Having thus developed a method capable of yielding rapid and conclusive results, the work was continued on more practical lines, the main results of which may be summarised. It is shown in the first place that, even where there is no intermittent cavitation, that is, the collapse of 'vacuum bubbles,' impingement attack can still take place as a result of air-bubble impingement. The size of these air-bubbles plays an important part in causing this type of corrosion, and, where the bubbles entangled in the water are very small, they appear to be comparatively harmless even under conditions of strong impingement. There are, therefore, two main causes of impingement attack, intermittent cavitation and air-bubble impingement, but in both cases the effect is known to be dependent on the occurrence of swirling motions in the water. Rotatory motion of the water should therefore be prevented both in the inlet water-box and inlet piping, if necessary by positive arrangements to guide the water. Air bubbles in the water, except very small ones, should be avoided, and the suggestion is made that a grid in front of the tube-plate of the condenser may be so designed that any bubbles passing through it are broken up sufficiently finely as to be harmless when they enter the tubes.

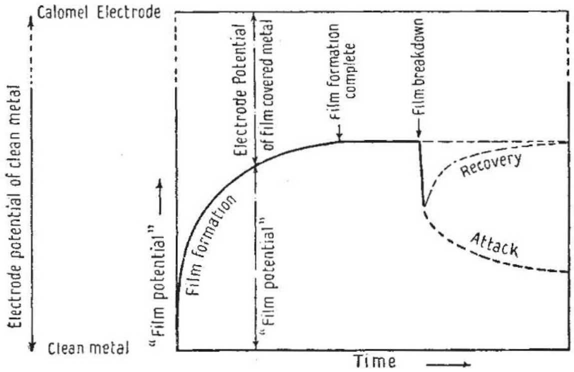

FIG. 2.—Diagrammatic curve of 'film potential' plotted against time, showing the relationship between 'film potential' and electrode potential. By courtesy of the Institute of Metals.

When the conditions cannot be moderated by mechanical means, the most hopeful solution of the problem would appear to be the use of tubes of a material specially resistant to this form of attack. Of such tubes already on the market those of 70 : 30 cupro-nickel seem to be quite satisfactory, but other materials, such as the aluminium-brass, to which attention has already been directed, appear to be at least as good. F. C. T.

The Swedish State College of Forestry Centenary Celebrations, 1928.

ON Oct. 14–16 the State College of Forestry, situated in the vicinity of Stockholm, celebrated its centenary. This College, formerly known as the Forestry Institute, was founded on Oct. 15, 1828, by that far-seeing man, Israel Adolf av Ström, who even at that distant date endeavoured to arouse his countrymen to a realisation of the economic importance of the forests of the country. The change in materials used for construction, especially in ships and buildings, witnessed the rise in demand for coniferous timbers, and during the second half of last century Sweden was mainly occupied in capturing and maintaining her hold on the European softwood timber markets. The advice of the few, who understood the danger which the more or less unrestricted lumbering in the forests which had been acquired by the great timber companies and in those numerous areas of varying size (designated farm-forests), owned by tenant farmers, went unheeded. The power of the lumbering interests predominated and the country undoubtedly prospered thereby. Before the end of the century, however, the Government became alarmed at the position and appointed a committee to consider what legal restrictions could be placed on the unchecked exploitation combined with a want of effective management in the greater bulk of the privately owned forests of the country. As a result of the committee's report a General Forest Law was enacted in 1903 and brought into force in 1905, which made it imperative that all areas of forest felled should be replaced by a new young tree crop within a reasonable period. At the same period a revival in the scientific aspects of forestry took place, and in order to endeavour to associate the scientific and commercial aspects of this question the Swedish Forestry Association was founded in 1903.

It is not the purpose of this notice to trace the great progress which the present century has witnessed in forestry matters in Sweden. The War acted as a setback to some extent, in so far that fellings were greatly increased to take advantage of the fantastic prices prevailing in the European markets. But perhaps, as a natural outcome of the extraordinary fellings made to take advantage of exceptional prices, the swing of the pendulum focused the attention of both the State authorities and those engaged in and dependent upon the enormous export trade upon the question of their ability to maintain the position, one vital to the country. To Great Britain the matter is of considerable importance, since we depend at present for a considerable amount of our coniferous imports—timber in various semi-fashioned and fashioned forms, pit-wood and, to an increasing degree, wood-pulp.

This being the position, it is not surprising that in the forestry revival the State College of Forestry became an important centre, since the State forestry probationers are trained there, and many of the larger timber companies either select fully-trained young men from the College or nominate their own probationers to proceed to the College. In some cases these men remain for a longer period as research students at the centre before joining their companies; for many of the latter undertake forest research work of their own and have their own research laboratories. This has been necessitated since conditions vary in different parts, and it is well recognised that it is impossible to localise forestry research for the whole country at any one centre. The timber companies of Sweden own a considerable portion of the most valuable forest land, the State forests occupying for the most part the less valuable soils in the north. The companies have a large capital invested in their undertakings and they have now realised to the full, a recognition which has only come slowly with the lumbering interests and is still absent in many parts of the world, that if this capital is to be safe in the future they must reafforest areas felled over so as to have a succession of crops to provide materials to keep their mills and other industries running. In other words, that primeval forests cannot last for ever. Sweden had arrived at that realisation by the beginning of the present century.

The importance attached to the centenary celebrations of the State College is therefore understandable. The King of Sweden graced the proceedings on two occasions, whilst the Crown Prince was present

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at most of the meetings, and presided at the State banquet, at which he gave an excellent résumé of the present position of forestry in Sweden and the enormous importance of the forests to the country, half of the exports of which consisted of forest produce in one form or another. The Crown Prince showed that he had a first-hand knowledge of the question; the best summary of his speech being the remark: "If you properly manage your forests they will be preserved for all time."

The chairman of the College Board, as also of the Forestry Association, was that remarkable man Admiral Arvid Lindman, recently appointed Prime Minister of the country. The Admiral spoke several times and laid especial stress on the great importance of the work the State Forestry College was accomplishing, and that it now held an unquestioned position in the country; and nowhere less unquestioned than amongst the great commercial industrial element dependent upon the forest for the raw product of their industries, as the indispensable centre at which forestry education in all its aspects was conducted, and that its functions were yearly becoming more valuable to the country.

The celebrations were attended by important delegations from universities and forestry colleges from most of the European centres, namely, Germany, Great Britain (from the Universities of Oxford, Cambridge, and Edinburgh), France, Austria, Belgium, Czechoslovakia, Yugoslavia, Poland, Soviet Russia, Finland, Norway, Latvia, etc., with two representatives from universities of the United States.

Radioactive Changes and Thermionics.[1]

H. J. BRADDICK AND H. M. CAVE.—The rate of emission of alpha particles from radium. A knowledge of the rate of disintegration of radium as measured by the number, Z, of α-particle disintegrations taking place in unit mass of radium in unit time is of considerable importance in the interpretation of radioactive changes, and in particular of the energy relations involved. Recently published values for this quantity Z range from $3\cdot40 \times 10^{10}$ to $3\cdot72 \times 10^{10}$. The heat evolution of radium and its products as determined experimentally is in agreement with that calculated from the number and energy of the α-rays, recoil atoms, β- and γ-rays if a value is assumed for Z of about $3\cdot7 \times 10^{10}$.

The authors have made a determination of the number Z by measuring the total charge carried by a known fraction of the α-rays from a source of radium active deposit, assuming that the normal α-particle carries twice the electronic charge, taken as $4\cdot77 \times 10^{-10}$ e.s.u. The experiment was carried out in a highly evacuated chamber placed in a strong magnetic field which served practically to eliminate β-ray and δ-ray effects. The α-ray current was measured by the Townsend compensation method, and the activity of the source was determined continuously throughout an experiment by γ-ray methods. Possible sources of error were investigated.

The value obtained is $3\cdot68 \times 10^{10}$ and leads to a value for the heating effect in good agreement with that observed in recent experiments. It seems that there is no necessity to assume the existence of an unrecognised heat-producing mechanism in the disintegration.

P. WHITE AND G. MILLINGTON.—The velocity distribution of β-particles after passing through thin foils. The source of β-particles was radium-B and -C on a narrow platinum wire, and their velocities were measured by the usual photographic method with semi-circular focusing. The source was covered by a thin screen of mica pierced with two or three small holes, the straggled and the unstraggled lines being obtained on the same plate. The relative number of particles falling on each part of the plates was determined from the density curves by using the known density-calibration curve for the plates. The frequency curves so obtained were corrected for the finite width of the unstraggled lines, and the abscissæ expressed as $\delta(H\rho)$. The curves for $H\rho$ 1410 to 1938 for thicknesses of mica 2 to 6 mgm. per sq. cm. are expressed in terms of a fundamental straggling curve. It is found that many more particles lose large amounts of energy than theory predicts. The relation between the most probable loss of velocity and the thickness of foil shows a small systematic divergence from Bohr's theory which is beyond the limits of experimental error, and the same is found for the relation between initial velocity and the most probable loss of velocity. The assumptions underlying Bohr's theory are discussed in relation to these divergences and the possible advances to be made on the theoretical side.

N. A. DE BRUYNE.—The action of strong electric fields on the current from a thermionic cathode. An account is given of an investigation into the rise of the saturation current from a thermionic cathode from a hot tungsten filament as the applied field is increased. Schottky's relation holds good for fields up to one million volts per centimetre; it is concluded that the electrons pulled out by fields of this magnitude have a Maxwellian velocity distribution.

In the case of one of the three filaments used there was an apparent departure from the Schottky relation; the only reasonable explanation of the anomaly is that at high field strengths produced adventitiously by the presence of irregularities on the cathode surface the Schottky relation no longer holds good; it is therefore concluded that the electrons pulled out by strong fields do not have a Maxwellian velocity distribution. From the results a value of the electronic charge is deduced.

J. C. MCLENNAN AND G. GREENWOOD.—The decomposition of ammonia by high speed electrons. In these experiments, carried out with a Collidge cathode ray tube, the pressure range studied was 0·5-4·0 mm. On bombarding ammonia at pressures within this range an equilibrium between hydrogen, nitrogen, and ammonia was established. By the use of rays of constant velocity the percentage decomposition decreased with increasing gas pressure. When the initial pressure of the gas was kept constant and the velocity of the rays varied, the percentage decomposition was found to be a linear function of the voltage applied to the cathode ray tube. No decomposition was found to occur below 82,000 volts, apparently because no rays with less speed penetrated the window. The presence of an excess of nitrogen increased the quantity of ammonia decomposed, while the presence of excess hydrogen lessened it.

Analysis of the results obtained showed that each electron having a definite velocity depending on the constant applied voltage was responsible for the decomposition of a definite quantity of ammonia molecules regardless of the pressure of the gas. With electrons of different speeds the amount of ammonia decomposed per electron increased with the speed. When the ammonia contained nitrogen in excess, the primary decomposition of the ammonia was not affected by the presence of the nitrogen. With hydrogen in excess, however, the speed of the initial decomposition of the ammonia was decreased.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

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