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NEW YORK, SATURDAY, OCTOBER 20, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A 21½-KNOT BATTLESHIP.

A battleship which is capable of carrying a battery of ten 45-caliber, 12-inch guns across the high seas at a sustained sea speed of 21½ knots an hour and a maximum speed, for a limited distance, of 22¼ knots, is a proposition which may well be commended to the serious consideration of that diminishing school of naval architects which believes that speed is a greatly overrated quantity in modern warship design. According to press dispatches, the British battleship "Dreadnought," which has been undergoing her official trials, steamed for eight hours over a course 172 miles in length, at an average speed of 21½ knots, during which she reached a speed at times of 22¼ knots. The turbine engines, which were designed for 23,000 horse-power, during the trial drove the ship at a maximum speed for which the corresponding horse-power would be 28,000. These results give to this remarkable ship the distinction of combining in herself, in the highest degree, the characteristics of the battleship and the cruiser; for she has the offensive and defensive qualities of the one and the speed of the other.

In view of the high speed of the "Dreadnought," we think that our naval constructors should depart from the rather conservative policy which they have followed, and allot a larger share of the displacement of our future battleships to motive power. It is true that the "Dreadnought" and the three sister ships which are being constructed are, of all foreign warships, the least likely to be arrayed against our own; but we must remember that since the mark set by this vessel will be the standard of attainment for all foreign governments, we must look for a speed of 20 knots and over in the typical battleships of the future.

Simultaneously with the announcement of the trials of the "Dreadnought," it was stated by a London daily, whose naval information is generally correct, that the designs of the three new British cruisers, "Invincible," "Inflexible," and "Indomitable," which were authorized last year, are based upon the "Dreadnought," and that like her they are to carry a main armament composed exclusively of 12-inch, 45-caliber guns, of which each vessel will carry eight. The three ships are to be of practically the same displacement as the battleship; and by placing the two broadside turrets *en echelon*, or diagonally, at the center of the ship, and the other two turrets on the center line, forward and aft, these cruisers will be able to deliver the same broadside and end-on fire as the "Dreadnought," namely, six 12-inch guns ahead and astern, and eight 12-inch on either broadside. Their contract speed is to be 25 knots an hour; they will be driven by turbine engines; and their armor is to be something between that of the cruiser and the battleship. To all intents and purposes, then, these vessels will be battleships of the first class, carrying armor superior to that of many existing battleships, and having a speed from 6 to 8 knots greater than that of 90 per cent of the ships of this class afloat at the present time. In contemplating these 21½ and 25-knot warships it is disconcerting to remember that we are spending $10,000,000 on two battleships, the "Idaho" and "Mississippi," which are to steam only 17 knots an hour.

In the presence of such facts as these, it is not too much to say that a speed of 17 or even 18 knots is, for all future battleships, obsolete. Hereafter no design should be laid down which contemplates a speed of less than 20 knots an hour.

COMPLETION OF THE PENNSYLVANIA DOUBLE TUNNELS.

At just a quarter past four on the afternoon of October 9, the two shields in the south tunnel of the Pennsylvania Railroad met beneath the Hudson River, and the chief engineer, Mr. Charles M. Jacobs, had the satisfaction of formally declaring that the boring was completed. The driving of the north tunnel was completed over a month earlier, the two shields on that occasion, as on this, meeting with great exactness.

Air pressure was first turned on at the Manhattan end of the north tunnel in June, 1905, and at the New Jersey end of the south tunnel, in the following month. During the intervening period, in which the air pressure has varied according to the depth of the tunnel from 20 to 37 pounds to the square inch, not a single life, according to the statement of the chief engineer, has been lost. During that time the enormous total of 66,000 tons of metal, consisting of the cast-iron lining, has been put in place, and the speed of driving has been such that all previous records on main line subaqueous tunnel work have been broken. Now that the tubes are in place, the important work of sinking the massive tubular piles through the bottom of the cylinders to the rock, which lies far below the silt and sand through which the tubes have been built, will be undertaken. These piles will be driven 15 feet apart along the axis of the tubes, and they are provided with a deep thread which, as the tubes are rotated, will carry them down to rock bottom. Where they pass through the cast-iron shell of the tube they will be rigidly connected to the same, and the weight of the tunnels and the trains that run through them will then be borne directly by the solid underlying rock and hardpan, assisted, of course, by the material through which the tubes have been driven. The strength and security of the tubes will be further insured by lining the interior with a coating of two feet of concrete. Each tube is 23 feet in diameter and over 6,000 feet in length from shaft to shaft. The present estimate of the time necessary to put the tunnels in condition for the operation of trains is about one year and a half.

PANAMA CANAL TO BE BUILT BY CONTRACT.

Next to the purchase of the Panama Canal, the most important step taken by the government affecting this great enterprise is its decision, recently announced, to have the construction of the canal done by contract. In no other way can it be built within a reasonable time. Proof of this has been abundant during the past few months, in which the great paucity of official information regarding the canal has raised a natural fear that matters were proceeding with halting steps, and that the government was encountering difficulties most serious and probably unforeseen. This silence has been in marked contrast to the stream of volubility which flowed from the Bureau of Publicity, or whatever it may have been called, which was instituted when the government first entered seriously upon the work of organization and construction. It is certain that perplexing problems have confronted the advocates of government construction. The Canal Commission appears to have been quite unable to solve the labor problem which, as the weeks have slipped by, has loomed large and perplexing, dwarfing, by comparison, the bugaboos of malaria, yellow jack, or even the turbulent Chagres River itself. For it has proved almost impossible to procure labor of the most simple and unskilled type, white or black, and this in spite of the fact that many experiments have been made with laborers from widely-separated localities, who were supposed to be peculiarly fitted to work under the conditions which prevail at Panama. Moreover, the many efforts made by the Commission to take to the Isthmus and retain there the more intelligent class of men capable of directing the common laborers and of performing other general duties of a more or less authoritative kind, have met with equal failure. It is more than probable that the discouraging results attending the efforts of the government to secure bids for the supply of Chinese labor, have proved to be the last weight in the scales to turn them in favor of doing the work by contract.

Many months ago, when this journal was strongly urging the government to take the step which it has now decided upon, we were taken to task by a technical journal devoted to the engineering and contracting interests of the country, for proposing something which we were assured was, in the very nature of things, an impossibility. It was urged that there were only one or two firms which could command the capital necessary for the undertaking of such a huge task, and that, therefore, competition was out of the question, and the government would be, in the matter of price and time, at the mercy of the contractor. We are willing to admit that if bids were called for upon this work according to the methods commonly followed, there would be much truth in the criticism. But in the plan which the government is about to adopt, the interests both of the country and the contractor are so secured, that we feel satisfied the canal will be built under conditions which will guarantee the interests of both parties to the contract. For although the construction will be let by contract, the government of the United States will not, in the least degree, relinquish its authority over the work. In fact, it will retain under its hand everything save the work of actual construction. The contractor will excavate and build, and the engineers of the government will supervise. The government will make the contract with a single individual or concern, which will be composed of several reputable concerns, each of which will be expert in some particular branch of the work to be done at Panama. The companies presenting bids under the single contracting concern must have an aggregate capitalization, outside of debts and encumbrances, of $5,000,000, and the successful bidder must furnish a bond of $3,000,000.

The bids will be awarded upon what is known as the percentage plan, each bidder setting forth for how small a percentage of profit on the total cost of the work he will undertake to do it. The contract will be awarded to the firm which offers to do the work for the smallest percentage, provided, of course, that the government is satisfied as to its ability to live up to the terms of its bid. The total cost upon which the compensation of the contractor will be based will be estimated by a board of engineers, two of whom will be appointed by the successful bidder, and three by the government. The chief engineer of the Commission will be one of the government's appointees and will act as chairman of the committee.

Before finally adopting the form of contract which is now announced, Chairman Shonts of the Canal Commission consulted with a large number of leading engineers and contractors, and the government is satisfied that several bids will be submitted to the Canal Commission for the work of construction. The competition is not limited to American bidders; and should any foreign firms submit bids to the Commission, they will be considered upon the same basis as those handed in by American firms. In a letter transmitting to Secretary of War Taft the form of contract which the Commission has drawn up, Chairman Shonts states that if the elements of time and cost did not enter so vitally into the undertaking, the Commission would have created its own organization and done the work by day labor. This was rendered impossible by the "unprecedented and greatly-extended industrial activity of the times and the consequent violent competition for all classes of superintendents, foremen, sub-contractors, skilled mechanics, and even ordinary laborers." The great contractors of the United States have organized forces which stand prepared and fully equipped to do such work as awaits them at Panama. The only new conditions which may threaten their efficiency are those due to the climate, with its attendant tropical fevers and general debilitating influences. The government claims, however, to have the problem of sanitation well in hand; and if General Gorgas and his staff of sanitary engineers are given a free hand there should be no cause for apprehension of such epidemics as have been wont to sweep through the Isthmus under the administration of earlier canal builders.

Conspicuous among the advantages of contract construction is the fact that thereby the work will be forever rid of the curse of political patronage. Furthermore, if the contractors are wise they will make it an indisputable condition in the bids that they shall be free to purchase supplies and plants in the cheapest markets, American or foreign.

THE STATUS OF THE LIQUID BARRETTER.

Of the many types of detectors devised for manifesting the presence of impinging electric waves on the aerial of a wireless telegraph receptor, none are more interesting in their various aspects than the liquid barretter of Fessenden.

Different from the coherer, the action of which was discovered by Branly, improved upon by Lodge, and perfected by Marconi, the liquid barretter, or, as it is perhaps better known, the electrolytic detector, is the result of the effort and ingenuity of one man, and to him alone is due the credit for evolving the idea, developing it experimentally, and finally applying it to the commercial reception of wireless telegraph messages.

The first detector Fessenden called a barretter—a euphonious name derived from "barretor," an old French word meaning "exchange," since it possessed the property of exchanging the energy of the oscillations surging through it for a continuous current—was based on the fact that a loop of wire having an exceedingly small diameter requires an infinitesimal amount of current to heat it. To obtain this heating effect by means of electric oscillations set up in the antennæ, the loop was made of a silver wire 0.002 inch in diameter and having a platinum core 0.00006 inch in diameter, the tip of which was immersed in nitric acid and the silver dissolved away, leaving a minute area of the platinum exposed. The ends of the loop were fastened to leading-in wires, which were sealed in a small glass bulb, the completed arrangement appearing very like a miniature incandescent lamp.

The action of this barretter is based upon the following theoretical considerations, namely, that if a wire having a specific heat factor of such value that the latent energy required to raise its temperature to a certain excess above the air is relatively compared with the energy lost by radiation during the time of a signal, then if such a wire is connected in a local battery circuit, when a given amount of current flows through it there will be a corresponding change in the magnitude of the current produced by the local battery. Thus it will be seen that such a detector is purely thermal in its action.

The hot-wire barretter formed an exceedingly sensitive detector, but it possessed the serious objection of burning out whenever the oscillations surging through it carried any excess of current. This difficulty led Fessenden to conduct a new series of researches, and in one instance a very small column of liquid was substituted for the platinum wire previously used. Many different modifications were tried, and among them may be cited a wire inserted in the liquid, so that the resistance might be concentrated in the neighborhood of the power.

This form finally became the liquid barretter, the subject of much litigation. It consisted of a Wollaston wire having a platinum core of two or three mils, the silver sheath being dissolved away in acid as before, and the exposed point of this was immersed in an acid or alkaline solution; the wire served as one of the terminals of the circuit, a small platinum vessel containing the electrolyte providing the other. This device was patented by Fessenden May 5, 1903.

Its inventor accounted for its action on the theory that the electric waves decrease the resistance of the barretter, since the temperature coefficients of liquids is generally negative, and as the resistance is decreased instead of increased, the efficiency of the detector is further improved.

The great value of the detector was quickly recognized by those versed in the art, and it was not long before there were a half dozen claimants in the field, who used it, insisting that to them belonged the perquisite of discovery and invention. Among these may be mentioned as the most aggressive Vreeland and De Forest in the United States, Schloemilch in Germany, and Ferrie in France.

In November, 1903, Schloemilch published an account of his alleged independent discovery of the liquid barretter principle in the Elecktrotechnische Zeitschrift, and in January, 1904, Vreeland in his book, "Maxwell's Theory and Wireless Telegraphy," puts forth his claim in the following words: "Another electrolytic detector was developed by the writer [Vreeland] in the course of a series of attempts to magnify the heating effects of Fessenden's barretter by immersing the wire in a liquid of high temperature coefficient and low specific heat, which was made a part of the local circuit. The attempt was unsuccessful, but it led to the discovery that a simple electrolytic cell, when polarized to the proper critical point by a current from a local battery, is remarkably sensitive."

De Forest outlined his claims to the liquid barretter in a paper read before the International Electrical Congress, St. Louis, 1904, in which he characterized the heat theory of Fessenden as untenable, stating that its operation was electrolytic. Upon this argument De Forest evidently wished to show an analogous action between his own electrolytic responder and the liquid barretter. Ferrie's claim was put forth by Blondel in the Electrical World in a letter published May 6, 1905.

With these various assertions of ownership, it is small wonder that litigation was inevitable, and as a matter of fact no less than six suits have been brought by the opposing interests, five of which were decided in favor of Fessenden, and one against him dismissed.

In the first suit filed by the National Electric Signaling Company (Fessenden) against the De Forest Wireless Telegraph Company et al., in the United States Circuit Court, Judge Wheeler in rendering his decision said the testimony seemed to show that the De Forest detectors operated by bridges formed by the local circuit between closely parallel electrodes broken by the aerial impulse to give the signal, while the liquid barretter does not appear to operate by the making or breaking of any such bridges, but by a fluid path between the electrodes at variable distances.

As to Vreeland's claim, the court held that his work was merely an employee's step in the continuous investigations carried out by Fessenden. The court also disposed of the De Forest contention that the barretter operated electrolytically rather than thermally, holding that th theory of its action was of no importance in the case, and that the device sued infringed the claims of the patent regardless of what its mode of operation might be.

A decision was also rendered on January 27, 1905, in a suit of the National Signaling Company (Fessenden) versus the Gesellschaft für Drahtlose Telegraphie (Schloemilch) and a decree of injunction handed down restraining this company from using the liquid barretter in any of its forms. This disposes of all the active claimants except Ferrie, and after the above decisions it is not probable he will ever attempt to prove priority in this country.

SOMETHING ABOUT CEREAL BREAKFAST FOODS.

There is no part of the world except the Arctic regions where cereals are not extensively cultivated. From the oats and rye of the North to the rice of the hot countries, grains of some kind are staple foods.

An idea of the importance of cereal foods in the diet may be gathered from the following data, gathered by Dr. Charles D. Woods and Prof. Harry Snyder for the Department of Agriculture, based upon the results obtained in dietary studies with a large number of American families. Vegetable foods, including flour, bread, and other cereal products, furnished 55 per cent of the total food, 39 per cent of the protein, 8 per cent of the fat, and 95 per cent of the carbohydrates of the diet. The amounts which cereal foods alone supplied were 22 per cent of the total food, 31 per cent of the protein, 7 per cent of the fat, and 55 per cent of the total carbohydrates—that is, about three-quarters of the vegetable protein, one-half of the carbohydrates, and seven-eighths of the vegetable fat were supplied by the cereals. Oat, rice, and wheat breakfast foods together furnished about 2 per cent of the total food and protein, 1 per cent of the total fat, and 4 per cent of the carbohydrates of the ordinary mixed diet, as shown by the statistics cited. These percentage values are not high in themselves, but it must be remembered that they represent large quantities when we consider the food consumed by a family in a year.

The reasons for such an extensive use of cereal foods are not hard to find. Besides being cheaply and easily grown, the grains contain unusually good proportions of the necessary food ingredients with a very small proportion of refuse. They are also readily prepared for the table and are palatable and digestible. Owing to their dryness they are compact and easily preserved without deterioration.

The grain as it grows on the stalk is surrounded by a hull or husk, which is so indigestible that it is removed before the seed is used for food. Each grain has an outer skin or bran layer, which may or may not be removed in milling. It is nearly always taken off from rice and buckwheat, sometimes from wheat, corn, and rye, and almost never from the other grains unless the outer sections are ground off as in pearled barley. Grains simply hulled or husked and slightly crushed are called groats or grits; more finely crushed they are termed meal, and when ground into a fine powder and sifted they are known as flour.

Grains in the raw state are not usually considered pleasant to the taste and are thought to be difficult of digestion, and therefore cereals are almost always cooked before eating. The simplest and doubtless the oldest way of cooking them was by parching. This was frequently all that was done to the oats which the Scotch Highlanders took as their only provisions in their border forays, or to the corn the American Indians used for a similar purpose. But other ways of cooking make the grain more palatable, and it is usually mixed with water or other liquid and either baked as bread and cakes or boiled or steamed as pudding or porridge. It is the use of cereals as porridge that is of special interest, as cereal breakfast foods are most commonly used in America for porridge making or as a substitute for porridge. When used in this form they are perhaps not as convenient to eat as bread, do not keep so well, and require long cooking, but in spite of these disadvantages porridge is much used the world over, and grains have been thus cooked since earliest times. Many varieties of porridge are found. Sometimes the cereals are simply boiled in water, sometimes with milk, or with meat or kale, as in Scotch brose. Welsh budrum is made from oats which have been allowed to ferment and are then cooked, and the Arabs have a similar dish, kouskous, made from fermented wheat. In the old-fashioned bag puddings of England, of which Christmas plum puddings are the direct descendants, suet and fruit were mixed with wheat or barley and all steamed together in a bag. The simpler kinds of porridge are, however, the most common, and it is from them that modern cereal breakfast foods have been developed.

The number and variety of cereal breakfast foods at present on the market are large, but the majority of them fall readily into one of three groups. The first includes those which are prepared by simply grinding the grain, the second those which have been steamed or otherwise partially cooked and then ground or rolled, and the third those preparations which have been acted upon by malt, which induces a greater or less chemical change in the starch present.

No class of foods is more extensively or ingeniously advertised than the cereal breakfast foods. The claims sometimes made for them are astonishing. Some of them are said to contain several times as much nourishment as the same weight of beef; others are lauded as especially valuable as brain food or nerve tonics, and very many are claimed to be particularly well suited for persons of weak digestion. Many of these claims are obviously preposterous, other are doubtless true, and still others contain an ingenious mixture of fact and fancy. Realizing that accurate information in regard to breakfast foods was needed, investigators at several agricultural experiment stations have recently studied their composition and food value, and it is now possible to make a number of definite and reliable statements about them.

SCIENCE NOTES.

In 1892, Frank Mira, of Jacksonville, Fla., discovered a twig which seemed to him of some use to the perfumer. He submitted it to Mr. E. Moulie of that city, who was engaged in the business of extracting essences. The plant immediately interested Mr. Moulie, who succeeded in producing from it an essential oil. Many attempts on the part of Mr. Moulie and the United States Department of Agriculture to ascertain the scientific name of the plant finally resulted in its identification as *Mentha citrata*, a very rare plant which is popularly called bergamot mint. From year to year Mr. Moulie has increased and developed the few plants which he has been able to obtain, and is now engaged in gratuitously distributing the plant for general propagation. We believe that in this manner a very valuable perfume industry may some day be built up on the cultivation of this rare plant.

A curious result of the frequent and severe seismological phenomena which have disturbed the earth in various parts of the world during the past few months, has been observed in connection with the water wells of Leicestershire, England, from which the inhabitants derive their drinking supplies. Whereas a few months ago the water obtained was sparkling and transparent in purity, during the latter months of the summer it became appreciably deteriorated. Little attention, however, was paid to this peculiarity, which was set down to the long drought and the probability that the wells were becoming exhausted somewhat, until animals refused to partake of it. The water became so highly discolored as to be practically opaque, as if heavily impregnated with yellow clay, while instead of being perfectly odorless it had a distinct smell resembling paraffin. This peculiarity led to the water being tested with a light to determine the possible presence of oil, and immediately it became ignited. Samples were then drawn and permitted to stand for several hours, during which period a thick oleaginous scum rose to the surface, while yellow sediment gathered at the bottom. The oil has been found to be petroleum, the presence of which in the district has never before been detected. A scientist, however, who has investigated the water states that twenty years ago, when the earth was similarly disturbed by earthquakes, a similar effect was produced, and the phenomenon is closely associated with the violent disturbances that have taken place recently in the earth's crust.

Prof. Omori, the eminent Japanese seismologist who has been studying the effects of the Californian earthquake for the past three or four months, has come to the conclusion that California will be free from seismic disturbances for half a century, and probably for a much longer time. He says that in all probability there will never again be so severe an earthquake in California as the one on April 18. The slipping of the crust of the earth was caused by the fact that at the point of weakness it was in unstable equilibrium, resulting from the redistribution of matter. It takes ages to bring this about, and the crust has probably settled to a position in which it will remain for centuries without any slipping. The position of countless tons of matter will have to be changed, and vast quantities of earth to be carried by the rivers into the sea, before there will be so great a redistribution of matter as to cause an earthquake. Prof. Omori says that he is confirmed in this opinion by the occurrence of many minor shocks since the great one, and by the manner of their occurrence. These shocks have been coming at regular intervals and diminishing in force, showing that the crust of the earth is slowly settling to rest in its new position. The minor shocks occur most strongly when the barometric pressure of the atmosphere is greatest. Most of the shocks are so slight that they can be discovered only by the aid of a seismograph, and are of no importance except as helps to an understanding of earthquakes. The professor says that an earthquake of any magnitude is preceded by a series of minor shocks, especially if the observation is made at a location distant from the center of disturbance. Tremors precede the great shocks, frequently by several days. If, therefore, careful observations of these tremors could be made, it might be possible to predict an earthquake. Prof. Omori recommends that bureaus, equipped with seismographs, be established all over the State of California, so that slight tremors may be observed and their effects carefully studied. When a shock occurs, reports would come in from many quarters to the chief observatory, and the center of the disturbance could be located quickly. The Japanese professor will publish a full report of his observations during his visit to California.