SCIENCE NEWS

Science Service, Washington, D. C.

THE MIGRATION OF ELECTRONS

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: (1) By the action of heat. (2) 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 Professor 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.

Professor 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 régime 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.

AERONAUTICAL RESEARCH AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

AN artificial windstorm blowing 240 miles per hour has been found possible in the remarkable wind tunnel recently constructed at Pasadena for the California Institute of Technology. The outfit is a feature of the new Guggenheim Aeronautical Laboratory. This terrific velocity exceeds the original hopes of the designers. A wind tunnel enables airplane investigators to reverse the conditions of normal flying with obvious experimental convenience. One simply runs the air past a stationary plane instead of running the plane through stationary air.

The Pasadena tunnel might be likened to a huge reinforced concrete doughnut, flattened to an oval contour and set on edge. The aeronautical laboratory itself is built around the tunnel. The "doughnut" is of course hollow, and varies from ten to twenty feet in cross section. A large direct current motor, mounted in the lower run of the tunnel, delivers 500 horsepower to a propeller. Air is driven in an endless circle to the upper level, where tests are made, and return. A section about thirty-five feet in length along the upper level is accessible to airplane parts and instruments. The investigator watches the hurricane through a curved window. He may then peacefully measure forces, velocities or what-not.

The apparatus was designed by Professor Harry Bateman and Professor Clark Milliken, in consultation with the European expert Theodor von Karman. The latter has now taken residence as director of aeronautical research activities at the institute.

Originally, velocities not much in excess of one hundred miles per hour were expected for this equipment, but practice has jumped ahead of promise. Apparently the air, once in motion, acquires great momentum, and not so much friction as feared. It is not seriously retarded by the tunnel walls. Upon return of the air to the motor after its first round trip it is again accelerated, and its velocity mounts until 200 miles is reached or even exceeded. The smooth interior finish and polished curved steel baffles on the corners permit the air to sneak around turns like a snake, without getting stirred up.

In practice the speed is held down to 200 miles to avoid undue strains. Even then the air becomes hot from friction without thermal relief. Velocity tests at numerous places show that the rate is uniform, not varying

as much as two per cent. from place to place across the stream. This permits accurate tests of air pressure against airplane wings, fuselages, etc.

Since 200 miles per hour exceeds common flying speeds, the Pasadena experts are enabled to work with small models. It is then practicable to calculate reasonably what a real airplane, which is larger, will do with a proportionally smaller velocity.

NEW ANESTHETICS

MORE effective sleep-producing and anesthetic drugs have been produced through research by Dr. H. A. Shonle, of the Lilly Research Laboratories at Indianapolis. The possibility of predicting the duration and the effectiveness of hypnotic sleep-producing drugs that have not yet been synthesized by the chemist is stressed in a report to the American Chemical Society.

Through the use of a new group of anesthetics, known as the amyl ethyl barbituric acids, developed by Dr. Shonle and his associates, it is possible for physicians to reduce the nausea that often follows operations, give the patients greater comfort and subject them to far less mental distress.

These amyl ethyl barbituric acids will not replace ether and other major anesthetics but they find use as substitutes for morphine in making the patient ready for the unpleasant experience of an operation. Since the new compounds are not habit-forming like morphine and other opium preparations, there is no danger of causing drug addicts through their use.

The new drugs are closely related to veronal or barbital, a synthetic compound that has found use in medicine as a sleep-producing drug. Alcohol, which Dr. Shonle calls the "simplest hypnotic," is one of the constitutional parents of the new anesthetics. Part of the alcohol molecule is replaced with barbituric acid, then a part of the barbituric acid is replaced with what chemists know as an amyl group. This makes the anesthetic action more rapid and the patient recovers faster. If plain alcohol were used, fifty times the dose of barbituric acid would be necessary to produce the same hypnotic effect. Veronal is a barbituric acid with two groups of ethyl in its structure instead of the one ethyl and one amyl in the new compounds.

CALCIUM CHLORIDE FOR THE RELIEF OF PAIN

THE intense pain of lead colic, gallstone colic and ureteral colic can be relieved by slow injection into the vein of calcium chloride, a salt of the metal which is necessary for bone formation, Drs. Walter Bauer, William T. Salter and Joseph C. Aub, of the Massachusetts General Hospital, have reported to the American Medical Association. This gives more rapid relief than any other form of treatment tried by these physicians. Their discovery of this new use of a calcium salt and of a way to give relief in these distressing conditions was made in the course of studies on the treatment of lead poisoning.

Lead and calcium, they knew, were both retained in the body in the bones. The chemical behavior of certain lead and calcium salts in the body are very similar. These facts suggested to Dr. Aub that the same physiologic variations which influenced the elimination and excretion of calcium would similarly influence the lead stream.

Medicines that caused decalcification or removal of calcium from the body resulted in an increased excretion of lead. Conversely, treatment that increased calcium storage also increased storage of lead. Consequently in treating lead poisoning, a high calcium diet is used until all symptoms of the poisoning have disappeared, usually within one or two days. The theory underlying this is that following increased calcium retention as a result of the high calcium diet, the lead is removed from the blood and stored in the bones.

In order to hasten this process and give more prompt relief from the severe pain of lead colic, Dr. Aub and associates tried giving a solution of calcium chloride directly into the veins. The results were dramatic. The pain stopped almost immediately, often before the injection was completed. Such prompt relief made them doubt whether the beneficial action of the calcium salt was due to fixation of lead and calcium salt in the bones. Further studies indicated that the calcium salt acts as an antispasmodic. The mechanism of its action, however, remains unexplained at present.

PSYCHOLOGICAL AGE OF THE OLD

NOT all old people are slow workers. Probably from one fourth to one third of persons over 74 years of age could release the accelerator of an automobile at the approach of danger as quickly as the average adult. And these aged persons differ in speed just as do those who are in their thirties or forties. These facts were among those reported to the New York branch of the American Psychological Association by Dr. Walter R. Miles, professor of experimental psychology at Stanford University.

Dr. Miles has been making a study of "later maturity" at Stanford under a special grant from the Carnegie Corporation. So far he has examined psychologically a total of 800 persons from all walks of life, excepting only the illiterate. A special study of reaction and coordination speed was made for 100 of these selected at random. The ages ranged from 25 to 87 years.

Commenting on the custom of retiring or dismissing an employee who has reached a certain chronological age, Dr. Miles said:

"Age is usually one of the important factors which define physiological and psychological efficiency. No machine can last forever; action necessarily means the reaction of wear and tear. But as the data presented in this paper indicate, there are distinct and measurable efficiency differences between individuals with chronological ages of about seventy years, just as there are differences among people who are in their thirties or forties. The average for all who are older than 74 years, for example, may show a decrement of one fourth

or one third from the general adult mean. But, on the other hand, one fourth to one third of these old people may still be as capable, in the functions tested, as the average adult, and to check them off just because they happen to have been born seventy or more years ago may be as unfair to the individual as to drop him because he was born of foreign parents.

"Psychologists have convinced themselves and the educational world that there is such a thing as mental age, which, although it may ordinarily run a parallel course with chronological age, does not do so in all cases. And for this reason individuals must be considered, rather than arbitrarily lumped in calendar-year units. Investigation such as is reported by the present sample of data indicates that calendar worship should be further curtailed as related to the problems and adjustments required in human life at its stage of later maturity."

The measurements of speed were made by an ingenious electrical device which not only timed the movements made by the persons tested, but also gave the signal to which the person was to respond. It times as closely as a one-hundred-twentieth of a second.

BIRDS IN EUROPEAN REFUGES

FROM many lands in Europe come encouraging reports of the increase of birds, notably on islands and in restricted areas set aside for sanctuaries and breeding grounds. The response of some hard-pushed species to protection gives good hope of their survival, and even for some degree of restoration.

One very notable bird paradise is the salt-marsh region of the Camargue, at the mouth of the Rhone in southern France. One bird that breeds here, the stilt, is found all the way from Spain to southern Russia. Here also may be found numerous nests of the flamingo, whose only other European breeding-place is in Spain.

New refuges have been opened up in Germany also. On one dune-covered island off the coast of Schleswig, where thousands of sea-birds breed, the number of nests has almost doubled since 1927, when the area was set aside. On the west coast of Schleswig-Holstein there are a number of tide-swept islands known as "Halligs" that make ideal homes for birds, particularly avocets. These have also been set aside as national bird sanctuaries.

In a reedy marshland in Holland, known as the "Naarder Meer," on the south shore of the Zuyder Zee near Amsterdam, two notable and very rare species make their home. These are the purple heron and the spoonbill. Of the former there are about 70 pairs, and of the spoonbill about 125 pairs.

Far to the north, in the Arctic Ocean west of Finland, is a great colony of puffins. They pretty much possess the land, and burrow their nests down into the earth to more than arm's length. But they have their troubles. They are persecuted by two species of gulls, one of which attacks them bodily and often kills and eats the puffins, while the other species, the Arctic long-tailed gulls, robs them of their legitimately acquired prey of fish.

ITEMS

MUSIC, when heard at a distance, has an entirely different quality on a dry day from that on a humid day. Experiments by Dr. Vern O. Knudsen, acoustic expert of the University of California at Los Angeles, show that sounds of high pitch can travel much farther in moist air than in dry air. The frequencies of sound most affected by atmospheric moisture are those from 2,000 per second upward. These include the two topmost octaves of the piano. Sounds of middle and low pitch, such as the principal tones in the human voice range, are hardly affected at all. This phenomenon is of concern principally in a very large auditorium. For example, a rear-seat auditor in the famous Hollywood Bowl might be listening to an orchestra 550 feet away. At this distance the high notes will be as much as ten times as loud in humid weather as in dry. Since the lower tones penetrate regardless of weather, there will be a great difference in the relative energies of tones of different pitch which strike the ear.

FIRE, avalanche, windstorms tearing down great swaths of forest—these are the path-clearers for the great thickets of rhododendron, mountain laurel and other fine shrubs whose beauty arouses the admiration of visitors to the Southern Appalachians. These plants, members of the heath family for the most part, go into such devastated areas and hang on there, in spite of the poverty of the soil and constant winds that try to suck the life-sap out of their leaves. This, in brief summary, is the story of a study of the "heath balds" of the Great Smoky Mountains recently concluded by Dr. Stanley A. Cain, of Butler University. The "balds" and "slicks" of these mountains are composed of thick tangles of shrubs, which in the blossoming season are often very beautiful. Dr. Cain found in many studies of the soil that a little digging would always disclose a layer of charcoal, even if the surrounding forest showed no signs of fire in past years.

A NEW fertilizer crop that promises well for the sandy, nitrogen-poor soils of Florida and other southeastern states, has been found in several species of Crotalaria, more familiarly known as rattle-pod and rattlesnake weed. It is a member of the legume or pea family, and has the same kind of bacterial nodules that grow on the roots of peas and clover, capturing nitrogen from the air and making it available for the use of higher plants. There are about 600 species in the genus Crotalaria, of which five are native to the eastern United States. The species tried out in Florida are partly native, partly imported from South America. The plant gets both its common and its scientific names from the hollow pods of many of the species, in which the seeds rattle when blown by the wind, giving a sound suggesting the buzzing of a rattlesnake. The scientific name of the rattlesnake genus is Crotalus, whence Crotalaria for the plant.