the like. Dr. Haddon promises an account of his recent visit to Borneo, with special reference to the industries and daily life of the natives. A discussion is being arranged on the subject of "Animal Worships," with reference to the vexed question of the significance of totemism; and Mr. David Boyle, of Toronto, will contribute a study of the phenomena of Neo-Paganism among the natives of certain parts of the Dominion of Canada. Among other archæological papers, special interest attaches to Mr. Arthur Evans's account of his recent discovery of tablets inscribed with an Ægean script, in the Mycenæan palace of Gnossus in Crete; and to Mr. F. Ll. Griffith's discussion of the origin of the Egyptian hieroglyphic system. There will be papers, as usual, on objects of archæological interest in the neighbourhood of Bradford.

BOTANY.

Prof. Vines, the President of Section K (Botany), in his address on Thursday, September 6, will take as his subject the progress of botany in the nineteenth century. It has been arranged to hold a joint discussion with some of the members of the Geological Section on the conditions under which the forests of the Coal Period grew. The origin and manner of formation of Coal, the climatic and physical conditions which prevailed during the deposition of the Coal-measures, the most striking characteristics of the vegetation, and other questions will probably be dealt with. The local committee propose to form a small museum of specimens and photographs to illustrate the botany and geology of the Coal Period.

On Friday afternoon a semi-popular lecture, illustrated by lantern slides, will be delivered by Mr. Percy Groom, on "Plant-form in relation to nutrition."

Among the papers already promised, the following may be mentioned:—On the presence of seed-like organs in certain Palæozoic Lycopods, by Dr. D. H. Scott; the origin of modern Cycads, by Mr. Worsdell; the fertilisation of *Caltha palustris*, by Miss Thomas; on a new type of transition from stem to root in seedlings, by Miss Sargant; the anatomy of the stem of *Angiopteris evecta*, by Miss Shove; the structure of the nucleolus, also a demonstration of the structure of the eye-spot and flagellum of *Euglena*, by Mr. Wager; the biology and cytology of a new species of *Pythium*, by Dr. Trow; the biology of *Acrospeira mirabilis*, by Mr. Biffen; the histology and reproduction of the Laminariaceæ, and additional notes on the cytology of the reproductive cells in the Dictyotaceæ and Fucaceæ, by Mr. J. Lloyd Williams; on the effect of salts on the CO_2 assimilation of *Ulva latissima*, by Mr. Arber; on fungi found on the scale-insects of Ceylon, by Mr. Parkin; the structure and affinities of *Dipteris conjugata*, with notes on the geological history of the Dipteridinæ, by Mr. Seward and Miss Dale.

RECORDING TELEPHONES.

NOW that the telephone has become, even in this country, an instrument of such universal commercial and general employment, the advantages of an apparatus that will satisfactorily record the messages transmitted through an ordinary telephone line are so strikingly apparent that it is unnecessary to enlarge upon them. That it should have been possible to construct such an apparatus has been evident since the invention of the phonograph. But the direct combination of the phonograph with the telephone, which seems so simple in theory, has presented difficulties in practice which up to the present have not been successfully overcome, and the phonograph of to-day, over twenty years since its invention, remains little more than a scientific toy, whereas its contemporary, the telephone, has become an almost indispensable adjunct of civilisation. It would appear, however, that the problem of recording telephone messages is nearing a practical solution, for there have been quite recently put forward, under the names respectively of the "Telephonograph" and the "Telegraphone," two separate inventions of a recording telephone.

The first of these instruments—the "Telephonograph"—is the invention of Mr. E. O. Kumberg, and contains little that is novel in principle, being simply a combination of the phonograph with a loud-speaking telephone receiver, in which the inventor has sought by a suitable design of apparatus to diminish the distortion of voice which is usual with such an arrangement. The invention consists of a phonograph in which a loud-speaking telephone receiver is substituted in place of the ordinary diaphragm to which one speaks. The telephonic currents varying in the receiver set up vibrations in a soft iron diaphragm which is attached by a short stiff wire at its centre to a second diaphragm of mica. The centre of this mica diaphragm is connected by a link with the cutting style, which accordingly traces on the wax cylinder of the phonograph a record of the message transmitted through the telephone. The cylinder can then be subsequently used in connection with the speaking diaphragm of the phonograph to repeat the recorded message. Unfortunately, neither the telephone nor the phonograph is free from distortion, and the "Telephonograph" may be expected to possess in an enhanced degree the imperfection of each of its components; from what we learn, it seems that Mr. Kumberg's invention is by no means perfect in articulation.

The second instrument which has been brought forward under the name of the "Telegraphone" is, we believe, entirely new in its principle, and if it realises but a part of what is claimed for it by its inventor represents a very great advance in telephony. This instrument is the invention of Herr Valdemar Poulsen, a Danish electrician, and is on view at the Paris Exhibition. It is briefly described in a note contributed by Herr Poulsen to the *Comptes rendus* for June 25, and somewhat more fully in an article which appears in the *Revue Générale des Sciences* for June 30.

It is, of course, perfectly well known that if a piece of steel be placed between the poles of an electromagnet which is excited by a current, a magnetic field is set up in the steel, the strength and direction of which depend upon the strength and direction of the current in the exciting coils of the electromagnet, and the magnetism thus induced in the steel is still retained by it when removed from the inducing magnetic field. This is the principle which Herr Poulsen has utilised in the construction of his new recording telephone. In place of the ordinary telephone receiver he uses a simple electromagnet, the current transmitted through the telephone line passing round the exciting coils of the magnet. When, therefore, any one speaks into the transmitting instrument at the far end of the telephone line, the magnetic field due to the electromagnet will vary in strength and direction in accordance with the varying electric currents transmitted through the lines. Between the poles of the magnet is passed a steel wire or band, which is moved forward in the direction of its length at a uniform and rapid velocity. At each point of this wire there will be produced a magnetisation proportional to the current which was flowing through the coils of the electromagnet at the moment when that section of the wire was passing between its poles. There will thus be established in the steel wire a magnetic record of the telephonic message, and just as the varying electric currents have been utilised to produce in the wire a magnetisation varying from point to point along its length, so, by the converse process, may this magnetisation be employed to set up currents in a telephone

receiver, and thus reproduce the original speech. It is only necessary to connect the coils of the electromagnet in series with a receiving telephone, and to cause the steel wire on which the magnetic record has been made to pass once again at the same speed and in the same direction between the poles of the magnet; for the variation of the magnetic field which the wire produces as it moves along will generate currents proportional to the rate of variation of this field, and the telephone will respond in the same way, and with the same degree of accuracy, as did the receiving telephone in the early Bell combination of a pair of magneto-telephones prior to the employment of a microphone and a battery.

The diagrams in Figs. 1 and 2 show the arrangement of the apparatus. C is the electromagnet on which are the bobbins of wire B and B′, which are connected either to the transmitting or receiving instrument according as it is desired to record a message or to listen to one already recorded. Between the poles P and P′ of the electromagnet passes the steel wire F, which is wound in a helix over two drums, T and T′, to which the ends of it are attached and which are driven by an electric motor,

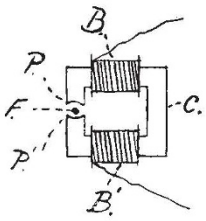

FIG. 1.

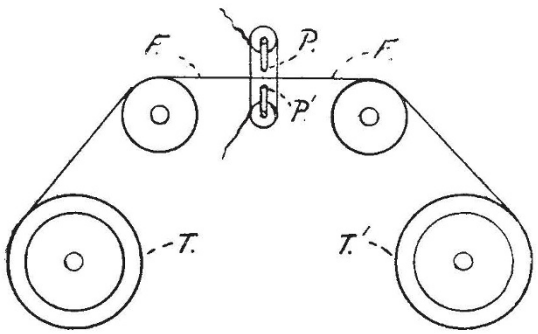

FIG. 2.

so that the wire winds off one drum on to the other. The drums rotate at such a speed as to give the wire a linear velocity between the poles of a metre per second. At the same time the magnet C is moved at right angles to the direction of motion of the wire, so that for one revolution of the drums the magnet moves a distance equal to the pitch of the helix.

The message thus recorded can be effaced, according to Herr Poulsen, by the simple process of passing the steel wire between the poles of the magnet when the latter is excited by a steady current from a battery. This operation establishes in the wire a uniform magnetic field at right angles to its length, and this field, so far from interfering with recording a future message, appears to be necessary before any such record can be made. But if it be desired to keep the record, this may be done instead, and the wire used over and over again to repeat the same message. A thousand repetitions can be made, it is said, without any diminution in loudness or distinctness.

If the recorded message is not sufficiently loud, it is possible with a comparatively simple arrangement to greatly increase its loudness. For this purpose it is necessary to arrange a series of parallel steel wires or bands as shown in Fig. 3, all of which have been previously prepared for receiving a magnetic record by being passed between the poles of a magnet excited by a steady current. The wires are moved at a uniform rate. The first wire, 1, passes first between the poles of an electromagnet M, which is connected to the telephone line, and consequently receives a magnetic record of the transmitted message. The wire next passes between the poles of a second electromagnet, A, which is connected in series with a similar magnet A′, between the poles of which the second wire, 2, passes. As the wire 1 passes between the poles of the magnet A currents are induced in the coils of this magnet, which, traversing also the coils of the companion magnet A′, produce a magnetic record in the wire 2. A similar action occurs as the first wire passes between the poles of the magnets B, C, . . . Z, which are connected in series with the magnets B′, C′, Z′, so that there is established in each of the wires 2, 3, 4, . . . n, similar magnetic records. The wires 2, 3, 4, . . . n pass finally between the poles of a number of electromagnets, Ω_2, Ω_3, Ω_4, . . . Ω_n, which are all joined in series with a telephone receiver, T. If the two magnets which are joined together in series, such as A, A′, B, B′, . . . are arranged in the same perpendicular to the direction of the steel wires, and if all

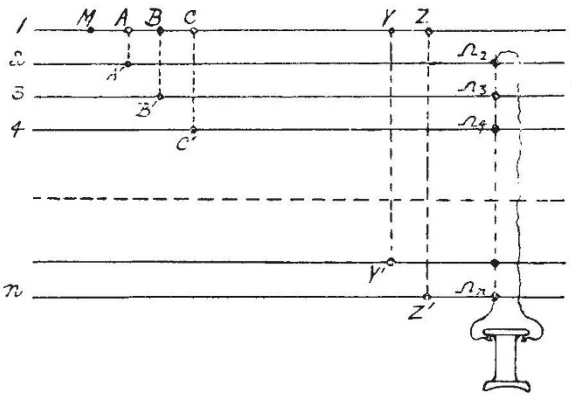

FIG. 3.

the wires are moved forward with the same velocity, then the magnetisations in the various wires—2, 3, 4, . . . n—at points lying in the same perpendicular will be similar; and since all these points will pass at the same instant between the poles of the magnets Ω_2, Ω_3, Ω_4, . . . Ω_n, they will there superpose their effects, and the intensity of the sound in the telephone, T, will be increased in proportion to the number of wires. It seems possible, therefore, with this device to indefinitely increase the loudness of the received message, and with quite a simple arrangement to easily double or treble the intensity of the sound.

There is a second ingenious method by which it is suggested that an increase in loudness can be obtained. In this advantage is taken of the fact, already pointed out, that the strength of the currents induced in the coils of the receiving electromagnet depends on the rate of variation of the magnetic field: it is therefore possible to increase the strength of the currents induced by a field altering from one given strength to another by diminishing the time in which such alteration occurs. If, therefore, we have a steel band on which a magnetic record has been made, we may increase the strength of the currents it will induce in the electromagnet connected to the receiving telephone—and consequently the loudness of the repeated message—by simply increasing the

speed at which the band passes between the poles of that electromagnet. But in order to obtain the amplification of the sound in this manner, it is apparent that the band must be moved more quickly when used to repeat the message than it was when used to record it, and thus the increased loudness will be accompanied by an increased quickness, and probably at a sacrifice of clearness due to the alteration in pitch. For if the speed of the band when used for recording be increased, the effect will be merely to spread out the message along the wire, as the intensity of the magnetisation set up in the wire depends only on the strength of the currents transmitted through the telephone, and this strength is determined by the loudness and quickness with which the message is spoken at the transmitting end

The invention of Herr Poulsen may be looked upon as the invention of a magnetic phonograph, and must be regarded as an extremely ingenious and beautiful attempt at the solution of the problem of recording telephonic messages. It possesses many advantages over the combination of the telephone and the wax-cylinder phonograph, especially in the fact that the recording is effected by the immaterial agency of magnetism, and not by the mechanical agency of a style writing on wax, so that the imperfections in the articulation due to mechanical causes should be entirely absent. The method of increasing the loudness by the use of a number of parallel bands appears exceedingly simple, and offers a possible means of making a telephonic relay, and thereby increasing the limits of distance to which sound can be transmitted; it is a method which might be imitated with the ordinary phonograph, by causing the message recorded on the wax cylinder to be repeated to one or more other cylinders, and finally making all repeat their records simultaneously; but in this case the practical difficulties would be very much greater. That Herr Poulsen's invention is still only in an experimental stage may be gathered from the fact that though the instrument itself is on view at Paris, it has been found too difficult at the Exhibition to make the necessary adjustments to exhibit it in operation publicly; but we await with interest its further development, for the introduction of a trustworthy recording telephone would be a benefit to the public, for which it is to be hoped they will not have long to wait.

NOTES.

THE French Minister of War has invited the Paris Academy of Sciences to advise as to the precautions to be adopted in selecting and planting trees in the neighbourhood of powder magazines, in order to secure the best protection from lightning.

THE Chancellor of the German Empire has issued an ordinance to the effect that the Réaumur thermometer will not be admitted to official control after January 1, 1901. This will lead to the exclusive use of the centigrade thermometer in Germany.

THE International Congress of Physics, held in Paris last week, appears to have been a complete success, more than a thousand members, including leading physicists of many nationalities, having been obtained. Lord Kelvin received a grand ovation at the opening meeting, and was nominated honorary president of the Congress.

M. OUSTALET and M. Depousarques are the two candidates who have been nominated by the Paris Academy of Sciences for the chair of zoology in the Muséum d'Histoire naturelle, rendered vacant by the death of Prof. Milne-Edwards. The appointment rests with the Minister of Public Instruction.

THE *Athenaeum* announces that Prof. Virchow has been elected an honorary member of the Mathematical and Natural Science Section of the Vienna Akademie der Wissenschaften, while Prof. Klein, of Göttingen, has been appointed corresponding member of the same section.

THE attention of persons interested in zoological gardens and keeping captive animals should be directed to the passing of the "Act for the Prevention of Cruelty to Wild Animals" (63 and 64 Vict., Ch. 33), which has just become law. This Act extends the provisions of the "Cruelty to Animals Acts 1849 and 1854" (which related to domestic animals only) to all birds, fishes and reptiles not included in that Act. By Sect. 2 of the new Act, "Any person shall be guilty of an offence who, whilst an animal is in captivity or close confinement, or is maimed, pinioned, or subjected to any appliance or contrivance for the purpose of hindering or preventing its escape from such captivity or confinement, shall, by wantonly or unreasonably doing or omitting any act, cause or permit to be caused any unnecessary suffering to such animal; or cruelly abuse, infuriate, tease, or terrify it, or permit it to be so treated." Any person committing such an offence may be proceeded against under the Summary Jurisdiction Acts, and on conviction is liable to be imprisoned for three months or fined £5.

A REUTER telegram from St. Petersburg states that the Imperial Academy of Science has just received news from the Russian expedition at Spitsbergen stating that in the month of September last the members of the expedition in question had erected, at Horn Sound, observatories for conducting meteorological, magnetic, astronomical and astrophysical researches. On October 20 the sun disappeared for four months, and at the end of October absolute and continuous night set in. The members of the expedition applied themselves constantly to scientific observations after November 17. On February 22 the sun was seen again for the first time. On June 5 and 8 the first boats arrived, ending the complete isolation of the expedition, which had lasted for nine months.

THE annual meeting of the French Association for the Advancement of Science was recently held at Paris. General Sebert, the president, delivered an address on the progress of mechanical industries and the means of developing them. In the course of his remarks he alluded to the value of technical education and research as factors in national advances. "It is noteworthy," he said, "that progress in mechanical industries has always coincided with the development of technical education in the countries in which the industries are carried on. The most rapid progress takes place in the countries where institutions for experiment and research are most numerous. Wherever research laboratories have been established to permit the study of the best conditions of invention, there the most marked advances first take place." The Association's grants for scientific purposes, made at the recent meeting, amounted to 21,241 francs, or about 850*l*.

MR. A. R. HUNT, writing from Torquay with reference to our note (p. 322) on the rumbling sounds heard at Bognor and Torquay on July 18, says: "I happened to go into my garden a few minutes after ten on the date named, and was at once conscious of a very unusual pulsating rumble. My first idea was earthquake, but the sound came steadily from one point, roughly south-east; and at last died away into distinct taps." The observation is interesting in showing how far the individual reports can be heard (see p. 378).

MR. J. STIRLING, Government geologist of Victoria, New South Wales, is at present in London as the mining representative of the Victorian Government, and during his stay here proposes to address some of the scientific, professional and mining