness, allowing the mechanism to turn freely, equably, and in perfect balance. The globe surface is as hard and smooth as a sheet of steel, being made of an entirely new material, which is unaffected by moisture, or heat, or cold. The meridian ring used for the support of the globe at its polar extremities, graduated for the measurement of latitude, is placed at some distance from the sphere to give lightness and beauty, and also to admit more easily examining the globe surface. It is held in any desired position by a simple swiveled clutch and holder. At the northern end the meridian ring is expanded into a holder for a transparent heavy plate glass clock dial, with the usual hour figures and minute marks. The hands are under the dial and the time is easily read, yet the dial is not an obstacle to the free examination of any portion of the globe. At the equator a zone dial encircles the globe, the hour figures and minute marks on which, by following the meridian line of any locality to it, gives the exact time of any place. In the illustration the hands of the clock show 12:20, the local time of New York city, the meridian line of which, it will be seen, stands also before 12:20 P.M. on the equatorial dial. It will be noted, also, that San Francisco is yet on the morning side of the meridian, while London is almost in darkness, and stands before 5:16 evening on the equatorial zone.

One half of the equatorial zone is darkened, being nearly black at midnight and shaded lighter on the left to 6 A.M., and on the right to 6 P.M., thus showing at a glance which part of the world is in daylight and which in darkness. The automatic motion of the globe, reproducing on a small scale the very movement of the earth, illustrates the phenomenon of day and night, and solves a problem that, simple as it is, is yet incomprehensible to many.

This globe is, in fact, a miniature earth in position and motion, being lightly and yet strongly made, with every portion of it visible. A clock and globe gives local and universal time with accuracy. It measures by its motion the comparative, and by the simplest computation the exact size of any country as it passes the meridian ring and equatorial zone. It can be placed in any position without derangement, and we are informed that it cannot be fractured by blows. It is unaffected by climatic changes. It is covered by a map which is a special edition of the celebrated Edinburgh (Johnston's) maps corrected to date, having all the recent political changes and geographical discoveries, and also blue lines indicating average winter, and red the average summer temperature of every country on the globe; the water being represented in blue of a desirable shade clearly shows by the white lines the ocean currents. Whenever a change in the boundaries of countries, addition of States, or important discoveries make it desirable, this globe can be remapped at a nominal expense. The axis of the earth is represented by a gracefully shaped arrow, the feathered end of which is used as a stem winder for the clock within, which runs four days, and is regulated from the outside. The works are simple, and can be taken apart or repaired by any mechanician.

It received the highest award of the Centennial Exhibition at Philadelphia, and has the most cordial indorsement of scientists at home and abroad. It is mounted simple or ornate, to meet various tastes. It is a fit ornament for any library, a valuable adjunct in every business office, and a necessity in every institution of learning. This beautiful piece of apparatus is patented in this country and in Europe.

For further information address Messrs. Juvet & Co., Canajoharie, N. Y.*

FISH CULTURE IN CANADA.—A Canadian official report states that during the fiscal year 1877–78 a sum of $20,088 was expended in restocking waters with fish, the number of young fish distributed during the year exceeding 27,000,000.

*See advertisement on another page.