"That these observatories should, if possible, be provided with both absolute and variation instruments, of which the latter should be self-registering instruments, and should be established for at least seven, and if possible, for eleven or twelve years, *i.e.* for a complete sun-spot period."

The Committee were informed by Dr. C. Schott that it was the intention of the Coast and Geodetic Survey of the United States to establish a magnetic observatory at Honolulu.

In the course of the discussion on the above resolution, the Committee also resolved :—

(3*a*) "That it is desirable to point out that observatories at great distances from others should be provided with both absolute and self-registering variation instruments."

(4) The fourth matter referred to the Committee was the question as to the relative advantages of long and short magnets, raised by M. Mascart at the Paris Conference (Report, p. 39).

On this subject a report, of which a copy is appended, had been prepared, at the request of the President, by M. Mascart.

After considering this report, the Committee resolved :—

"Unless special reasons exist to the contrary it is desirable that the dimensions of the magnets should be as small as possible, provided that the accuracy of the results is adequately maintained."

(*b*) Resolutions passed by the Committee on matters arising during the International Conference.

(5) Prof. Eschenhagen made a statement to the Conference as to his recent investigations on minute disturbances made by very sensitive apparatus with a very open time scale.

In view of this statement, the Committee expressed their sense of the importance of the resolutions on this subject passed by the Paris Conference (Report, p. 35), and the hope that the principal observatories would carry out simultaneous observations of the character proposed.

M. Moureaux informed the Committee that preparations for such observations were already complete in the observatory at Parc St. Maur.

The Committee took note of the statement that Prof. Eschenhagen would be willing to give information as to the construction of the instruments used by him.

(6) The Committee also passed the following resolution :—

"The Committee is of opinion that the early establishment of a magnetic observatory at the Cape of Good Hope, provided with absolute and self-registering variation instruments, would be of the highest utility to the science of Terrestrial Magnetism, especially in view of the Antarctic expeditions which are about to leave Europe, and that the observatory should be established at such a distance from electric railways and tramways as to avoid all possibility of disturbance from them."

Directions were given that the proper steps should be taken to obtain the approval of the British Association for this resolution, with the request that, if approved, it should be forwarded to the Colonial Government.

(7) On the motion of Prof. Adolph Schmidt, the Committee resolved :—

"That it is desirable that magnetic observations taken in regions not included in a magnetic survey, should be repeated from time to time, care being taken to secure the identity of the point of observation."

(8) Prof. Eschenhagen was requested to draw up a detailed scheme for the exchange between the various observatories of the curves of the self-registering variation instruments taken during important magnetic storms, and to lay the scheme before the next meeting of the Conference.

(9) With reference to certain inquiries which Prof. Eschenhagen suggested should be addressed to the Directors of Magnetic Observatories, the Committee was of opinion that, although it would be outside the scope of their duties to make the inquiries, it was desirable that the information should be collected and published.

(10) After the discussion on the magnetic disturbances introduced by electric railways and tramways, the following resolution was adopted by the Committee :—

"The Committee are of opinion that any sensible magnetic disturbance produced in a magnetic observatory by electric railways or tramways, is seriously detrimental and may be fatal to the utility of the observatory. They consider that special precautions should be taken to prevent such disturbances, and append as an example the provisions for the protection of the Kew Observatory, inserted in a Bill passed by the British Parliament authorising the construction of an electric railway, the nearest point of which is to be at a distance of one kilometre from the observatory (Appendix II.)."

Future Organisation of the Committee.

(10) The Committee took into consideration their own future organisation, and passed the following resolutions :—

"It is desirable that terrestrial magnetism should continue to be within the scope of the International Meteorological Conference, provided that :—

(*a*) Invitations to attend that Conference are issued as widely as possible to Directors of Magnetic Observatories and to all students of Terrestrial Magnetism.

(*b*) That the Permanent Committee on Terrestrial Magnetism and Atmospheric Electricity, as established at the Paris Conference, be continued.

(*c*) That in future there shall be a magnetic section of the International Meteorological Conference, which shall elect, or otherwise share in the appointment of, a permanent Magnetic Committee.

(*d*) That the Magnetic Committee have power to summon an International Magnetic Conference at times other than those at which the whole of the International Meteorological (and Magnetic) Conference may meet."

The Committee also consider that the President of the Permanent Magnetic Committee should hold office between two successive meetings of the International Meteorological (and Magnetic) Conference.

(Signed) ARTHUR W. RÜCKER, *President.*

September 13, 1898.

APPENDIX II.

Clause for the protection of Kew Observatory.

(1) The whole circuit used for the carrying of the current to and from the carriages in use on the railway shall consist of conductors which are insulated along the whole of their length to the satisfaction in all respects of the Commissioners of Her Majesty's Works and Public Buildings (in this section called "the Commissioners"), and the said insulated conductors which convey the current to or from any of such carriages shall not at any place be separated from each other by a distance exceeding one hundredth part of the distance of either of the conductors at that place from Kew Observatory.

(2) If in the opinion of the Commissioners there are at any time reasonable grounds for assuming that by reason of the insulation or conductivity having ceased to be satisfactory a sensible magnetic field has been produced at the observatory, the Commissioners shall have the right of testing the insulation and conductivity upon giving notice to the Company, who shall afford all necessary facilities to the engineer or officer of the Commissioners or other person appointed by them for the purpose, and the Company shall forthwith take all such steps as shall in the opinion of the Commissioners be required for preventing the production of such field.

(3) The Company shall furnish to the Commissioners all necessary particulars of the method of insulation proposed to be adopted, and of the distances between the conductors which carry the current to and from the carriages.

APPLICATIONS OF ELECTRICITY.[1]

LIGHTNING.

THE first practical application of the science of electricity was for the protection of life and property. Franklin in 1752 showed how to secure ourselves and our buildings from the disastrous effects of a lightning stroke. Very little has been done since to improve upon his plan. A Lightning-Rod Conference, upon which I served, met in 1878, and its report, published in 1881, remains an admirable and useful standard of reference. The principle advocated by Franklin was prevention rather than protection. If a building or a ship be fitted and maintained with good continuous copper conductors, making a firm electrical contact with the earth or the sea, and

1 Abridged from an inaugural address delivered at the Institution of Civil Engineers, on November 1, by the President, Mr. W. H. Preece, C.B., F.R.S.

be surmounted well up in the air with one or a cluster of fine points, all the conditions that determine a charge of atmospheric electricity and a flash of lightning are dissipated silently away and no terrible discharge is possible. A mischievous and baseless delusion is prevalent that protectors actually attract lightning and may be sources of danger. Every exposed building should be fitted, but a well-protected dwelling-house is the exception not the rule. Even when protectors are fixed apathy leads to their imperfect maintenance. Their failure to act is always traceable to the neglect of some simple rule. Carelessness is the direst disease we suffer from. Telegraph and telephone wires which spread all over our towns and country are very much exposed to the influence of atmospheric electrical effects. Every instrument is now protected. Every telegraph pole has a lightning conductor. Accidents are rare, and the system itself is a public safeguard. In some countries like California and South Africa thunder-storms are very frequent and very severe, but their effects have been tamed.

TELEGRAPHY.

In 1837 Cooke and Wheatstone showed how electricity could be practically used to facilitate intercommunication of ideas between town and town and between country and country. The first line was constructed in July of that year upon the incline connecting Camden Town and Euston Grove Station, the resident engineer being Sir Charles Fox, father of the senior Vice-President. Five copper wires were embedded in wood of a truncated pyramidal section and buried in the ground. The instrument used possessed five needles or indicators to form the alphabet. A portion of this original line was recently recovered *in situ*.

The pioneer line of 1837, $1\frac{1}{3}$ miles long, has, during a period of sixty years, grown into a gigantic world-embracing system. The extent of the present system of British telegraphs is shown by the following table:—

	Miles of wire.
General Post Office and its Licensees ..	435,000
Railway companies	105,000
India and Colonies	387,966
Submarine cables	183,400
Total	1,111,366

The speed of signalling and the capacity of working have been increased sixfold, and wires can now be worked faster than messages can be handled by the clerical staff.

The form of submarine cable and the nature of the materials used in its construction have varied but very little since the first cable was laid in 1851. The recent invasion of our channels and seas by the *Limnoria terebrans*, a mischievous little crustacean which bores through the gutta-percha insulating covering, and exposes the copper conductor to the sea-water, leading to its certain destruction, has led to the use of a serving of brass tape as a defence. It has proved most effective.

No one has done more than Lord Kelvin to improve the working of submarine cables. His recording apparatus is almost universally employed on long cables. By the duplex method of transmission the capacity of cables has been practically doubled, and this has been still further improved by applying to cables the system of automatic working, which is such a distinguishing feature of our Post Office system. The number of electrical impulses which can be sent through any cable per minute is dependent upon its form, and is subject to simple and exact laws, but it varies with the quality and purity of the materials used. There is no difficulty in maintaining the purity of copper. Indeed, copper is frequently supplied purer than the standard of purity adopted in this country—known as Matthiessen's standard. The purity of gutta-percha is, however, questionable. The supply of this dielectric has dwindled; it has failed to meet the demand; its cultivation has been neglected. The result is a dearth of the commodity, a great increase in price, and its adulteration by spurious gums. India-rubber, its sole competitor for cables, is being absorbed for waterproof garments and pneumatic tyres, but for underground purposes paper is being used to an enormous extent. Paper has the merit, when kept dry, not only of being an admirable insulator, but of being very durable. There is paper in existence in our libraries over 1000 years old. The difficulty is to keep it dry. This is one of the problems the engineer delights to consider. He has been most successful in obtaining a solution. The lead-covered paper cables, which are being laid in the streets of all our great cities, are admirable. I am laying one of seventy-six wires for the Post Office telegraphs between London and Birmingham, and the Cable Companies are contemplating leading their long cables from Cornwall up to London, so as to be free from the weather troubles of this wet and stormy island.

It is impossible to forecast the future of telegraphy. New instruments and new processes are constantly being patented, but few of them secure adoption, for they rarely meet a pressing need or improve our existing practice. The writing telegraph originating with our late member of Council, E. A. Cowper, which reproduced actual handwriting, much improved by Elisha Gray, and called the "Telautograph," is steadily working its way into practical form, and electrical type-writing machines of simple and economical form are gradually replacing the A B C visual indicator. The introduction of the telephone is revolutionising the mode of transacting business. There seems to be a distinct want of some instrument to record the fleeting words and figures of bargains and orders transmitted by telephone. Hence a supplement to that marvellous machine is needed. The telautograph and electrical type-writer will fill this want. Visions of dispensing with wires altogether have been fostered by the popularity of Marconi's "wireless telegraphy"; but wireless telegraphy is as old as telegraphy itself, and a practical system of my own is now in actual use by the Post Office and the War Department.

TELEPHONY.

I was sent, in 1877, together with Sir Henry Fischer, to investigate the telegraph system of the American continent, and especially to inquire into the accuracy of the incredible report that a young Scotchman named Bell had succeeded in transmitting the human voice along wires to great distances by electricity. I returned from the States with the first pair of practical instruments that reached this country. They differed but little from the instrument that is used to-day to receive the sounds. The receiver, the part of the telephone that converts the energy of electric currents into sounds that reproduce speech, sprang nearly perfect in all its beauty and startling effect, from the hands of Graham Bell. But the transmitting portion, that part which transforms the energy of the human voice into electric currents, has constantly been improved since Edison and Hughes showed us how to use the varying resistance of carbon in a loose condition, subject to change of pressure and of motion under the influence of sonorous vibrations. The third portion, the circuit, is that to the improvement of which I have devoted my special attention. Speech is now practically possible between any two post-offices in the United Kingdom. We can also speak between many important towns in England and in France. It is theoretically possible to talk with every capital in Europe, and we are now considering the submersion of special telephone cables to Belgium, Holland, and Germany.

RAILWAYS.

The employment of electricity in the working of railways has not only been highly beneficent in the security of human life, but it has vastly increased the capacity of a road to carry trains. The underground traffic of the metropolis is conducted with marvellous regularity and security, though the trains are burrowing about in darkness and following each other with such short intervals of time, that the limit of the line for the number of trains has been reached. Electric traction is going to extend this limit by increasing the acceleration at starting and improving the speed of running. It will also reduce the cost of working per train-mile, so that the advent of electricity as a moving agency is certain to prove highly economical. What it will do as a remover of bad smells and foul air and for personal comfort cannot be estimated. Time alone will enable us to assess the intrinsic value of public satisfaction acquired by the change.

DOMESTIC APPLIANCES.

The introduction of electricity into our houses has added materially to the comfort and luxury of home. If we were living in the days of ancient Greece, the presiding domestic deity would have been *Electra*. The old bellhanger has been rung out by the new goddess. Electra has entered our hall-door, and attracts the attention of our domestics, not by a gamut of ill-toned and irregularly-excited bells, but by neat indicators and one uniform sound. The timid visitor fears no more that he has expressed rage or impatience by his inexperience of the mechanical pull required at the front door. The domestic telephone is coming in as an adjunct to the bell. Its use saves two journeys. The bell attracts attention, the telephone transmits the order. Hot water is obtained in half the time and with half the labour. Fire and burglar alarms are fixed to our doors and windows; clocks are propelled, regulated and controlled. Even lifts are hoisted for the infirm and aged. Ventilation, and in warmer countries coolness, are assisted by fans. Heating appliances are becoming very general where powerful currents are available. Radiators assist the coal fire by maintaining the temperature of a room uniform throughout its length and breadth. Ovens are heated, water is boiled, flat-irons become and are maintained at a useful temperature, breakfast dishes and tea-cakes are kept hot, even curling-tongs have imparted to them the requisite temperature to perform their peculiar function.

ELECTRIC LIGHT.

But it is in supplying us with light without defiling the air we breathe in our dwellings with noxious vapour, that electricity has proved to be a true benefactor to the human race. The Legislature has facilitated the acquisition by municipalities of those local industries that affect the welfare of the whole community, such as road-making, sewerage, the supply of water, tramways, and, above all, electric light.

It is on board ship that electric light has been pre-eminently successful, and where it filled such a crying want that its introduction met with no check. It was almost immediately and universally adopted. Search lights, prompted by the great development of the torpedo, were introduced into our Navy as early as 1875 by Mr. Henry Wilde. The first ship to be fitted with internal electric lighting was the *Inflexible* in 1882. In 1884 the Admiralty ordered it to be applied to all H.M. warships. The first application of electrical power was in the case of H.M.S. *Barfleur*, where motors were used for working guns and for the supply of ammunition. It has subsequently been partially extended to the working of gun-turrets, ventilating fans, capstans, and boat-hoisting gear; but hydraulics, the child of our venerable Past-President, Lord Armstrong, is the form still more generally preferred and used for power in our Navy, though other nations make a much more extended use of electricity. The technical reports received by the United States Navy Department indicate that the electrical appliances on their warships worked very successfully during the recent war.

LIGHTHOUSES.

The introduction of electricity into our lighthouses has not been such an unqualified success as into our ships. No new electric light has been installed on the coast of Great Britain since St. Catherine's (Isle of Wight) was fitted up in 1888. Other electric lamps are to be found at the South Foreland, at the Lizard, and at Soutar Point, only four lighthouses in all upon our coasts.

This is due chiefly to the great prime cost of its installation and to the annual expense of its maintenance. But the sailor himself is not enamoured of it. It does not assist him in judging distances. It is too brilliant in clear weather, while in bad weather it penetrates a fog no further than an ordinary oil lamp. Moreover, great modern improvements have rapidly followed each other in other apparatus, lenses and lamps. A third order light of to-day can be made superior to a first-order light of ten years ago. Oils have improved and gas has been introduced. Lord Kelvin proposed that lighthouses should signal their individuality to passing ships by flashing their number in the Morse alphabet. But the Morse alphabet, in 1875, was as unknown as Egyptian hieroglyphics to our nautical authorities. The same end was obtained with less mental exertion by occulting and group-flashing systems.

A new and very promising plan has recently been introduced in France, called the "Feux-éclairs" or "lightning flash" system. It has been installed in many places, but especially at the two Capes dominating the Bay of Biscay. Nothing more brilliant or more effective is to be seen anywhere than the lights that rapidly sweep across the horizon, like well-directed flashes of summer lightning, with a motion that conveys the idea of a wave of some illuminated spirit-arm warning the navigator away from the rocky dangers of Ushant.

Our Trinity House has not yet introduced this plan. Any change of our well-considered and deeply-important coast-lightning system is not to be hastily effected. We are very proud of our well-guarded shores. Every headland and land-fall, every isolated rock, all dangerous shoals and banks and narrow channels in lines of trade are so illuminated that navigation by night is as safe and easy as by day. Lighthouses and lightships stud our channels. Most of them are placed in direct communication with our Post Office telegraph system, so that the speediest help can be secured in moments of difficulty and danger.

We, however, want improvement in fogs and storms. Here electricity steps in. I wrote, in 1893, of wireless telegraphy:—"These waves are transmitted by the ether; they are independent of day or night, of fog or snow or rain, and, therefore, if by any means a lighthouse can flash its indicating signals by electro-magnetic disturbances through space, ships could find out their position in spite of darkness and of weather. Fog would lose one of its terrors, and electricity become a great life-saving agency." We are nearing that goal.

TRACTION.

Electrically worked railways originated in Europe. The first experimental line was constructed by Dr. Werner Siemens in Berlin in 1879. When I visited America in 1884 there was only one experimental line at work in Cleveland, Ohio. Now there are more miles of line so worked in Cleveland alone than in the whole of the United Kingdom. The reason for this is not difficult to comprehend. The climatic influences of the States, the habits of the people, the cost of horseflesh, the necessity for more rapid transit, soon proved the vast superiority of electric over every other form of traction. Horses and cables will soon disappear. The successful progress in the States and on the Continent has proved contagious, and everywhere our great cities are rising to the occasion. The relative merits of overhead and underground conductors, and the use of storage batteries, are practically the only important engineering questions under discussion. The underground conduit system has been materially helped by the practical object-lesson to be seen in New York, where the tramways are being very successfully worked on this plan. The trolley system is much more economical. Its erection does not interfere with the traffic of the streets. The principal objection to it is its anti-aesthetic appearance, but it is wonderful how ideas of utility and the influence of custom make us submit to disfigurement. What is more inartistic than a lamp-post, or more hideous than the barn-like appearance of many a railway terminus?

The corrosion of water- and gas-pipes, the disturbances of telegraphs and magnetic observations, are serious questions arising from the introduction of powerful currents into the earth, but fortunately the remedies are simple, easily attainable, and very effective.

I have alluded to the proposed working of our underground railways. The success of the Mersey Dock line, and of the South London and Waterloo lines, have placed the question beyond controversy. The problem to be solved is how is the conversion from steam to electricity to be effected without interfering in any way with the existing traffic or with the existing permanent way? This is not to be solved on paper. It must be determined by actual trial, and this is about to be done on the short line connecting Earl's Court and High Street, Kensington. Electric traction as an economical measure in all cases of dense traffic is so certain that every great railway company must consider, sooner or later, the working of their surburban traffic by electricity. This experiment on the Metropolitan Underground Railways, therefore, should interest them all. It is a question deeply affecting the interests and comfort of the public and the condition of the congested traffic of our streets.

The storage battery fulfils a very important function in the economical working of an electric railway. It equalises the pressure on the circuits. It meets the fluctuations of the load. It takes in current when the load is light; it lets out current when the load is heavy. It thus secures the continuous working of the engines at their full constant and most economical conditions, and it enables the engines to be shut down altogether when the load is very light, as it is at night, in the early morning, and on Sundays.

In Buffalo the battery is charged by energy from Niagara, twenty-one miles away, and the local engines are shut down for twelve hours every day, and for ten hours on Sunday.

ELECTRO-CHEMISTRY.

The transference of electricity through liquids is accompanied by the disintegration of the molecules of the liquids into their constituent elements. The act of conduction is of the nature of work done. Energy is expended upon the electrolyte to break it up, and the quantity thus chemically decomposed is an exact measure of the work done. Every electrolyte requires a certain voltage to overcome the affinity between its atoms, and then the mass decomposed per minute or per hour depends solely upon the current passing. The process is a cheap one and has become general. Three electrical HP. continuously applied deposit 10 lbs. of pure copper every hour from copper sulphates at the cost of one penny. All the copper used for telegraphy is thus obtained. Zinc in a very pure form is extracted electrolytically from chloride of zinc, produced from zinc blende, in large quantities. Caustic soda and chlorine are produced by similar means from common salt. The electroplating of gold, silver and nickel is a lucrative and extensive business, especially in Birmingham and Sheffield. Gold and silver are refined by this electrolysis in Russia, and nickel in the United States. Sea-water is decomposed in this way for disinfecting purposes by the Hermite process.

The passage of electricity through certain gases is accompanied by their dissociation and by the generation of intense heat. Hence the arc furnace. Aluminium is thus obtained from cryolite and bauxite at Foyers by utilising the energy of the Falls. Phosphorus is also separated from apatite, and other mineral phosphates. Calcium carbide, obtained in the same way, is becoming an important industry.

It is remarkable that our coalfields have not been utilised in this direction. Electrical energy can be generated on a coal-field, where coal of good calorific value is raised at a cost of 3*s.* per ton, cheaper than by a waterfall, even at Niagara.

Electro-metallurgy is now a very large business, but it is destined to increase still more, for the generation of electrical energy is becoming better understood and more cheaply effected.

THE TRANSMISSION OF POWER.

The energy wasted in waterfalls is enough to maintain in operation the industries of the whole world. Great cities as a rule are not located near great falls; nor has a beneficent Providence provided great cities with waterfalls as, according to the American humourist, He has with broad rivers. There is but one Niagara, and we are seeing how industries are rather going to the falls than the energy of the falls is being transmitted to the industrial centres. The arbitrament of money is limiting the distance to which energy can be profitably transmitted. The Cataracts of the Nile can be utilised in irrigating the waste lands of the upper regions of the river, but their energy cannot compete, at Alexandria, with that of coal transported in mass from England.

At Tivoli, fifteen miles across the Campagna, the energy of the falls are economically utilised to light Rome and to drive the tramways of that city. The electric railways at Portrush and Bessbrook, in Ireland, are worked by water-power, and Worcester, Keswick and Lynton use it in this country, but on a very small scale. It is not used more, for the simple reason that there are no more falls to use. Water-power is used very extensively in Switzerland, because it is so abundant there, and in our Colonies, especially in South Africa; but it is in the United States, especially in Utah and California, where the greatest works have been installed especially for the transmission of energy to mines.

In mines electricity is invaluable. It is used for moving trams and for working hoists. It lights up and ventilates the galleries, and by pumping keeps them free of water. It operates the drills, picks, stamps, crushers, compressors, and all kinds of machinery. The modern type of induction motor, having neither brushes nor sliding contacts, is free from sparks and safe from dust. Electrical energy is clean, safe, convenient, cheap, and it produces neither refuse nor side products. It is transmitted to considerable distances. In mountainous countries the economical distance is limited by the voltage which insulation can resist; 40,000 volts are being practically used between Provo Canyon and Mercur, in Utah, in transmitting 2000 horse-power thirty-two miles.

CONCLUSION.

I have touched lightly—I fear too lightly—upon some of the applications of electricity. I have confined myself, in a very general sense, to those with which I have been personally associated. I have shown how electricity began its beneficent career by protecting our lives and property from the disastrous effects of nature's dread artillery, how it facilitates intercommunication between mind and mind by economising time and annihilating space. It

> "Speeds the soft intercourse from soul to soul,
> And wafts a sigh from Indus to the Pole."

By its metallic nerves it brings into one fold not only the scattered families of one nation, but all countries and all languages, to the manifest promotion of peace and general good will. Not only does it show us how to utilise the waste energies of nature, but it enables us to direct them to the place where they are most wanted and to use them with the greatest economy. It opens to our view nature's secret storehouses, presenting us with new elements, new facts and new treasures. It economises labour and purifies material. It lightens our darkness in more senses than one, and by enabling us to see the unseen, it tends to aid the gentle healing art and to alleviate both suffering and pain. It aids us in the pursuit of truth, and it has exploded the doctrine that the pursuit of truth means the destruction of faith.

RECENT CORAL BORING OPERATIONS AT FUNAFUTI.

THE subjoined extract from the *Sydney Daily Telegraph* of September 9, containing particulars as to the coral-boring operations at Funafuti, has been sent to us by a correspondent:—

News has just been received *via* New Zealand, through the U.S.S. Co.'s steamer *Poherua*, which coaled H.M.S. *Porpoise* at Funafuti, as to the progress of the two bores, one on land, and the other in the lagoon of that coral atoll. With regard to the lagoon bore, operations were commenced on August 15, Commander Sturdee having succeeded in mooring the war-ship so taut that it was possible to work the boring pipes without risk of their bending or breaking from the bows of the war-ship. Mr. G. H. Halligan, who is in immediate charge of the boring plant, reports that for the first twenty-four hours of boring a depth of 109 feet was attained, the total depth of the bore being 212 feet below the water level of the lagoon, the depth of water to the bottom of the lagoon being 103 feet. The *Poherua* left at the end of the first day's boring. As regards the nature of the material bored, Mr. Halligan states that the first 80 feet below the bottom of the lagoon were formed of sand, composed of joints of Halimeda (a seaweed which secretes a jointed stem of lime) and of fragments of shells. The remaining 29 feet were in similar material, but containing small fragments of coral getting larger at the deeper levels.

This is a record rate of boring, and considering the difficulty of holding the war-ship at her moorings absolutely steady, in spite of wind and tide, is a wonderful performance. The whole undertaking may be looked upon as a success from a scientific standpoint, even if no greater depth than 109 feet be ultimately reached. As, however, there was still nearly a week available for further boring, it is hoped that before the war-ship has to leave Funafuti, the bore may have been considerably deepened. This is probably the first bore that has ever been made in the bottom of the lagoon of a coral atoll.

The deepening of the old bore, discontinued last year at a depth of 698 feet, on the main island of Funafuti, has been proceeding slowly but steadily. The party were landed there by the London Missionary Society's steamer *John Williams*, on June 20 last. As was anticipated, little difficulty was experienced in re-driving the lining pipes into the old bore, and washing out the sand and rubble which had choked the bore-hole. Pipes were laid from the site of the old bore to some small water-holes from which a supply of fresh water was obtained for the boiler. By July 25, the re-lining and cleaning of the old bore having been successfully accomplished, boring was resumed, and up to the time when the steamer *Poherua* left, a depth of 840 feet had been reached. The bore last year terminated in soft dolomite limestone at 698 feet, but it has now been ascertained that below this is a hard rock, so hard that the portion of the bore-hole which penetrates it no longer needs to be lined with iron pipes, a condition which must facilitate the work of boring.

Mr. A. E. Finckh reports that this hard rock is largely composed of corals and shells. This depth of 840 feet is exactly the crucial depth which it was hoped the bore might reach, and if possible exceed, as at a corresponding depth on the ocean face of the reef there is a strongly marked shelf, as shown by the soundings by Captain A. Mostyn Field, of H.M.S. *Penguin*,