to positive. These facts can be explained by assuming that the foreign atoms play a double rôle: (1) furnish free electrons (or holes) by Wilson's mechanism (increases conductivity); and (2) scatter electron waves in the manner accepted for ordinary metals (decreases conductivity)[3]. Is the first process also present in ordinary metals? Calculation shows that

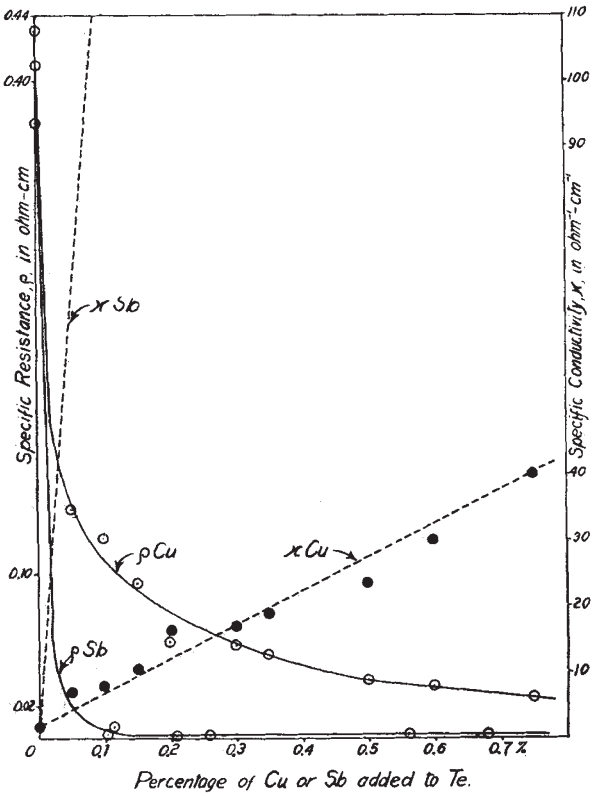

FIG. 1.

when few free electrons are present (semi-conductors) the first mechanism predominates; when many free electrons are present (conductors), the second. Wilson's mechanism, if present in ordinary metals, is masked and can be assumed without contradicting experience (for example, the Matthiessen rule for conductors).

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[1] A. H. Wilson, *Proc. Roy. Soc.*, A, **133**, 458; 1932. **134**, 277; 1932.
[2] R. H. Fowler, *Proc. Roy. Soc.*, A, **140**, 505; 1933.
[3] W. V. Houston, *Z. Phys.*, **48**, 449; 1928.

Magnetism of Tin

IT is well known that the diamagnetic susceptibility of colloids of graphite and bismuth depends on the size of the colloidal powders[1]. The specific intensity of magnetisation of a ferromagnetic metal like nickel also shows a similar dependence on particle size[2]. An investigation was therefore carried out with tin to study the effect of colloidalisation on its magnetic properties.

White tin has a small paramagnetic susceptibility[3] of $0 \cdot 025 \times 10^{-6}$, while grey tin is strongly diamagnetic, its susceptibility[3] being $0 \cdot 35 \times 10^{-6}$. A sample of pure white tin powder was carefully sorted out by settling in propyl alcohol and centrifuging. It was found, on testing the colloidal powders magnetically, that as the particle size decreases, the susceptibility becomes diamagnetic, this diamagnetism attaining larger values for smaller particle sizes. On melting and recrystallising, the substance becomes once again paramagnetic. Careful experiments showed that these results were not due to chemical or ferromagnetic impurities. It seems, therefore, most likely that the paramagnetic susceptibility of white tin is not an atomic property, but is dependent on the crystal structure of the metal in some manner which at present is uncertain. Full details will be published elsewhere.

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[1] See, for example, *Ind. J. Phys.*, **6**, 241; 1931. **7**, 35; 1932.
[2] *Phys. Rev.*, **44**, 850; 1933.
[3] "International Critical Tables", vol. 6, p. 355.

Induced Positron Radioactivity

RADIOACTIVITY induced by proton, diplon, neutron and α-particle bombardment can be explained on the hypothesis that the nuclear structure of stable isotopes consists of α-particles, neutrons and diplon. Missing isotopes of mass number less than twice the atomic number contain, on this theory, a free proton in addition to the other nuclear components[1]. Such nuclei are unstable and radioactive, emitting positrons. They may be produced artificially by bombarding appropriate stable isotopes with protons, diplons or α-particles but, being short-lived, have not at present been detected. These positron radioactive isotopes will only be found among elements below scandium in the periodic table, and are of the structural type, for example, ${}_{7}N^{13}$ $(3\alpha + p)$, ${}_{6}C^{11}$ $(2\alpha + D + p)$, ${}_{15}P^{30}$ $(7\alpha + p + n)$.

Accordingly, the following radioactive isotopes are possible:—

Type 1. ${}_{3}Li^{5}$, ${}_{7}N^{13}$, ${}_{9}F^{17}$, ${}_{11}Na^{21}$, ${}_{13}Al^{25}$, ${}_{15}P^{29}$, ${}_{17}Cl^{33}$, ${}_{19}K^{37}$, ${}_{21}Sc^{41}$.

They are produced by bombarding the corresponding stable isotopes, ${}_{2}He^{4}$, ${}_{6}C^{12}$, ${}_{8}O^{16}$, ${}_{10}Ne^{20}$, ${}_{12}Mg^{24}$, ${}_{14}Si^{28}$, ${}_{16}S^{32}$, ${}_{18}Ar^{36}$, ${}_{20}Ca^{40}$ with protons or diplons. If the bombarding particles are diplons, neutrons will be emitted during the formation of the radioactive isotopes, for example:

$$ {}_{14}Si^{28}\,(7\alpha) + p \rightarrow {}_{15}P^{29}\,(7\alpha + p) \rightarrow {}_{14}Si^{29}\,(7\alpha + n) + {}^{+}_{e}\nearrow $$

$$ {}_{14}Si^{28}\,(7\alpha) + D \rightarrow {}_{15}P^{29}\,(7\alpha + p) + \overset{\nearrow}{n} \text{ and} $$

$$ {}_{15}P^{29} \rightarrow {}_{14}Si^{29} + {}^{+}_{e}\nearrow . $$

Type 2. ${}_{2}He^{3}$, ${}_{6}C^{11}$, ${}_{8}O^{15}$, produced by bombarding ${}_{1}H^{2}$, ${}_{5}B^{10}$, ${}_{7}N^{14}$, respectively, with diplons. Neutrons will be emitted during the formation of the radioactive isotopes.

Type 3. ${}_{11}Na^{22}$, ${}_{13}Al^{26}$, ${}_{15}P^{30}$, ${}_{17}Cl^{34}$, ${}_{19}K^{38}$, ${}_{21}Sc^{42}$, produced by bombarding ${}_{9}F^{19}$, ${}_{11}Na^{23}$, ${}_{13}Al^{27}$, ${}_{15}P^{31}$, ${}_{17}Cl^{35}$, ${}_{19}K^{39}$ with α-particles. Neutrons are emitted during the bombardment, followed by positrons from the radioactive isotope.

The following isotopes of type 2 are also