writer prepared a hurried account of the above theory intended for publication in the Proceedings of the Royal Society. It unfortunately gave no explanation of the mathematics which latter were faulty at one point. A careful and complete revision has now proved the soundness of the theory, and publication will follow as quickly as possible.

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The Microstructure of Some Magnetic Alloys of High Platinum Concentration

In a recent paper [Phys. Rev. **34**, 1217 (1929)] the writer has described an attempt to measure the magnetic properties of ferromagnetic atoms in a somewhat isolated state. The method used was to study alloys of platinum with a small percentage of cobalt. Alloys of 5% cobalt and 10% cobalt were both ferromagnetic. Provided these alloys are solid solutions, which was believed to be the case, the cobalt atoms in them could be regarded as mostly isolated from one another by the intervening platinum atoms.

A microscopic study of these alloys has since been made. The diagram of thermal equilibrium has not been obtained for the Pt-Co series, although Carter has investigated many high-platinum alloys and believes platinum and cobalt form an isomorphous series of solid solutions. However, it was necessary to be sure that two solid solutions did not exist together in a given alloy, with the result that a particular cobalt alloy would generally consist of a cobalt-rich phase plus a platinum-rich phase, or of a platinum-cobalt mixed crystal in pure platinum; in this case, increased platinum concentration would not mean further isolation of cobalt atoms, but a different proportion of the two phases.

Sections of each alloy were prepared, polished and etched with hot aqua regia. Wires in the hard-drawn state showed, under the microscope, that their crystals were elongated and distorted in the direction of strain. In the annealed state, however, each alloy showed the polygonal polycrystal pattern characteristic of pure metals or single solid solutions. If two phases were present in, say, the 10% cobalt-90% platinum alloy, they would have to exist in nearly equal proportions or one phase might be present in a small quantity between the grain boundaries. The 5% cobalt alloy, however, showed the same structure, although it, too, could not contain equal amounts of the two phases. In neither alloy was the characteristic eutectic structure of one phase imbedded in the other present. The sections were etched a little at a time and examined at each stage, but intercrystalline material was never detected. The sections etched uniformly, but the 5% cobalt several times more slowly than the 10% cobalt; as the acid more readily attacks cobalt, this again indicated that the cobalt atoms were distributed over all the crystals uniformly, the cobalt concentration in the 5% alloy being less throughout and the resistance to the acid hence greater. For comparison, a section of an annealed wire of pure platinum was similarly examined, and its microstructure was practically identical with that of the cobalt alloys. The alloys must, therefore, be solid solutions of cobalt in platinum, and the cobalt atoms in them isolated.

Platinum possesses a face-centered cubic lattice, while cobalt is hexagonal for lower temperatures and face-centered cubic at higher ones (about 600°C). As transformation points are generally rapidly lowered by alloying, e.g., the Curie point, these high-platinum alloys might be expected to have the cubic structure. High magnification (1300 times), revealed definite cubic formations in many of the crystals.

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Recombination of Electron and Alpha-Particle

The writers have computed by quantum mechanical means the probability of recombination between an electron and a hydrogen atomic ion or an alpha-particle, when the final state is the hydrogen atom or helium ion in some quantum state. The initial wave function used is that developed by Mott,[1] and represents a unidirectional

[1] Mott, Proc. Roy. Soc. **A118**, 542 (1928).

beam of electrons travelling toward a nucleus with velocity v. The final wave function is the usual one for the atom in one of its quantum states.

The matrix element of the moment corresponding to this transition is proportional to the target area of recombination, $q(v, \nu_i)$, discussed by Mohler.[2]

The calculations indicate that the target area for recombination of an electron and a nucleus of charge Ze is

$$q = \frac{6.10 \times 10^{-11} Z^6 \ \exp[\pi k - 4k \ \tan^{-1}(1/k)]}{v\nu^2 \ \sinh \pi k}$$

where V is the electronic energy of motion relative to the nucleus in volts, ν is the frequency of the radiated light in wave-numbers, $k = 3.67 \ Z/V^{1/2}$, and the final state is the normal state. This agrees remarkably well with the theoretical and experimental formulas given in the recent summary by Seeliger.[3] No approximations have been made in the derivation of this formula.

The q's for the upper states are similar expressions, none of them showing any maxima in the range of V between zero and infinity. Therefore the maxima obtained by Davis and Barnes must be due to some mechanism involving more than one electron and one alpha-particle. The explanation offered by E. Q. Adams[4] might be the correct one, despite Barnes's[5] objection. For the quantum mechanics indicates that processes not involving the electrical forces between the nuclei hold equally well for single nuclei, with the quantities giving the relative proportions of the resulting end products appearing as probabilities. In other words, if a stream of electrons falling on N alpha-particles creates n He$^+$ ions in time t, then when this same stream of electrons falls on one alpha-particle, there is a probability n/N that this one alpha-particle will become a He$^+$ ion in time t.

The authors have carried through this reasoning by probabilities from the beginning and have obtained an equation substantiating Adams's result. Since, however, the values of all the constants involved are not known, it is impossible to know at present whether this mechanism will account for the observed peaks.

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[2] Mohler, Phys. Rev. Supplement **1**, 217 (1929).
[3] Seeliger, Phys. Zeits. **30**, 354 (1929).
[4] E. Q. Adams, Phys. Rev. **34**, 537 (1929).
[5] Barnes, Phys. Rev. **34**, 1224 (1929).