UNIVERSITY AND EDUCATIONAL NEWS

IT is stated in *Nature* that the first list of donations in response to the appeal of the University of Birmingham for £500,000 shows gifts or promises to the amount of more than £250,000. Nearly half of this amount is given to the Petroleum Mining Endowment Fund. The largest single gift is an anonymous one of £50,000 for the general fund. A sum of £5,000 is for a chair of Italian, and an equal amount is given by the James Watt Memorial Fund for a James Watt research chair in engineering.

ASSISTANT PROFESSOR EUGENE TAYLOR, of the University of Wisconsin, has been appointed professor and head of the department of mathematics at the University of Idaho.

DR. J. C. WITT, assistant professor of analytical chemistry in the University of Pittsburgh, has resigned, to become chief research chemist for the Portland Cement Association with headquarters in Chicago. Dr. C. J. Engelder, of Hornell, N. Y., has been appointed to the position at the University of Pittsburgh.

MR. WILLIAM B. BROWN, associate physicist of the aeronautic power plants section of the Bureau of Standards, has been appointed instructor in physics at the Ohio State University.

DR. RODNEY B. HARVEY has resigned as plant physiologist, bureau of plant industry, Washington, D. C., to accept the position of assistant professor in plant physiology at the University of Minnesota and assistant plant physiologist in the Minnesota experiment station.

DR. BENJAMIN SCHWARTZ, assistant zoologist in the Bureau of Animal Industry, has been appointed professor of protozoology and parasitology in the University of the Philippines and will sail for Manila late in December.

DISCUSSION AND CORRESPONDENCE

HELIUM AND HYDROGEN MODELS

TO THE EDITOR OF SCIENCE: In a communication to the SCIENCE issue of June 18 Dr. Irving Langmuir proposed a model of the helium atom consisting of a nucleus of charge $2e$ accompanied by a pair of electrons which execute symmetrical oscillations about two nearly circular arcs on opposite sides of the nucleus. In the issue of November 5 he has proposed a similar model for the hydrogen molecule, and another, of a somewhat different type, for the positively charged H_2 ion. The writer was particularly interested in these models, for in each case the resultant angular momentum is zero, a circumstance which seemed to offer an explanation of the diamagnetic behavior of helium and hydrogen, and of the failure of the theories of the specific heat of hydrogen based on the assumption that the molecule is gyroscopic.

Unfortunately, Dr. Langmuir did not see how to apply the Wilson-Sommerfeld quantum conditions to the determination of the energies of these models, and therefore was not able to fix the theoretical energies and ionization potentials definitely. These quantum conditions are

$$\begin{aligned} \int p_1 dq_1 &\equiv \int \left(\frac{\partial T}{\partial \dot{q}_1}\right) dq_1 = n_1 h, \\ \int p_2 dq_2 &\equiv \int \left(\frac{\partial T}{\partial \dot{q}_2}\right) dq_2 = n_2 h, \\ &\cdots\cdots, \end{aligned} \quad (1)$$

where T is the kinetic energy of the atom or molecule, $q_1, q_2, \ldots$ are a properly chosen set of coordinates, $p_1, p_2, \ldots,$ are the corresponding momenta, and $n_1, n_2, \ldots$ are any integers. Each integral is to be extended over a complete cycle of values of the corresponding coordinate. Dr. Langmuir states that he is unable to apply these equations to his models[1] because he does not know what systems of coordinates to use. The choice of a proper coordinate system is not essential, however, to the application of these conditions to the type of problem under consideration. For whatever coordinates are used, they will have a common period t, which makes possible a con-

[1] With the exception of the positive H_2 ion. He does apply the conditions to this model, and correctly, but expresses doubt concerning the validity of the somewhat unsatisfactory result on account of his uncertainty regarding the coordinate system.

venient combination of the conditions. The set of equations (1) can be written in the form

$$\int_0^\tau \frac{\partial T}{\partial \dot{q}_1}\dot{q}_1 dt = n_1 h,$$
$$\int_0^\tau \frac{\partial T}{\partial \dot{q}_2}\dot{q}_2 dt = n_2 h, \qquad (2)$$
$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$

Adding, we obtain

$$\int_0^\tau \left[\frac{\partial T}{\partial \dot{q}_1}\cdot \dot{q}_1 + \frac{\partial T}{\partial \dot{q}_2}\dot{q} + \cdots\right] dt = (n_1+n_2+n_3+\cdots)h.$$

By Euler's theorem for homogeneous functions, the integrand of the left hand member is equal to twice the kinetic energy. Consequently this integral is equal to the action of the system for the type of motion under consideration. Denoting the sum of the integers n_1, n_2, etc., by n, we have

$$A = \int_0^\tau 2T dt = nh; \quad n = (0), 1, 2, \cdots. \qquad (3)$$

This integral is invariant of the choice of coordinates and can be evaluated easily if the orbit and potential energy function are known. Equation (3) is not equivalent to the quantum conditions (1), but it is a deduction from them for the type of problem under consideration, which is sufficient to fix the possible energy values of the atom or molecule. In the normal state the atom will have the least energy possible and the quantum number n should therefore be small, though the value zero must be ruled out if there is to be any dynamic equilibrium at all. In the case of the helium atom or the hydrogen molecule, it is to be expected that n will be either one or two.

I have carried through the numerical evaluation of the action integral for the helium atom model and regret to say that the calculation shows that if the atom is given an energy corresponding to its ionization potential, the quantum condition (3) is *not* satisfied.

In making the calculation I have used an approximate expression for the path of the electron. This is permissible, since, by the principle of least action, the variation in the integral produced by a small variation in the path, holding the total energy constant, vanishes to small quantities of the first order. The determination of the approximate path was based on the data furnished by Dr. Langmuir. He says that the path of each electron is very nearly an arc of an eccentric circle subtending an angle of 155° 56′ at the nucleus. The radius vector from the nucleus to the midpoint of the orbit is 0.2534×10^{-8} cm. for an ionization potential of 25.59 volts, and the radius vector at the end of the orbits is 1.138 times as great. By expanding the expression for the radius vector into a power series in θ (the angle between the momentary radius vector and the radius vector to the midpoint), and discarding higher power terms, it is easy to show that an equation of the form

$$r = r_0(1 + k\theta^2) \qquad (4)$$

can be used to define an approximate orbit. Here r_0 is 0.253×10^{-8} cm. and k is easily calculated from the known values of r and θ at the end of the path.

The expression for the potential energy of the system is

$$\Phi = -\frac{4e^2}{r} + \frac{e^2}{2r\cos\theta}, \qquad (5)$$

where e is the charge on the electron. The total energy W is easily calculated from the above equation by inserting the values of r and θ for the end of the path. The kinetic energy of the two electrons is

$$T = W - \Phi = mv^2. \qquad (6)$$

By means of equations (5) and (6) the expression for the action is easily transformed into the form

$$A = 4\int_0^{s_m} 2mvds$$
$$= 8e\sqrt{m}\int_0^{s_m}\sqrt{\frac{4}{r} - \frac{1}{2r\cos\theta} - \frac{W}{e^2}}\cdot ds, \qquad (7)$$

where s is the rectified length of the path from its midpoint to the point (r, θ), and s_m is the maximum value of s. The graphically determined value if the integral which forms the right hand member of (7) is 1.57 h. This result is in conflict with the quantum condition (3) and shows that if the quantum conditions (1) are correct, the Langmuir model of the helium atom will not account for the observed ionization potentials of that element.

EDWIN C. KEMBLE
JEFFERSON PHYSICAL LABORATORY,
HARVARD UNIVERSITY

REPRINTS FROM SCIENTIFIC INSTITUTIONS

THE librarian is not alone, I imagine, in considering the bound scientific reprints issued as contributions from a given laboratory, most difficult to handle. There should really be no place for articles already published to appear except as reprinted separates. Without doubt, a bound volume of the publications of an institution serves as a report of the work done. But a list of the authors and titles of papers with the place and time of publication would serve this purpose just as well or better. Certain universities issue such lists of the publications of their staffs, and give these lists under the different departmental heads. This seems eminently worth while even where the number of publications in a department is scant.

The department of physiology of one university and the department of botany in another send to this library serial lists of their publications and with the lists the separates themselves, placed in order in a folder. This seems as nearly a perfect method as can be devised. The lists may be filed in any convenient way and the separates dealt with according to the method found most useful to the recipient. The expense of binding is saved to the institution issuing these separates, and while the distribution of the separates may be selective, the printed lists can be given a wide publicity. Such lists if issued very generally would make useful bibliographies and could be systematically filed. At the same time, the departmental library, so important in these days of disappearing private libraries, would have to handle a given article but twice, the original in journal form and the separate.

PRISCILLA B. MONTGOMERY
ASSISTANT LIBRARIAN,
MARINE BIOLOGICAL LABORATORY,
WOODS HOLE, MASS.

OBSERVATIONS ON THE PHILOSOPHY AND ETHICS OF RESEARCH AND PUBLICATION

TO THE EDITOR OF SCIENCE: Dr. Erwin F. Smith may have performed a service to the plant pathologists in publishing his "Introduction to bacterial diseases of plants," as I have no doubt he has; but he has surely performed a service to scientists everywhere, of every denomination, in publishing the last chapter of that book, "Part V. General Observations." In this he has collected the results of observation in the realms of the literature of science, the scientific method, the life of science and the science of life, all of which really does not express the material he has there collected. A catalogue of the headings the author has used will be more revealing. Here they are:

On subsidiary studies
On seeing things
On experimentation
On beginning work thoughtlessly
On interpretation of phenomena
On repetition of experiments—other people's, one's own
On publication
On clearness in presentation
On brevity of statement—when brevity is not desirable
On the ethics of research
On keeping one's own counsel
On team work
On sharing credits
On attending meetings and keeping up membership in societies, and on being generally public-spirited and helpful in science
On rest and recreation

The student of science will find here counsel of the greatest value on such a subject as the preparation of a paper. Would that I might quote all that he says! "Many a big book could have been boiled down to a few chapters, and in some cases to a few sentences, or to nothing at all, had its author been possessed of *clear ideas.*" "Easy writing is hard reading." ". . . it is your solemn duty to sum up the substance of your contribution in a series of brief conclusions which everyone will read, and which, if well put, may induce many to turn back and read your whole