The Cracking of Lead Cable Sheathing.

A PAPER on the important practical subject of "The Deterioration of Lead Cable Sheathing," by Messrs. S. Beckinsale and H. Waterhouse, read at the spring meeting of the Institute of Metals, represents work done in the Research Department, Woolwich, for the British Non-Ferrous Metals Research Association. The authors have examined a large number of lead cable sheaths which have failed in service by inter-crystalline cracking, and it was found in all cases that the material which had failed was lead of a high degree of chemical purity. It has been suggested that this type of cracking may have resulted from overheating during the extrusion of the sheath. It is shown, however, in the present paper that for lead of the composition generally used, working can be done from room temperature up to within a few degrees of the melting point without leading to cracking, and the only difference observed in the lead rolled at different temperatures was that the grain size tended to increase as the temperature was raised. It was not found possible to reproduce any cracking corresponding with that observed in service by variations of the working temperature.

It has been observed previously that the structure of the same cable sheath varies very appreciably so far as the size of the crystals is concerned. This point has been taken up with considerable care by the present authors, and they have shown that there is no probability that appreciable grain growth has occurred during service. They have also failed to find any reason to believe that there is a relationship between the frequency of the cracking and the crystal size. This type of cracking has also been attributed to allotropic changes in the lead, but careful work, both pyrometric and mechanical, has failed to reveal any evidence of such allotropic change, and it is considered that the possibility of such things being in any way responsible for the cracking must be dismissed.

Cracking is well known to occur in brass which is subjected to the simultaneous effect of stress and corrosive action. Similar cracking in lead has been obtained under the combined action of tensile stress and corrosion with solutions of acetic acid or lead acetate. It is not believed, however, that such corrosive attack can have any important bearing on the present subject, since it was observed that the cracking in service commenced on the inner surface of the sheath and spread outwards, and that it was not until the cracks had reached the exterior surface that the slightest evidence of local corrosion of the inner surface could be detected. It was shown, however, that while silver, copper, bismuth, and nickel all diminished the resistance of lead to corrosion in soluble acetates, arsenic, cadmium, and particularly tin and antimony, all rendered lead more resistant. There are cases on record where acetic or some other organic acid appears to have played an important part in the failure by corrosion of lead sheet and cable sheathing which had been in contact with oak, though pitch pine and deal appear to be without action. Creosote, if free from acetic acid, also has no influence in the production of inter-crystalline cracking.

The failure of the sheathing occurs generally in situations subject to vibration, or where the metal is subject to changes of length due to fluctuations of temperature, and the view that the cracking is due to 'fatigue' is one for which there is considerable support. Fatigue tests have been carried out which indicate a range of stress at the fatigue limit of approximately only 0·18 ton per square inch, and cracks were found in the fatigue test pieces which bear a striking relationship to those in the cable sheathing which had failed.

Since the cracking in service was thus in all probability due to fatigue, experiments were carried out with lead alloys in which the fatigue limit was higher. Even very small amounts of metals, such as bismuth and silver, which are regarded as undesirable impurities in certain respects, have a beneficial effect in raising the fatigue limit. The most satisfactory method of doing this, however, is to use the binary or ternary alloys of lead containing tin, antimony, or cadmium; 0·5 per cent of cadmium increases the fatigue limit to more than three times that of pure lead, while similar increases can be obtained by using ternary alloys containing cadmium and either tin or antimony. These ternary alloys have not only a high fatigue limit, but they also have a permanence of composition during melting and a resistance to oxidation at raised temperatures which are superior to those of the binary alloys, while in addition they possess good corrosion-resisting properties. F. C. T.

University Statistics,[1] 1926–27.

SINCE the acceptance by Oxford and Cambridge of annual parliamentary grants and the consequent inclusion of these two universities in the University Grants Committee's returns, these statistics have presented a fairly comprehensive survey of university work in Great Britain. For five years now the returns have comprised all universities and, with few exceptions, all university colleges in Great Britain, and it seems a pity that they are not supplemented by others, in identical form, for the excepted institutions.

The total number of full-time students of both sexes in 1926–27 was 42,354. The proportion of women to men has risen during the past five years from 14 : 36 to 15 : 35. In England as a whole women formed, in 1926–27, 28·3 per cent of the total number; in Wales, 39·3 per cent; in Scotland, 34 per cent; in London institutions, 35·7 per cent. Since the War the large body of students aided under the government scheme for the higher education of ex-service men has obscured the situation in regard to student enrolments. As this large body has gradually passed out of the universities the total number of men students has continuously fallen until 1925–26, when only 17 of the ex-service scholarship holders remained. Now for the first time the actual tendencies of student enrolments to increase are exhibited in the returns, which show an increase of 748 (men 658, women 90) over the number of full-time students in the preceding year. If from the figures shown in the returns for preceding years the number of ex-service scholarship holders are deducted, the decreases shown in 1925–26 and 1924–25 are converted into increases of 58 and 360 respectively, and the decrease in 1923–24 is reduced to 113. Similarly, the increase in the proportion of women is converted to a slight decrease.

[1] Returns from Universities and University Colleges in receipt of Treasury Grant, 1926–27. (London: H.M. Stationery Office, 1928.) Pp. 24. 3s. net.