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NEW YORK, SATURDAY, JUNE 23, 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.

PRESENT CONDITION OF THE ASSOUAN DAM.

In view of the fact that persistent reports have been circulated to the effect that the Assouan dam is being undermined by the rush of the water through the sluices, and, further, that the impounded reservoir has not improved the agricultural conditions of Egypt in any proportion to the great outlay of capital which has been made, the latest report of Lord Cromer on the condition of Egypt comes as a very effective denial of both statements. He dwells upon the material benefits which have accrued to Egypt as the result of the operation of the reservoir during the year 1905. Had it not been for its existence, the country would have been in a poor way because of the shortage of last year's flood; but by skillful regulation of the sluices, the impounded water was so distributed that the area of cultivated land that was left unwatered was comparatively small, less, indeed, than during the low flood of 1904.

As regards the cavities and depressions which have been cut out by the rush of water through the sluices, and which it was said must ultimately cause a large section of the dam to overturn about its toe, we learn that these washouts have been entirely filled up with solid granite masonry set in cement mortar. This work has been carried up to the level of the sills of the sluices, and its surface falls on an easy grade until it meets the natural rock surface nearly 200 feet downstream from the dam. The water has been flowing over this new masonry at great velocity since August last, and it has stood the rush of waters without any signs of failure. The report announces that since the completion of this work any doubt as to the stability of the dam is entirely removed. The question of raising the dam to a greater height is still under discussion.

TRANSATLANTIC WIRELESS TELEGRAPH TROUBLES.

In the years that have elapsed since Marconi startled the world with the statement that he had transmitted a wireless message from England to America, a large amount of experimental investigation has been carried on, with the object of determining the laws which govern this most fascinating of modern discoveries. It was natural enough that, when he had proved the possibility of wireless communication over three thousand miles of ocean, even though the message consisted of a single letter ever so faintly heard at the receiver, Marconi should have supposed that for the transmission of regular commercial messages all that was required was apparatus of greater height, capacities of greater area, and the installation of sending apparatus of larger power. Costly stations were equipped on this supposition both in Cornwall, England, and on the Atlantic coast, and an actual message was transmitted from President Roosevelt to King Edward. That was in January, 1903, and in the following March the Marconi Company undertook to furnish the London Times with daily wireless dispatches from the United States. These, however, were discontinued after only a couple of dispatches had been sent, and to those who were following closely the progress of the art, it soon became evident that, although the transmission of a full message had been proved to be possible, there must be certain atmospheric or other conditions affecting transatlantic wireless telegraphy, which would have to be understood and met before it would be possible to maintain a regular service free from interruption.

Meanwhile other investigators who had been doing good work in the field of wireless telegraphy on a less ambitious scale, were beginning to turn their attention to the great problem which Marconi had so boldly attacked, and with such promising initial success; and ultimately De Forest and Fessenden established stations in which elaborate experimental work has been carried on continuously. Both of these gentlemen claim to have succeeded in establishing transoceanic communication, and Prof. Fessenden has recently broken through the reticence that has characterized investigation in this field in the past, and has contributed to the Electrical Review, of London, an article in which he gives a very frank statement of the work which he has accomplished, and the obstacles which must be overcome before it will be possible to establish an absolutely reliable service free from interruption. The distance between the Fessenden stations at Brant Rock, Mass., near Boston, and Machrihanish is about 3,000 miles, and under favorable conditions messages are exchanged without any difficulty. It has been found, however, that the ability to send messages varies very greatly, not only on different days, but even during different parts of the same day; and Prof. Fessenden has found that on certain days the signals received were of five hundred times greater intensity than other messages sent out under apparently similar conditions on other days. From this it follows that to make certain of being able to transmit messages on any day of the year, the apparatus must be built to correspond to the days of least intensity; or, in other words, a "factor of safety" of at least 500 must be adopted. The problem might be attacked, either by providing an increase of sensitiveness in the receiving apparatus, or an increase in power at the sending station, and in all probability both means will be adopted. On the other hand, if an intensity of transmission be used which is sufficient to meet the worst conditions, it may be found that on the days when conditions are favorable to transmission, such intense signals would be detrimental. Not only might they injuriously affect the operation of other stations, but they might even interfere with the station at which they were directed; for Prof. Fessenden has noticed during his transatlantic tests what he has called an "echo signal," that is, a signal coming about one-fifth of a second later than the main signal; and he believes that this second signal reaches the receiving station later because it goes the longer way around. If transmission of great intensity were used, these echo signals might become loud enough to have a confusing effect at the receiving station. Transmission conditions must be tested frequently in order to determine the proper intensity for current use, for the changes in conditions affecting transmission take place with some rapidity.

As for the causes of these rapid changes, it was pointed out some time ago by Prof. Fessenden that not only is one of the causes to be found in the action of sunlight, but that there appear to be in the atmosphere large masses of absorbing material which considerably reduce the intensity of the transmission. These masses vary in size and in the height above the sea level at which they exist. They appear to be nearer sea level in the tropics, where long-distance transmission is more difficult than in the temperate zone, and in some cases the absorption by these masses is found to be so great as to leave only about one-tenth per cent of the energy of transmission available. Another effect of which the cause has yet to be found, is that messages at certain times can be transmitted more easily in an east and west direction than in one north and south; moreover, there are indications that diffraction takes place. It is considered that both of these effects may be due to the shifting of the position of the so-called absorbing masses, which are supposed to be the most serious obstacle to transatlantic transmission.

THE INFLUENCE OF INCREASED BAROMETRIC PRESSURE ON THE HUMAN BODY.

A series of interesting experiments for determining the influence of the varying atmospheric pressures upon the human system have been carried out by two English scientists, Mr. Leonard Hill, F.R.S., and Mr. M. Greenwood, Jr., M.R.C.S., under the auspices of the Royal Society of Great Britain. These experiments are of particular importance owing to recent extensive engineering works which depend largely on caisson working and deep-sea diving. During the past few years numbers of mechanics employed in caisson operations have developed symptoms of paralysis of the muscles after prolonged immersion in the working area at abnormal atmospheric pressure, and to this malady the term "caisson disease" has been applied. It was with the object of ascertaining the cause of this complaint, and also with the purpose of determining the greatest depth at which a diver can work with safety, that Messrs. Hill and Greenwood conducted their investigations.

From the results of previous experiments carried out by Mr. Hill upon animals, he discovered that every 100 cubic centimeters of blood or tissue fluid dissolved at body temperature about 1 cubic centimeter of nitrogen under one atmosphere of air, 2 cubic centimeters under two atmospheres, and so on. When the decompression period is accelerated, the nitrogen is set free as bubbles in the capillaries and tissue spaces, and by the resultant embolism of some vessel in the body, symptoms varying in nature and intensity are liable to be produced. The usual working shifts of caisson mechanics range from two to four hours, and in this time the body fluids of the men become saturated with nitrogen.

Mr. Hill ascertained that no ill effects were experienced by animals when exposed to pressures up to seven atmospheres, provided a period of 20 minutes was allowed to each atmosphere for decompression. He thereupon resolved to ascertain personally the effects produced upon the human system under varying pressures. The apparatus employed by Hill and Greenwood consisted of a large steel cylinder of 42.2 cubic feet capacity fitted with a mattress, blanket, and pillows, upon which the subject could recline in a comfortable position. The interior was electrically illumined, and by means of the telephone and electric bell the subject was able to communicate with his companion outside. A two-cylinder motor-driven pump was used for compressing the air, and this was capable of raising the air pressure within the cylinder to six atmospheres in approximately 40 minutes. There were two decompression pipes with taps of fine bore, so that the rate of escape could be very finely adjusted. In order to avoid any accumulation of carbon dioxide gas, a constant ventilation was maintained.

In one of the tests Mr. Greenwood, upon emerging from the chamber, experienced itching in both forearms, more especially in the right. At first the pains were light, but after a lapse of about 20 minutes they increased, becoming neuralgic in character. After remaining moderately intense for five minutes, they gradually subsided. Later investigations indicated that the pains were due to the fact that the subject remained practically motionless during the period of decompression.

In the course of the investigations pressures ranging up to 92 pounds were attained. In no instance were any severe after-effects experienced. A pressure of 90 pounds is equivalent to a water depth of 210 feet, which is some 90 feet in excess of the safety limit fixed by the British Admiralty for divers. It is thus evident that an adult may be safely submitted to a total barometric pressure of seven atmospheres. Even a greater depth than 210 feet might be attained, since the limit appears to be fixed by the pressure at which the toxic effects of high-tension oxygen become an immediate danger. These toxic effects have been closely studied by several scientists. When the partial pressure of oxygen reaches two atmospheres, corresponding to ten atmospheres of air, or a depth of 350 feet in water, convulsions may occur in animals within 20 minutes. It is possible that this limit may be extended by diluting the air with nitrogen, but upon this point the investigators do not claim to afford any testimony. However, the results of their practical observations show that the diving depth may be safely increased up to 210 feet.

The observers prepared a careful record of the various sensations they experienced under pressure. The feeling of discomfort in the ears, due to a different air pressure on opposite sides of the tympanum, is well known. Previous to the experiments Mr. Hill had not practised the opening of the Eustachian tubes, and the effect of the test was most disturbing. When, however, the method of opening these tubes had been explained to him, he experienced no further trouble. The power of hearing appeared to be much more acute when the subject was under pressure. The signal of a tap with a spanner upon the outside of the cylinder was heard with painful intensity. The change in the voice which is so well known among caisson workers was well marked during these trials. The voice assumed a peculiar nasal and metallic quality, and the individual characteristic tones were lost. At three atmospheres the power to whisper or whistle was almost entirely lost, and this loss of the vibratile movements of the tongue and lips was a result due probably to the damping effects of the dense air. One of the most important results obtained by these experiments is the imperative necessity of moving every muscle and joint in the body during the period of decompression, and this for the purpose of keeping the capillary circulation active in every part. In the brain, spinal cord, and abdominal organs, this circulation is kept active by the work of the respiratory pump. In the limbs, muscles, fat of the back and chest, the movement of the blood and lymph back to the heart depends mostly on changes of posture and the expressive action of contracting muscles. In one test Mr. Greenwood was decompressed from 75 pounds in 95 minutes, and during this period he flexed and extended all the limb joints at frequent intervals, with the exception of the knees. A little while after leaving the chamber no pains or stiffness were felt, except in the knees, which had not been exercised. In another test Mr. Hill was decompressed from five atmospheres in 105 minutes, a pause of five minutes being made at each atmosphere. During the decompression the muscles of the limbs and back were regularly moved, and the only part of the body which the subject omitted to move and massage was the front of the chest. In the evening of the day of the experi-

ment painful places were felt in this region, and a peculiar purplish rash appeared. Forty-eight hours after the test this rash was still discernible. The opinion of the investigators on this point is that the rash was attributable to small bubbles embolizing the vessels of the subcutaneous fat, while in the case of Mr. Greenwood the pain experienced was probably caused by small bubbles in the nerve sheaths in the first case, and in the knee joint in the second instance. The imperative necessity of active movement during decompression is thus shown, and caisson workers should be instructed to freely exercise and massage every part of the body while undergoing decompression in the air lock.

THE INDUSTRIAL USES AND VALUE OF ALCOHOL.

BY HENRY HALE.

The decision of the government to permit the manufacture and sale of ethyl alcohol free of any tax where it is denaturized, or rendered unfit for use as a beverage by treating it with some suitable denaturant, is of the highest importance to this country, owing to the effect it will have on so many different industries. While the number of plants for the manufacture of alcohol will undoubtedly be greatly increased, its benefit in other forms of industry is of far more moment.

It is needless to more than refer to the raw material from which alcohol can be produced at such a small expense that it can be utilized in place of refined petroleum and other liquids to a greater advantage. As corn is one of the principal materials, a brief reference to the quantity of spirits which can be secured from this grain may be given. Tests which have been made at distilling plants in Illinois show that from one bushel of corn no less than five gallons of proof alcohol can be distilled. This means a liquid which is from 90 to 95 per cent pure and from 185 to 190 degrees proof—a standard which allows it to be utilized in nearly every product in which it is required as an ingredient, and which shows it to be superior to gasoline and kerosene as a fuel and as an illuminant. Estimating the cost of a bushel of corn at 42 cents, the entire expense of a gallon of this alcohol is but 10.78 cents, for with the modern equipment of a distilling plant the cost of mechanical treatment is actually less than two cents per gallon. According to recent statistics compiled by the government, crude wood alcohol costs no less than 40 cents per gallon to manufacture. As low-grade molasses from sugar cane is another base for the spirit, reliable data have been obtained as to the percentage which a given quantity of it will yield. The Cuban distilleries extract a gallon of alcohol (which is 90 per cent absolute) from two gallons of the molasses—molasses of a quality which is brought to this country and sold at three cents a gallon. The average expense of manufacture, based on this price for the raw material, is less than 10 cents. The difference between the molasses and corn spirit is that the former has an odor which is somewhat disagreeable, but it can be utilized as effectively as the other for all purposes except in preparation of liquors and medicines. The low cost of the molasses alcohol is of much significance, as this base is similar to the waste product obtained in the manufacture of sugar from beets. Consequently, it should be an additional incentive in the expansion of the beet-sugar industry, while an opportunity is offered to manufacture alcohol especially in Louisiana and Hawaii.

As is well known, potatoes and fruit are two other inexhaustible sources of supply in this country. The importance of the potato as an alcohol producer can be appreciated when it is known that 20 per cent of its substance represents alcohol, and that an acre of potatoes yielding 300 bushels will supply over 250 gallons. At present the aggregate American potato harvest exceeds 200,000,000 bushels, grown practically in every part of the United States. Overripe fruit, which is now largely a waste product in the various orchard districts, can be utilized in the same manner.

As ethyl alcohol can be employed to greater advantage than the methyl spirit in nearly every branch of manufacture in which alcohol is an essential, some of the products in which it will be utilized extensively may be mentioned. They are as follows:

Aniline colors and dyes; hats (stiff, silk, and straw); electrical apparatus; transparent soap; furniture; picture moldings; burial caskets; cabinet work; passenger cars; pianos; organs; whips; toys; rattan goods; lead pencils; brushes; wagons; boots and shoes; smokeless powder; fulminate of mercury; brass beds; gas and electric-light fixtures; various kinds of metal hardware; incandescent mantles; photographic materials; celluloid and other like compounds; sulphuric ether and organic chemicals.

Nearly every one of these represents material extensively used in this country as well as in Europe. The manufacture of aniline dyes, however, has been greatly handicapped for the reason that Germany, permitting the use of tax-free alcohol, has become the great center of the industry, as the spirit is one of the main essentials. At present only 200 barrels of grain alcohol are used yearly for this purpose in the United States. In the making of hats about one-half gallon of ethyl or methyl spirit is needed to every half dozen, which will give an idea of the extent it is used in this industry. Its value in finishing woodwork, such as furniture and pianos, lies in the fact that it is the best solvent for shellac, and is indispensable as an ingredient in the preparation of fine varnishes and polishes. It is an interesting fact that solutions of shellac and alcohol enter largely into the manufacture of hats, and are used also as a lacquer for the coating of polished metalwork. In modern explosives alcohol is required in such quantities in the preparation of fulminates and smokeless powders, that here again some of the European nations have had the advantage of us, since they have been enabled to secure supplies of ammunition at a much smaller cost. Tax-free alcohol is therefore of vital importance to the country from a military point of view. Most of our fulminates, for example, are made in Canada from American alcohol and returned to the United States to be sold.

The popularity of illumination by means of the incandescent mantle has caused this device to be made literally by the millions. From one plant alone in Camden, N. J., come 15,000,000 mantles a year. The spirit required by this company is about 50,000 gallons. In the past it has largely consisted of wood alcohol mixed with cotton especially treated to form a coating which protects the mantle while being handled. It is this coating which is "burned off" when the mantle is placed upon the fixture for service. In chemical solutions for photographic work, and for the artificial drying of negatives and prints, grain alcohol may be considered invaluable. Substitutes have been employed for it to a large extent in America, but the price of such articles in Europe averages considerably lower than in this country, owing to the higher grade of spirit which can be employed tax-free. As an indication of the enormous quantity of inferior substitutes utilized in place of ethyl alcohol at present, the report of the Commissioner of Internal Revenue shows that during 1905 less than 175,000 gallons of ethyl spirits were used by American manufacturers of aniline dyes, soap, woodwork, photographic material, celluloid, and electrical apparatus. Prior to 1862, when the internal revenue law, which has been abolished, went into effect, the annual production of this grade of alcohol was 90,000,000 gallons, of which a large percentage was consumed in industries exclusive of the preparation of beverages.

Thus far reference has been made only to some of the minor ways in which grain alcohol will take the place of other fluids when the tax upon it is removed. Unquestionably, its importance as a factor in producing light, heat, and power is of the greatest magnitude. Indeed, it promises to become one of the main elements for illumination in the United States, not excluding petroleum, gas, and the electric lamp, for the light produced by it is of a very high quality. We have been chiefly familiar with the small taper used in the sick chamber, where the expense of buying alcohol at 40 and 50 cents a pint for this purpose could be met. With a flame of intense whitness, almost free from odor, the spirit lamp has recommended itself to physicians and nurses. To illustrate its advantage over kerosene and other forms of illuminating oils, a French inventor has perfected a lamp which burns alcohol in connection with a Welsbach mantle. The alcohol is drawn by means of a wick into the burner, as in the example furnished by the ordinary kerosene lamp, by means of capillary attraction. In thirty seconds after being lighted the light is at its maximum brilliancy, unless it is turned down purposely. Tests which have been made with this type of lamp resulted in producing illumination equal to 25 candle-power for a period of 59 hours with a consumption of one gallon of alcohol. This quantity therefore sufficed for 1,475 candle-power hours. With the same quantity of kerosene and employing the same lamp, the illumination was equal to only 783 candle-power hours, the average candle-power of the oil light being but nine. Consequently, the total illumination furnished by the alcohol was nearly double that of the oil. The tests referred to were conducted by experts at the Electrical Testing Laboratories in New York. They agree with the statements of Prof. Rousseau, of the University of Belgium, that alcohol at 31 cents per gallon is more economical as an illuminant than kerosene at 15 cents per gallon, owing to its superior light-producing properties. Prof. Rousseau bases his argument on a series of photometric tests conducted at Brussels, when it was found that denaturized alcohol 90 per cent absolute would give this result. It has been shown in laboratory investigations that high-grade kerosene contains but 8,000 heat units per pound, while ethyl alcohol contains 12,000, thus being 50 per cent more productive of heat. As already stated, alcohol has been made from both corn and molasses, at a total cost not exceeding 12 cents a gallon. According to Prof. Rousseau's conclusions, a given quantity for lighting and heating purposes is equal to at least twice the quantity of highly-refined petroleum in the form of kerosene. As recent market quotations for the latter fluid at retail are from 15 to 20 cents per gallon, the fact seems to be verified beyond question that the spirit is preferable to the oil from the standpoint of economy, aside from the fact that it is without offensive odor, is less liable to ignition in handling, and gives a far better light or fuel where it is designed for cooking and other domestic purposes.

(To be continued.)

AUTOMOBILE NOTES.

The Automobile Club of America is planning to conduct an alcohol fuel consumption test next fall.

Simultaneously with the news that Percy Pierce finished the 1,000-mile Herkomer Trophy test with a perfect score for his Pierce "Arrow," word has been received that the 3,000-mile European circuit endurance test in which he is entered has been indefinitely postponed. Mr. Pierce will doubtless return at once to America in order to compete for the Glidden Trophy, which he was so successful in winning last year.

In order to test the energy consumption of electric carriages under unfavorable conditions, a 100 kilometer (62 mile) test run was recently organized in Paris over dirty and slippery roads, fog prevailing at the time. A number of carriages carrying four passengers, and weighing complete over 2 tons, covered the entire distance at an average speed of nearly 15 miles an hour, and consumed less than 160 watt-hours per ton mile. The first prize was gained by a carriage entered by M. Védrine, which required 155 watt-hours per ton-mile. According to L'Industrie Electrique, the energy consumption of this vehicle under ordinary conditions is from 110 to 120 watt-hours per ton-mile.

The leading automobile event of the season is to be the Grand Prix, organized by the Automobile Club of France, which will be run on the 26th and 27th of June upon a circular route known as the circuit of the Sarthe, not far from the town of Le Mans. The foreign automobile constructors have been making great efforts to surpass the cars which ran in last year's Gordon Bennett Cup race. As the list of entries has now been completed, we are able to give a list of the new cars which are to enter the race, and also some points about their construction. In the order of starting, we find the following makes: De Dietrich, Fiat, Renault, Darracq, Richard-Brasier, Mercedes, Gobron-Brillié, Itala, Gregoire, Panhard & Levassor, Vulpes, Hotchkiss, and Bayard-Clement. Three cars of each of these makes have been entered (excepting three) making 36 in all. The first series of 13 cars will be started, then the second and third, beginning at 6 o'clock A. M. We expect to illustrate some of the leading types at an early date. As to the main points of this year's cars, we find that chain and jointed rod driving are used in about an equal proportion, and none of the makers have changed their system. The gasoline tanks contain in general about 50 gallons, and the cars will all take on gasoline *en route*. About 15 or 20 gallons per 100 miles is expected for the consumption, this differing according to the power of the motors, the carbureters, the speed, etc. Special precautions are taken to re-fill the tanks as quickly as possible. Owing to the hard wear of the tires, the makers have been looking specially to this matter, and are to employ a rather light form, but very solid and having a great number of cloth layers. They are lessening the thickness, seeing that it is not the absolute wear, but the separation of the cloth that is to be feared in the circuit race. This year many of the new spring damping devices are used to deaden the shocks and jumping of the cars. The Truffault suspension is used on some of them, and also the new Eds spring damper. On the Panhard cars we find the progressive damper of Capt. Krebs, while the Renault cars have a liquid damper. This year the Mercedes cars use the Truffault suspension, and also a Jenatzy damper, which consists of a strong rubber band used to check the rebound. As to the carbureters, each maker uses his standard type, but some improvements have been made this year. In general, the wheels are larger than in last year's cars. This tends to diminish the wear of the tires, seeing that the latter will now have a lower speed. Most of the cars will have three gear speeds, but four will also be used on some of them. As to weight, the lightest cars are the Darracq and Gregoire, which weigh 1,900 and 1,980 pounds respectively. Most of the others are very near the limit of 2,240 pounds. The motor power is quite variable, and while the Richard-Brasier, Renault, and Gregoire motors have from 100 to 110 horse-power, the Itala, for instance, has 140 horse-power. With one exception, the chassis are built of pressed steel. One of the Gobron cars uses a steel chassis. All of this year's motors have four upright cylinders, and most of them are cast in pairs. Only the Bayard-Clement and the Panhard are using copper water jackets. The Gobron-Brillié motor continues to use a double piston in each cylinder. Italy, Germany, and France only are represented in the race. The Fiat and the new Itala cars will represent Italy and the Mercedes Germany.