REGISTER. 3.10.25.

WONDERS OF THE EARTH.

ITS CONSTITUTION AND AGE.

The Progress of Science.

A meeting of the British Association for the Advancement of Science was recently held at Southampton. The President (Professor Horace Lamb), in his address, which was amplified for the convenience of the large audience, said:—The subjects of these meetings range from the most abstract points of mathematical philosophy to the processes of agriculture. They have been so subdivided and specialized that works in adjacent fields have often a difficulty in appreciating each other's ideas, or even understanding each other's language. What is the real purpose, the common inspiration, the common ambition behind such enthusiastic and sustained effort in so many directions?

The Forces of Nature.

An official answer has often been given summing up the general aim in the almost consecrated formula, "to subdue the forces of Nature to the service of man." As it was impossible to foresee what abstract research might or might not provide a clue to something useful, the more speculative branches of science were not only to be tolerated, but to be encouraged within limits, as ancillary to the supreme end.

PROFESSOR HORACE LAMB.

The apologists of pure mathematics, for instance, have been wont to appeal to the case of the conic sections, which from the time of Apollonius onwards had been an entirely detached study, but was destined after some 2,000 years to guide Kepler and Newton in formulating the laws of the planetary motions, and so ultimately to find its justification in the Nautical Almanac.

We may recognize that practical utility has been a conscious aim in scientific work, and sometimes its main justification; but we can hardly admit that any such formula as I have quoted wortlily conveys what has been the real inspiration of discovery. We cannot suppose that Apollonius was thinking of posterity; he was engaged in a study which he no doubt held to be legitimate and respectable in itself. Or, to take a recent instance, when Faraday and Maxwell were feeling their way towards an electric theory of light, they could hardly have dreamed of wireless telegraphy, though as we now know this was no remote development.

The primary aim of science is to explore the facts of Nature, to ascertain their mutual relations, and to arrange them as far as possible into a consistent and intelligible scheme. This endeavour is the true inspiration of scientific work, as success in it is the appropriate reward. The material effects come later, if at all, and often by a very indirect path.

Art and Science.

We may claim for this constructive task something of an aesthetic character. The provinces of art and science are often held to be alien and even antagonistic, but in the higher processes of scientific thought it is often possible to trace an affinity. Is it not the case that the widespread interest excited by the latest achievements of physical science is due not to the hope of future profit, though this will doubtless come, but to the intrinsic beauty as well as the novelty of the visions which they unfold. It is possible, I trust, to insist on these aspects of the scientific temperament without wishing to draw a sharp and even mischievous antithesis between pure and applied science. The most severely utilitarian result comes often as the result of a long and patient process of study and experiment, conducted on strictly scientific methods. We must recognize also the debts which pure science in its turn owes to industry, the impulse derived from the suggestion of new problems, and not least the extended scale on which experiment becomes possible. But perhaps the most momentous consequences of the increased scientific activities of our time have been on the intellectual side. How profound these have been in one direction we have recently been reminded by the centenary of Huxley. Authority and science were at one time in conflict over matters entirely within the province of the latter. The weapons were keen, and the strife bitter. We may rejoice that these antagonisms are now almost obsolete: one side has become more tolerant, the other less aggressive, and there is a disposition on both sides to respect each other's territories.

Constitution of the Earth.

It is expected that the President should deal with some subject in which he has himself been interested. I propose to deal briefly, and mainly from the mathematical and physical standpoint, about some branches of geophysics, and in particular those relating to the constitution of the earth. The accurate investigation of the figure of the earth is intimately connected with the variation of gravity over its surface. In view of the local irregularities some convention was necessary as to what is meant by the shape of the earth as a whole. The usual definition is that it is a level surface as regards the resultant of true gravity and centrifugal force: often that particular level surface of which the sea forms a part. Briefly, the general result is this, that in mountainous regions the observed value of gravity is abnormally low, while on oceanic islands, and so far as can be ascertained on the sea, it is abnormally large, when all allowance has been made for altitude and the normal variation with latitude. The fact that this has been found to be the case in so many different places shows that we have here to deal with no casual phenomenon. The accepted explanation originated by Archdeacon Pratt, of Calcutta, in 1859, and since developed especially by Hayford and Bowie, of the United States Survey, is that if we imagine a level surface to be drawn at a depth of about 100 kilometres, the stratum of matter above this, though varying in density from point to point, is approximately uniform, in the sense that equal areas of the surface in question bear equal weights. The altitude of the mountains is held to be compensated by the inferior density of the underlying matter, while the oceanic hollows are made up for by increased density beneath. Leaving aside the technical evidence on which this hypothesis is based, there are one or two points to be noticed. In the first place it suggests, as is highly plausible on other grounds, that the matter in the interior of he earth, below the stratum referred to, is in a state of pressure uniform in all directions. So far as this stratum is concerned, it might be floating on an internal globe of liquid, although no assertion is really made, or is necessary, to this effect. But the stratum itself shearing forces must be present, and it is necessary to consider whether the actual material is strong enough to withstand the weight of continents and mountains, and the lack of lateral support due to the oceanic depressions. The researches of Professor Love and others show that this question can fairly be answered in the affirmative.

New Method of Measuring Gravity.

The accurate determination of the acceleration of gravity at any place is a matter of great delicacy. In the pendulum method the yielding of the support due to the reaction of the pendulum as it swings to and fro affects the time of oscillation. So far back as 1818 Kater, in his absolute determination of the length of the seconds pendulum in London, was on his guard against this effect, and devised a test to make sure that it was in his case negligible. In a portable apparatus, such as is used for comparative determinations, it is difficult to give sufficient rigidity to the support, and a correction has, in some way, to be applied. Recently Dr. Victor Meinesz, of the Dutch Survey, who has carried out an extensive gravity survey in Holland, has sought to minimize this effect by the use of pairs of pendulums swinging in opposite phases, and so reacting on the support in opposite senses. This has opened out a prospect of accurate gravity determination at sea. The use of a pendulum method on a surface vessel is hardly possible, but a submarine when sufficiently immersed offers comparative tranquility, and it is hoped that the small residual horizontal motions may be capable of elimination and the diminished vertical oscillation allowed for.

It is a matter of regret that the observational side of geophysics has, of late, been little cultivated. Nothing so far as I know has been done towards a gravity survey since the time of Kater, more than a century ago. It is therefore some satisfaction to record that a modest beginning has been made at Cambridge by the institution of a Readership in Geodesy, and that when the requisite pendulum outfit is complete it is hoped that a gravity survey of the British Isles may be initiated. Lord Kelvin's historic attempts to limit the age of the earth by consideration of the observed temperature gradient as we go downwards from the surface lost their basis when it was discovered that the rate of generation of heat in the processes of radio-active change was amply sufficient to account for the present gradient. Assuming an average distribution of such material similar to what is found near the surface, a stratum of some 16 kilometres in thickness would provide all that is wanted.

Age of the Earth's Crust.

Radio-active speculation has gone farther. A comparison of the amounts of uranium, and of the end-products associated with it, has led to estimates of the time that has elapsed since the final consolidation of the earth's crust. The conclusion is that it must lie definitely between 10·9 and 10·10 years. The figure is necessarily vague owing to the rough value of some of the data, but even the lower of these limits gives ample scope for the drama of evolution. Physics has at length amply atoned for the grudging allowance of time which it was once disposed to accord for the processes of geological and biological change. The radioactive arguments on which these estimates are based are apparently irrefutable; but from the physical point of view there are reasons why one would welcome an extension even of the upper limit of 10·10 years, if this could possible be stretched. For if this barrier be immovable, we are led to conclusions as to the present internal temperature of the earth which are not quite easy to reconcile with the evidence as to rigidity to be referred to later. In the space of time mentioned, enormous as it is, the great mass of the earth could hardly have cooled very much from the temperature when it was in a state of fusion. The central portion, whatever its nature, and however high its thermal conductivity, is enclosed by a thick envelope of feebly conducting material, just as a steam boiler, for instance, may be packed with a layer of asbestos. To take a calculable hypothesis, we may assume with Wiechert that we have a central core of three-fourths the earth's radius, with an outer shell of rock. We may give the core any degree of conductivity we like, for mathematical simplicity we may even regard it as infinite. Then, if the outer layer consists of material having some such conductivity as the surface rocks, the internal temperature would take to fall to one-half its original value a period of at least 16 times the limit I have named.

Interior Heat of the Earth.

Even on this rapid review of the subject it should be clear that there is an apparent inconsistency between the results of two lines of argument. On the one hand, the thermal evidence points to the existence of a high temperature at a depth which is no great fraction of the earth's radius, so high indeed as to suggest a plastic condition which would readily yield to shearing stress. On the other hand, the tidal arguments, as well as the free propagation of waves of transversal vibration at great depths, indicate with certainty something like perfect elasticity in the mathematical sense. The material with which we are concerned is under conditions far removed from any of which we have experience; the pressures, for instance are enormous; and it is possibly in this direction that the solution of the difficulty is to be sought.

We have some experience of substances which are plastic under long-continued stress, but which behave as rigid bodies as regards vibrations of short period, although this combination of properties is, I think, only met with at moderate temperatures. It is conceivable that we have here a true analogy, and that the material in question, under its special conditions, though plastic under steady application of force, as for instance centrifugal force, may be practically rigid as regards oscillatory forces, even when their period is so long as a day or a fortnight. But beyond that we can hardly, with confidence, go at present.

ADV. 9.10.25

FORESTRY EXPERT.

PROFESSOR CORBIN ENTERTAINED.

A farewell luncheon was tendered to Professor H. H. Corbin, who has relinquished the position of lecturer in forestry at the University to become professor of forestry at Auckland University College, at the South Australian Hotel on Thursday, by the executive of the South Australian branch of the Forest League. Among those present were the president (Sir William Sowden), who occupied the chair, Mr. E. Anthoney, M.P., Mr. G. McEwin, Captain S. A. White, the secretary (Mr. E. Stevens).

The chairman, in proposing the health of Professor Corbin, said he was a gentleman in the truest sense of the word. (Applause.) He was an expert among experts in a key industry. He had studied forestry in its every department, and understood it from end to end. South Australia was in the extraordinary position of training experts at the expense of the taxpayers, and for the sake of a few pounds allowing them to go to other places. They imported experts and exported them, but preferred to keep prize sheep and cattle than prize men. The league was sorry to lose Professor Corbin, and thought his departure was the result of a short-sighted policy. People were beginning to realise, chiefly due to Professor Corbin's lecturing, that the planting of trees was as important to South Australia as the planting of wheat. Professor Corbin was leaving behind him living monuments in the hundreds of thousands of trees he had had planted, and he had other living monuments in the men he had trained, who were now occupying high positions elsewhere. The best monument for the forest at Kuitpo, famous throughout Australia. (Applause.) They were saying farewell to him with sorrow, but were happy to know Auckland was already preparing to extend him the glad hand. (Applause.)

Mr. Anthoney said he regretted losing a forester of Professor Corbin's calibre. With regard to the question of afforestation, it was pleasing to know that all the States, in fact, all the world, was beginning to realise the seriousness of the position. Men competent to judge, had shouted from the housetops that there would be in a few years a shortage of timber. Governments were at least waking up, and realising that Australia should be self-supporting with regard to timber resources. He regretted having to say it, but he felt Professor Corbin's services would be better appreciated in Auckland than they had been here.

Mr. McEwin said forestry needed officials who could look 30 to 40 years ahead. South Australia, of all the States, needed a progressive forestry policy. It was not like other States with ready-planted forests, and would have to plant its own trees.

Captain White said he felt the loss of Professor Corbin greatly; it was a calamity to this State. No one had worked harder for forestry than Professor Corbin.

Mr. Stevens also wished the guest every success.

Professor Corbin thanked all for their kind remarks about him personally and his work. He regarded the forest movement as a useful and necessary institution. The league was not active all the time, but it was like a watchdog, ready to help when needed. The league had done and would continue to do tremendously useful work. Regarding Kuitpo, if any of his work there was as deserving of credit as they had said, then he was satisfied. If the forest was a success, it was not entirely attributable to what he had accomplished, for he could hardly have done without such an able lieutenant as Mr. Durward, and he could not speak too highly of him and others employed in the work. He regretted leaving the State and such good friends. (Applause.)

ADV. 9.10.25

The following appointments have been made in the Adelaide Hospital by the Executive Council:—Hon. surgeon, Dr. John Corbin; hon. assistant surgeon, Dr. Leonard Charles Edward Lindon; hon. assistant physician, Dr. Henry Kenny Fryer.

REG. 9.10.25.

ELDER CONSERVATORIUM.

On Monday, in the Elder Hall, a chamber music recital will be given. Included in a programme of exceptional interest is Mozart's string quintet in G minor. Another work to be given is Arensky's trio in D minor for piano, violin, and cello. This trio has become one of the most popular of its kind, owing more to its extraordinary brilliancy and effectiveness than to the depth of its musical ideas. Miss Hilda Gill will sing a group of four Russian songs. The concert will not be broadcast. Plan at S. Marshall & Sons, Gawler place.

NEWS. 8.10.25

Sir Douglas Mawson (retiring president of the Royal Society of South Australia), will be unable to attend the annual meeting tonight owing to indisposition. Consequently there will be no presidential address. The annual report will be presented, and an election of officers for the ensuing year will take place.