expressly for the occasion by Mr. Norman H. Hardy. A large number of books and pamphlets dealing with ethnological subjects were also on view. The exhibition of illustrations and literature was a great attraction, and was of great educational value. Considering the very few people connected with the congress who knew or cared about scientific matters or methods, the scientific results may be considered as fairly satisfactory.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers was held at Zurich and northern Switzerland, commencing on Monday, July 24. In addition to the meetings for the reading and discussion of papers, an extensive programme of visits to works and hydro-electric power stations had been arranged, and formed an important part of the meetings. The works visited included those of Brown Boveri, Esher Wyss and Co., Oerlikon Machine Works, Sulzer Brothers, and the Swiss Locomotive and Machine Works. The power stations at Rheinfelden, Laufenburg, Wangen, Schaffhausen, Beznau, and Löntsch were also included. The institution dinner was held on July 25. Brief notices of the papers read are given below, and a fuller abstract of a paper on high-pressure water-power works will appear in a later issue.

A paper on electric traction in Switzerland was presented by Mr. E. Huber-Stockar, of Zurich. It may be found astonishing that progress in electric traction has not been greater in Switzerland when one considers that it is necessary to buy all the coal supply from foreign countries, and that a large amount of water-power is still undeveloped. Further, Switzerland has had certain railways electrified at a comparatively early date, and might have been expected to go onward on this basis, especially as applied electricity is highly developed in the country generally. Economy of operation is having a decisive weight, and makes the problem, as it is presented, difficult. The railways already electrified, or about to be electrified in the near future, are such that the smoke nuisance would be an almost prohibitive feature with steam traction, as in the case of the Simplon tunnel, or where the capabilities of steam are near exhaustion, as in the case of the St. Gothard Railway. There are two gauges in use, 1·435-metre "normal" and 1-metre "narrow." There has been but slow progress in normal-gauge railways since 1883, and rapid progress in narrow-gauge railways since 1887.

The author describes very fully several typical Swiss railways and the methods of operation. Reference is made to the valuable scientific work which has been carried out by the Schweizerische Studiencommission für electrischen Bahnbetrieb. This society has investigated such problems as the elucidation of the question of general railway electrification under Swiss conditions. The merits of the several systems, the cost of plant and of operation, and the comparison of steam and electricity for definite lines or groups of lines. The electrification of the St. Gothard Railway, to be carried out in the near future, has been well prepared by the work of this society.

Railway electrification is making noteworthy rather than rapid progress in Switzerland. As regards system, single-phase current of low periodicity (15) and high contact-line voltage, varying from 5000 to 15,000, according to circumstances, is being sanctioned by experience and by authority. All electrification in Switzerland is directly connected with the utilisation of water-power. The heavy variations of load and the rapid seasonal variations in the fresh-water supply make water storage desirable, and even imperative.

A short survey of the practical development of the Diesel oil engine up to the present day was given by Mr. F. Schubeler, of London. It will be remembered that the characteristics of the Diesel principle are compression in the working cylinder up to the ignition temperature of the fuel (about 500 lb. per square inch and about 1000° F.) and the use of an independent multiple-stage air-pump for raising the pressure of the injection air to 600 or 850 lb. per square inch; the injection air is used for the introduction of atomised air into the cylinder. The extreme high pressures and temperatures of the Diesel process put a limit to the dimensions of the cylinders, which will scarcely exceed 30 inches in diameter. Assuming 150 revs. per min. and the ordinary Otto cycle, this corresponds to an approximate cylinder output of 300 to 400 horse-power. It is not desirable to have more than six cranks; hence, in dealing with large powers, it becomes necessary to seek means of increasing the specific cylinder output. For this there are three possibilities:—(1) by carrying out the single-acting Otto cycle machine as a double-acting one; (2) by adopting the single-acting two-stroke cycle process; (3) by adopting the double-acting two-stroke cycle process. The first method approximately doubles the cylinder output; the second produces the same result, but necessitates the provision of special scavenging pumps; the third theoretically quadruplicates the cylinder output, but in practice about 3·4 may be secured.

For small and medium size units the single-acting Otto cycle takes the preference. Such machines have worked for periods of six to eight weeks without interruption, even in cement factories and mills. The two-stroke cycle shows a somewhat higher consumption of fuel, amounting at least to the percentage of the energy absorbed by the air-pump; it has, however, a more favourable turning moment, and guarantees better starting and better conditions for regulation, which is specially important for direct coupling with alternators. The space required is smaller, and the engine is lighter and cheaper. There are many difficulties involved in the problem of the double-acting Diesel engine, and the author deprecates the proceeding at once to the double-acting two-stroke cycle without first gaining experience with the single-acting engine. Some firms have already claimed to be able to carry out a double-acting two-stroke marine engine. The results obtained with such engines are unknown to the author, and he feels somewhat doubtful whether success has already attended such efforts. Attempts have been made to build Diesel locomotives. The adoption of the Diesel engine for motor-cars and aëroplanes does not seem to be very promising.

Dr. Alfred Amsler, of Schaffhausen, described two new types of transmission dynamometers. The first of these is of the torsion type, and is intended for measuring the power transmitted to or from high-speed machines. The dynamometer couples the shaft of the driving engine direct to the driven machine, and consists essentially of a shaft the angle of twist of which gives a measure of the torque. To measure the angle of twist three discs are used, one fixed to one end of the shaft and the other two fixed to the other end. A transparent celluloid rim is attached to the first disc, and has divisions cut on it; each of the other two discs has a radial slit. The scale divisions are strongly illuminated, and may be clearly read through the slits when the shaft is running. An impression is given to the eye every revolution, and at high speeds these impressions become a continuous stationary image.

The other type of dynamometer is intended for use with slow-running machines of variable resistance. Two pulleys are placed close together on a common shaft, one being fixed to the shaft and the other pulley runs loose. The pulleys are connected by means of two cylinders fitted with pistons and charged with oil. The drive from the source of power is communicated to one pulley by belt, and the machine under test is driven by belt from the other pulley. In operation, the oil in the cylinders is put under pressure corresponding to the torque being transmitted. The shaft is hollow, and serves to make communication between the cylinders and a pressure gauge, the readings of which give a measure of the torque.

A paper on rack-railway locomotives of the Swiss mountain railways was read by Mr. T. Weber and Mr. S. Abt, of Winterthur. Switzerland has a total of 120 steam locomotives, as well as 45 electric locomotives and motor coaches arranged for working with rack gear. The total length of the rack railways is 87 miles. The whole of the systems of racks which are in use have been designed in Switzerland. The Abt system has been most adopted, and consists of flat-toothed plates, of which two or three, according to the tractive power, are bolted together on chairs in such a way that the tooth of one plate in regard

to the other is displaced one-half or one-third of the pitch. The pitch is 4·7 inches, and the rack ensures a quiet motion and permits the trains to work at high speed.

A paper descriptive of the Zoelly steam turbine was presented by Mr. H. Zoelly, of Zurich. This turbine is of the impulse type, and as made at the present time has eight stages for turbines running at 3000, twelve stages for 1500, and sixteen stages for 1000 revolutions per minute. The first diaphragm plate of the high-speed turbines has nozzles which extend for a portion of the circumference only in the bottom half of the diaphragms, whilst in the other diaphragms the nozzles usually extend completely round the circumference. In the case of large units, steam is admitted through channels extending completely round the circumference for all stages. Governing is effected by throttling the live steam. The efficiency of this type of turbine will be evidenced by the following results for a 4000-kw. turbine:—steam consumption per horse-power-hour at full load, 9·36 lb.; at about three-quarter load, 9·58 lb.; at almost half load, 9·84 lb.; at about one quarter load, 10·12 lb. A set of two marine Zoelly turbines, each of 7500 horse-power, has been installed recently in the torpedo-boat destroyer G. 173 of the Imperial German Navy.

Prof. Franz Prášil, of Zurich, communicated the results of some of his tests on Francis turbines and on Pelton turbines. It is of interest to note that both types have developed in the direction of increase of horse-power per unit since 1900, and have now reached as high as 16,000 horse-power per wheel. The Francis turbine is applied with success to falls of 3·3 to 492 feet, the Pelton wheel to falls of 131 to 3116 feet. There has been steady improvement in the construction of the turbines, in the efficiency of the automatic governing, and in the safety mechanism.

In the case of four Francis turbines in open-wheel pits and working under heads of 4·4 to 10·4 metres, the efficiency was found to be more than 85 per cent. at about 80 per cent. of full load. Five Francis turbines in spiral wheel cases gave results showing that efficiencies of 85 per cent. and more are attainable in this style of turbine. The heads in the latter case ranged from 42 to 147 metres.

Four Pelton wheels were tested under falls ranging from 90 to 850 metres. At about 55 per cent. of full load all four turbines showed efficiencies lying between 84 and 85 per cent. The most favourable efficiencies varied between 84 and 89 per cent. The efficiency was lower than 80 per cent. only under loads which were 25 to 30 per cent. of the full load.

In regard to efficiency, there is not to be expected much further advance in the future. The problem of governing can still be considered as not yet completely solved, since there still appears in view a series of applications which will influence the further development of this problem.

THE BELFAST HEALTH CONGRESS.

THE annual congress of the Royal Sanitary Institute, which was held at Belfast on July 22–29, proved a great success; and if the papers dealing with the scientific research side were few, those dealing with the administrative side of preventive medicine amply made up for this deficiency. It is only possible in this short article to indicate those contributions which were of special interest and importance.

In a paper upon the non-nitrification of sewage in sea-water, Messrs. Purvis, McHattie, and Fisher recorded the results of many experiments, which demonstrated:—"That even after seventy days' incubation of 10 per cent. sewage in sea-water, with every facility for complete aeration, there was no production of nitrates or nitrites, and that the free-ammonia figure was increased in the sewage and sea-water at the end of forty-two days. The most obvious explanation of these facts is to assume that the sea-water destroys the useful nitrifying organisms. With regard to the continuous presence of free-ammonia, even after fifty-two days' incubation, it is of interest to note that it supports the suggestion of Kenwood and Kay-Menzies as affording a valuable clue to the contamination of sea-water by sewage."

Drs. T. Houston and T. Rankin contributed an important paper upon the diagnostic value of blood reactions in epidemic cerebro-spinal fever and allied conditions, and they maintain that their observations show that the cerebro-spinal cavity is the proper place to attack the causal organism—the Meningococcus—by means of an anti-serum.

Dr. Williams, the medical officer of health of the Port of London, contributed a paper on plague precautions in reference to the destruction of rats. After discussing the various means of destroying rats aboard of ships, and testifying to the unsatisfactory results obtained from pathogenic bacterial methods, he records the results of experiments on the lethal qualities of air containing 3 per cent. sulphur dioxide gas. These experiments indicate that rats and beetles are killed within from two to three hours of exposure to such air.

In a paper on the viability of *B. typhosus* in water and its isolation therefrom, Drs. J. Wilson and C. Dickson conclude that uncultivated *B. typhosi* (viz. those actually present in the urine and fæces of "carriers") may be recovered from water after a period of three weeks and two days, when conditions closely resembling those found in nature are imposed. "Dr. Houston was unable to recover uncultivated typhoid bacilli from water at a later period than one week from the time of addition, and states that 'less than a month's storage of a raw river water is apparently absolute protection against typhoid fever.' Our experiment shows that Dr. Houston's statement should be accepted with reserve."

Dr. King-Kerr, in an interesting and suggestive paper on the prevention of typhoid fever, dealt with the experience of Belfast. As recently as ten years ago the death-rate from typhoid fever in Belfast was a very high one (1·04 per 1000 in 1901), whereas for the past three years the rate has been only 0·05. Dr. King-Kerr explains that several factors were found to have exercised a powerful influence in this reduction, and that their coming into operation was followed by a marked, definite, and even immediate fall in the death-rate. These factors were the substitution of water-closets for privies, the stoppage of the sale of cockles, the establishment of an additional fever hospital, the sterilisation of the infected hospital sewage, and the more complete isolation of typhoid patients. The decline in the typhoid, zymotic, and general death-rates coincides with these operations.

In a paper on municipal hospitals, Dr. P. Boobbyer directed attention to experiments extending over fifteen years, which had been carried out at Nottingham, to test the value of the open-air treatment for all classes of acute specific diseases, including small-pox, scarlet fever, diphtheria, measles, whooping-cough, pneumonia, erysipelas, and even enteric fever. He was moved to make this experiment in the first instance by the reputed liability of isolation hospitals to favour the spread of many (and often complicated) cases in confined atmospheres. "During the past few years it has been our constant practice to nurse the more severe cases of the diseases mentioned above, as far as possible, in the open air, in bell tents with open sides, in the freely ventilated corridors between the various ward blocks of the hospital, or in the covered approaches to the latter. Cases of an acute and septic character certainly clear up more speedily in the open air than in closed wards. In no single instance, so far as I have been able to discover, has any untoward result accrued from the exposure."

The State endowment of motherhood, a paper by Dr. Eric Pritchard, aroused considerable interest. He advocated that the mother should be endowed in her capacity of mother in order to mitigate the evil effects of poverty and labour upon the woman advanced in pregnancy; and he impressed the importance of the adequate provision and training of midwives in the principles and practice of infant feeding and management. The whole object of maternity endowment should be centred in efforts to safeguard the interests of the infant before and immediately after birth, and these interests would be best studied by an efficient midwifery service, supplemented by the domiciliary visits of properly trained health visitors, both before and after birth; and both midwives and health visitors should be empowered to dispense free benefits of food, clothing, or other necessity which they might think proper for the welfare of the State's new citizen.

Mr. A. J. Martin's advocacy of a "National Health Week" met with much acceptance. We cannot expect