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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-