he must have been present³—"Even now indeed telegraphy without wires is possible within a restricted radius of a few hundred yards, and some years ago I assisted at experiments where messages were transmitted from one part of a house to another, without any intervening wire, by almost the identical means here described."

That article appeared in 1892, and was an anticipation of genius. Too little appreciation is felt to-day for the brilliant surmises and careful and conscientious observations of a great experimental worker like William Crookes; and on some of his researches orthodox science still turns its weighty and respectable back.

OTHER METHODS OF DETECTING WAVES.

In 1889 I had come across the effect of cohesion under electric impetus, and employed it to ring a bell under the stimulus of the overflow of a Leyden jar, as described in my paper to the Institution of Electrical Engineers in 1890 (vol. xix. pp. 352-4, where D. E. Hughes's comment on it is also recorded). In 1893 I heard—through a demonstration by Dr. Dawson Turner at Edinburgh—of Branly's filings-tube—an independent discovery of M. Branly, which really constituted an improvement on the first rough coherer idea. What I had called a coherer was not this, but a needle-point arrangement, or the end of a spiral spring touching an aluminium plate, which was and is extremely sensitive, but rather unmanageable.

With a Branly's filings-tube I made many more experiments, developing the subject; and on the untimely death of Hertz I determined to raise a monument to his memory by a lecture at the Royal Institution on these experiments (Friday, June 1, 1894), which I styled "The Work of Hertz"—meaning that it was a direct outcome and development inspired by that work. I soon found that the title was misleading, so that in the next edition I changed it into "The Work of Hertz and some of his Successors," and afterwards changed it still further into "Signalling across Space without Wires"; for that, of course, is what was being

³ Colonel Crompton now tells me that the experiments to which Crookes was probably referring were conducted not by Hughes but by Willoughby Smith, who seems to have demonstrated that some sort of communication was possible in this way.

done in laboratory fashion all the time. The depression of a key in one place produced a perceptible signal in another—usually the deflection of a spot of light—and, as I showed at Oxford, also in 1894, employing a Thomson marine speaking galvanometer lent me by Alexander Muirhead, a momentary depression of the key would produce a short signal, a continued depression a long signal;—thus giving an equivalent for the dots and dashes of the Morse code—if the filings-tube were associated with an automatic tapper-back. One form of such tapper-back was then and there exhibited—a trembler or vibrator being mounted on the stand of a receiving filings-tube. This was afterwards improved, with Mr. E. E. Robinson's help, into a rotating steel wheel dipping into oiled mercury. Our aim was to get signals on tape, with a siphon recorder, and not be satisfied with mere telephonic detection. We succeeded; but more rapid progress would have been made had we stuck to the telephone, as wiser people did.

TELEGRAPHY 1894 TO 1896.

My Royal Institution (1894) lecture was heard by Dr. Muirhead, who immediately conceived the desire to apply it to practical telegraphy. When my lecture was published—as it was in the *Electrician*, with diagrams roughly depicting the apparatus shown, drawn (some of them) skilfully but not always quite correctly, by the then editor of the *Electrician*, Mr. W. H. Snell—it excited a good deal of interest; stimulating, to the best of my belief, Capt. (now Admiral Sir Henry) Jackson, Prof. Righi, and Admiral Popoff to their various experimental successes which have been elsewhere described.

I was too busy with teaching work to take up telegraphic or any other development; nor had I the foresight to perceive, what has turned out to be, its extraordinary importance to the Navy, the Merchant Service, and indeed Land and War service too. But fortunately in Italy there was a man of sufficient insight to perceive much of this, and with leisure to devote himself to its practical development. In 1896 Signor Marconi came to this country—and the rest is public knowledge.

Man and the Ice Age.¹

By Prof. W. J. SOLLAS, F.R.S.

THE great advance recently made in our knowledge of the Quaternary epoch begins with the observations of General de Lamoignon on the ancient shore-lines which run along the coast of Algeria at heights of about 100, 60, 30, and 20 metres above the existing sea-level. They maintain their course with such remarkable uniformity that M. de Lamoignon was unable to regard them as due to elevation of the land, and consequently attributed them to changes in the level of the sea, and was thus led to predict that similar shore-lines would be discovered on the opposite coast of the Mediterranean and particularly in Provence; a prediction which was subsequently verified by Prof. Depéret.

Next Prof. Gignoux, a friend and former pupil of Prof. Depéret, made a detailed investigation of these shore-lines and their associated deposits in the Western

Mediterranean, and embodied his results in a masterly monograph.

Finally, Prof. Depéret himself extended these investigations to the Eastern Mediterranean and the west coast of the North Atlantic Ocean. In a comprehensive review of the whole subject he proposed the following classification of the Quaternary deposits, based on the four marine terraces of de Lamoignon.

1. SICILIAN (Döderlein). Coast-line at from 90 to 100 m. The most perfect example of this stage is afforded by the Conca d'Oro or basin of Palermo, an ancient bay of the Mediterranean now filled up with Quaternary deposits. They commence with a blue clay containing near its base the famous fauna of Ficarazzo, which points to cold conditions and a depth of 90 metres. Traced towards those localities where the sea was clearer, the clay passes into a Polyzoonal

¹ A lecture delivered to the Geological Society of London on January 10.

limestone resembling our Coralline crag, while towards the shore it becomes sandy. Ascending in the series, the sand increases and finally passes into conglomerates, which at the summit (90 m.) extend over a rocky platform bored by *Lithodomus* and encrusted with barnacles—to end against the foot of steep cliffs which are undercut and penetrated by sea caves.

The Sicilian stage is sharply marked off from the Calabrian (Upper Pliocene) by a stratigraphical unconformity and a fauna which is distinguished by the disappearance of many Pliocene mollusca, and the advent of many "cold" species from the North Atlantic. These were brought probably by a cold marine current. At Reggio the Sicilian terrace has yielded an entire skeleton of *Elephas antiquus*.

2. MILAZZIAN (Depéret). Coast-line at from 55 to 60 m. The deposits of this stage are chiefly littoral with a fauna indicating a temperate climate, but warmer than that of the existing Mediterranean.

3. TYRRHENIAN (Issel). Coast-line at 28 to 30 m. This includes the well-known Strombus beds (*Strombus bubonius*) which are found all round the Mediterranean. The fauna is characterised by "warm" species, such as still live off the coast of Senegal and the Canary Islands.

4. MONASTIRIAN (Deperet). Coast-line 18 to 20 m. This is named from the city of Monastir in Tunisia, adjacent to a locality very rich in fossils of the stage. The fauna is almost identical with the Tyrrhenian, but on the north coast of the Mediterranean contains no "warm" species.

THE FOUR CORRESPONDING RIVER TERRACES.

General de Lamothe has shown that the four Quaternary beaches or shore-lines of Algeria correspond with the four Quaternary terraces of the river Isser in Algeria, and Prof. Depéret has similarly identified the Quaternary river terraces of the Rhone with the ancient beaches of Provence.

Thus the river terraces were determined by the base level of erosion, *i.e.* in the first place by the position of the sea-level at the time of their formation.

They are thus liberated from their supposed dependence on the four glacial episodes of Prof. Penck. This distinguished investigator had, as is well known, attributed the transport of the material of which they consist to the action of the comparatively feeble rivers which issued from the moraines of the glaciers at their full extension during a glacial episode,—a view scarcely inconsistent with palæontological evidence.

Commont has correlated the four terraces of the Somme with those of the Rhine, and de Lamothe has correlated them with the four Quaternary sea-levels. But the three lower terraces of the Somme, *i.e.* the first or Monastirian, second or Tyrrhenian, and third or Milazzian, all contain in their lowest deposits a warm fauna, which in the case of the lower two includes Hippopotamus—an animal which certainly was not swimming in the Somme at a time when Switzerland and the Baltic buckler were covered with ice and ice was floating in the English Channel. Messrs. Hinton and Kennard have further shown that a warm mammalian fauna characterises the greater part of the terraces of the Thames.

Thus both marine and river terraces unite in pro-

claiming a warm climate and so far, apart from the Sicilian, we have encountered no signs of an Ice Age.

CONNEXION OF THE TERRACES WITH THE MORAINES.

We turn then to the moraines which afford evidence of the intercalation of glacial episodes in the otherwise genial climate of the Quaternary age. Prof. Depéret considers that he has proof of the association of the Milazzian terraces with the external moraine of the Rhone (Mindel), of the Tyrrhenian with the intermediate moraine (Riss), and of the Monastirian with the internal moraine (Würm). This association by no means implies synchronism, but it enables us to assign the several moraines to their respective stages.

From the point of view we have now reached it will be perceived that the term "Great Ice Age" is a misnomer, and that instead of speaking of a glacial age interrupted by genial episodes, it would be far more in accordance with fact to speak of a genial age interrupted by glacial episodes.

Since these glacial episodes were quite certainly intercalated it will naturally be asked why they are not more obviously represented in the fauna of the Quaternary age. The answer to this is that the remains of a cold fauna are by no means infrequent, but the gravels at the base of a terrace are not the place to look for them. It is to the slopes between the terraces that we should turn, for it is these which correspond with glacial episodes, and when, as generally happens, they are covered with löss we find in it the bones and teeth of such cold-loving species, as we might expect.

It may further be pointed out that terraces, both marine and fluvial, mark a stationary level of the sea when deposits were accumulating, in which the contemporary warm mammalia might easily be preserved.

In the intervals when the sea-level was changing the work of denudation ruled supreme and undisturbed deposits were formed but sparingly. Now and then no doubt the bones of some animal belonging to the cold fauna might escape destruction and find burial in a marine terrace along with the warm fauna proper to it, and thus possibly have arisen some of those perplexing anomalies of distribution with which we are only too familiar.

REGRESSIONS.

The movement of the sea-level does not appear to have been a simple fall from the Sicilian to the Milazzian

FIG. 1.—Oscillations of the Quaternary sea-level. *ab*, Sicilian stage; *bc*, Milazzian; *cd*, Tyrrhenian; *d* to Neolithic peat, Monastirian. The numbers indicate the heights of the marine terraces in metres.

coast-line and from the Milazzian to the Tyrrhenian; there is evidence to show that it fluctuated (Fig. 1), first

sinking from the Sicilian to somewhere not far from the existing sea-level and then rising to the Milazzian, and similarly for all the succeeding stages.

CHRONOLOGY OF THE HUMAN FAMILY.

The researches of Mr. Reid Moir have made us familiar with the existence of some member of the Hominidæ in the Red Crag, *i.e.* in the Calabrian stage of the Pliocene system, and if Prof. Depéret is right in referring the Forest Bed to the Sicilian, man seems to be also represented in this stage.

In the Milazzian (third terrace of the Somme) human artefacts are found associated with a warm fauna. Some of them are primitive forms of the Chellean boucher, and the industry as a whole is known as the Strepyan or Pre-Chellean.

The Tyrrhenian (second terrace of the Somme) affords the typical Chellean industry. It was indeed from this stage at Abbeville that Boucher des Perthes obtained the so-called "coup de poing" by which he established for the first time the existence of man at this remote period.

In the Monastirian, represented by the lowest gravels of the first terrace, the Chellean attains its final stage of evolution. It is still associated with a warm fauna. But these gravels are "ravinées" by a later one which brings with it Acheulean implements and the mammoth. If our preceding correlations are correct, the Acheulean must evidently be referred to a later stage of the Monastirian when the Würm glaciation was beginning to make itself felt. The Mousterian and all the succeeding industries of the Upper Palæolithic would then belong to the closing days of the Monastirian and the final retreat of the ice.

The interpretation seems to represent the present state of our knowledge, but it is not without its

difficulties; one of the most perplexing is suggested by the "warm" Mousterian of Commont. More than one explanation may be offered of this, but the question may well be left to future research.

COMPARISON OF THE COAST-LINES OF THE NORTHERN AND SOUTHERN HEMISPHERE.

A eustatic movement of the sea-level is by itself unproved and unlikely, but a general deformation of the globe might well produce effects involving such a movement. That epeirogenic movements cannot be excluded is shown by the fact that the Tyrrhenian coast-line is deformed by local disturbances so that in the Strait of Messina it stands at 100 m. instead of 30 m., and in the Isthmus of Corinth even reaches 300 m. The Quaternary age was indeed by no means so reposeful as seems to be generally assumed; it includes movements of the earth's crust affecting wide areas and on no inconsiderable scale, as is shown by the recent observations of Prof. Bosworth in Peru, and Dr. Molengraaff in the East Indies.

This immensely complicates our problem. Prof. Depéret has sketched in bold outline a remarkable and suggestive history of the Quaternary age. To work it out in all its details will be the arduous task of more than one generation of geologists.

That a general deformation of the globe was in progress during Tertiary and Quaternary times is suggested by the general presence of raised beaches on both sides of the equator. On the north, General de Lamoignon determined the existence of ancient coast-lines in Algeria at 325, 255, 204, 148, 108, 60, 30, and 18 m. On the south, they have been observed in Mejillones Bay, Chile, at 320-300, 225, 133, 111-108, 40, and 15-18 m.

It looks as though the earth accomplished its contraction by pulsations.

Obituary.

PROF. PAUL JACOBSON.

ON January 26 the death occurred at Berlin of Prof. Paul Jacobson, who was widely known as the general secretary of the German Chemical Society and as the editor of important chemical works. He was born on October 5, 1859, at Königsberg in Prussia, and he studied under A. W. Hofmann at Berlin and Victor Meyer at Göttingen. In that university he became a lecturer, and followed Victor Meyer to Heidelberg, where he became professor. Jacobson carried out a number of researches in the field of organic chemistry, especially on azo- and hydrazo-compounds, which earned him the reputation of a careful and original research worker. At the same time he began with Victor Meyer the "Lehrbuch der organischen Chemie," in which these two workers have put on record an immense amount of knowledge and experiences. After the early death of Victor Meyer, Jacobson continued to work alone, unfortunately without being able to finish it.

In 1897 Jacobson removed to Berlin as editor of the *Berichte der Deutschen Chemischen Gesellschaft* and general secretary of the society. He transacted the business of this society with indefatigable industry and perfect tact until September 1911. He then became

scientific editor of the *Abteilung für Sammeliteratur*, which was founded by the society for the purpose of re-issuing F. Beilstein's "Handbook of Organic Chemistry" and M. M. Richter's "Lexicon of the Carbon-Compounds," and between 1900 and 1906 Jacobson edited five supplementary volumes to the third edition of Beilstein's Handbook. Then he commenced the fourth edition of this standard work, which is to be completed in the near future. The new editions of M. M. Richter have been continued under the supervision of Jacobson by R. Stelzner, as "Literaturverzeichnis der organischen Chemie."

The death of Paul Jacobson will be deeply regretted by all who came to know him in the meetings of the Society and at international congresses. Scientific research suffers a great loss by his death.

PROF. W. N. PARKER.

THE death occurred on February 22, at the age of sixty-five, at his residence at Cardiff, of Prof. W. N. Parker, emeritus professor of zoology at the University College of South Wales and Monmouthshire.

Prof. Parker was a pupil of Huxley and for a time acted as his demonstrator. During 1881 and 1882 he