Deepwalls are all the more interesting because at least 15 inches of precipitation are added to the ordinary rainfall as the result of condensation by the forest canopy of hydrometeoric mists.

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The Complex Structure of the Copper–Tin Intermetallic Compounds.

THE equilibrium diagram of the copper–tin system is one that shows a bewildering complexity of phases. The great majority of these exist only at high temperatures or form solid solutions of variable composition, but there exist at ordinary temperatures three phases which show a very limited range of composition. These have been usually considered by metallurgists, following the classical work of Heycock and Neville, as the intermetallic compounds: δ bronze Cu_4Sn; η bronze Cu_3Sn; and ϵ bronze CuSn.

Recent studies of these compounds by the method of X-ray analysis of single crystals have been carried out partly at the Davy Faraday Laboratory and partly in the Department of Mineralogy at Cambridge with the invaluable assistance of the Department of Metallurgy. It has been shown conclusively that definite intermetallic compounds exist, but that their compositions and structures are much more complex than those usually assigned to them. The complexity is such that the complete structural analysis will take some considerable time, so that it has seemed of interest to give the following preliminary results.

The compound δ bronze has been most carefully studied from some minute single crystals without faces prepared by Dr. Weiss; it is found to have a cubic structure with a face centred lattice of side 17·92 A., thus confirming the powder photograph observations of Westgren and Phragmen (*Ark. f. Mat. Ast. u Fys.; K. Sven. Vet. Akad.*, **19** B, No. 12; 1926). With a cell of this large size it is difficult to be certain of the number of atoms in the cell. However, its close relation to the structure of γ brass worked out by Bradley and Thewlis (*Proc. Roy. Soc.*, A, **112**, 678; 1926), which has a cell of almost exactly half the dimensions, 8·87 A., and gives intensities of reflections for the 50 corresponding planes of almost identical values, makes it almost certain that the total number of atoms in the cell is $8 \times 52 = 416$. Such a number cannot be made up from molecules of Cu_4Sn, and the most probable values to fit with the density 8·95 are 328 atoms Cu and 88 atoms Sn, which makes the simplest formula $Cu_{41}Sn_{11}$. In order to check this, Mr. J. Stockdale has kindly carried out a micrographic analysis of a set of specimens of composition ranging from 19 to 22 atomic per cent tin at 0·2 atomic per cent intervals, and annealed for three weeks. He has found clear evidence of a two-phase structure, except in the case of the specimen containing 20·6 atomic per cent tin, which agrees very closely with the value found by X-rays. In any event, it is clear that the formula Cu_4Sn must be abandoned; its retention up to the present being due on one hand to insufficient annealing, and on the other to the desire for a simple formula. The positions of the atoms in δ bronze are very similar to those in γ brass. They have been found with sufficient accuracy to give a reasonable account of the 700 observed plane intensities. The space group is T^2_d.

The compounds η bronze and ϵ bronze were examined in the shape of single crystals prepared by Mr. Heycock by dissolving alloys of appropriate composition with concentrated hydrochloric acid.

η bronze grows in lath-shaped crystals with corroded faces sufficiently good, however, to show that the symmetry is orthorhombic. This is confirmed by X-ray analysis, which shows a cell unique outside organic crystals, $a = 4·33$, $b = 5·55$, $c = 38·1$ A. There is, however, a pseudo cell with the same a and b axes, but with the c axis 4·76 A., one eighth of the true value, the dimensions of which resemble nearly a close-packed hexagonal arrangement. This is the structure found by Evans and Jones (*Phil. Mag.*, **4**, 1302; 1927) by the powder method, which is of course powerless to deal fully with a structure of such complexity. In this case the accepted composition is probably correct, analysis of the actual crystals giving 25·2 atomic per cent tin, which gives 16 molecules of Cu_3Sn per cell. Micrographical analysis, however, gives 24·3 per cent, which agrees better with the formula $Cu_{50}Sn_{16}$. The lattice is bc face centred Γ^1_o, and the space group probably Q^{17}_h.

ϵ bronze grows in beautiful needles, which, measured optically, show hexagonal symmetry. Its structure is the most curious of all the compounds. The lattice is hexagonal Γ_h, $a = 20·85$, $c = 25·1$ A., very closely simulating one of one fifth of these dimensions. Such a cell would contain two molecules of CuSn with a nickel arsenide structure. The composition in this case, however, differs widely from CuSn. Analysis of the crystals gives 45 atomic per cent tin, while micrographic analysis leads to the value 46 atomic per cent. With a density of 8·27 the cell has from 230 to 250 atoms of tin and 280 to 300 of copper, the simplest formula being 50 Cu_6Sn_5, but further study will be required to arrive at the exact numbers.

From these studies two things appear; there is first the extreme regularity of the internal structure of compounds that repeats exactly with cells of such magnitude and of such complex composition, and secondly, there is a distinct tendency to mimic much simpler cells: cubic close packing in the case of 'Cu_4Sn,' hexagonal close packing in the case of 'Cu_3Sn,' and a nickel arsenic structure for 'CuSn.' The second property is plainly the same as exists in the more usual metals and compounds such as the silicates, in this case connected with the ratio of the free electrons of the atoms of tin and copper as suggested by Bradley and Gregory (*Proc. Manch. Phil. Soc.*, **72**, 91; 1928). The extreme complexity is in the author's opinion due to some incommensurability in the atomic diameters which cannot adjust themselves in less than a certain number of atomic steps.

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Quality of Soil in Relation to Food and Timber Supply.

THE statement made by the "Writer of the Article" in NATURE of June 2, to the effect that no land should be planted which is capable of providing food, is surely a very sweeping one if applied literally to the British Isles. The "Writer" doubtless knows that a mild and humid climate enables ground to be utilised for grazing in Ireland which would be practically worthless under more arid conditions. This means that food production is not confined to good land, and sheep in particular can and do produce large quantities of meat on land which is even too poor and exposed for timber production. The relative advantages of food and timber production