PHYSICS

More Facts On Free Electrons Yielded By Quantum Theory

Roving Particles, Which Give Metals Characteristic Properties, Have Been Registered by Quantum Numbers

SCIENCE now believes that the electrons in a piece of cold metal are more active and sociable than formerly but current theories make it still as difficult for an electron to get a passport to the foreign air beyond the metal's boundaries.

Dr. Charles E. Mendenhall of the University of Wisconsin has presented to physicists an interesting picture of the changes in the behavior of the free or roaming electrons in metals, which has been brought about by the revolutionary discoveries of the new quantum theory. It is to the electrons of this kind that the most characteristic properties of metals are due, notably their reflecting surface and the ease with which they conduct electricity and heat.

Formerly there was no check on the activities of the individual electrons of this family. They were all vagrants. The new statistical theories of Heisenberg, Shroedinger and Dirac change all this. Each electron is now registered in the census of the mathematical physicist, by a series of tags known as "quantum numbers."

Further, an edict known as Pauli's principle now decrees that a given series of number tags can belong to, at most, only two electrons. We can regard this series of numbers as the address of the electron in the phantom city of the physicist's imagination. Dr. Mendenhall describes this principle as "social legislation to prevent overcrowding of the electrons," an admirable contribution to electron welfare.

Quantum City must be rather dull, however, if it contains nothing but two-room apartments. And physicists used to refer to "free" electrons!

There are two ways in which the electrons can escape from their neatly arranged homes in the metal: first, by the action of heat; second, by the falling of a beam of light on the surface.

It is with light that Dr. Mendenhall's experiments have been concerned. This so-called photo-electric effect has played a very important part in reviving Sir Isaac Newton's idea that light consists of particles rather than waves.

Only a few electrons, those that have much more energy than the rest, have the privilege of escaping from the metal when the artificial sun of the experimenter comes out. A wall of force known as the "work function" keeps all but a few within the city limits.

The changes introduced by the new theory of metals, due to Prof. Arnold Sommerfeld, might be compared to the effects of the industrial revolution. The average energy, or wealth, of the floating electron population is now believed to be much higher than formerly. It is this energy that enables an electron to get around and do things and to escape from the metal from time to time.

Prof. Sommerfeld seems at first to have done an excellent thing. It turns out, however, that the disobliging wall of force has increased under the new regime to just the same degree as the average energy, and it is just as troublesome as before for an ambitious electron to break through the surface of the metal and cavort before the waiting experimenter.

Dr. Mendenhall says this is a "protectionist trick by which wages are increased but prices go up correspondingly." These effects, however, influence the electrons on the surface, that is in the first thousand or ten thousand layers of atoms.

Dr. Mendenhall's recent experiments have helped check the application to metals of this new quantum theory, which scientists believe is of much more immediate importance than Einstein's relativity theory.

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Cases of sunstroke sometimes occur in Alaska.

Government scientists have found that there is less wind resistance in an open automobile when the top and the windshield are up than when they are down.