of the latter class of reactions are capable of mediating the oddness of valence-change by undergoing both, thus permitting reaction to occur by a sequence of bimolecular steps. In several cases observed catalytic activity of the substance has led to the discovery of an additional valence state not previously suspected. It seems probable that mediation of an odd valence-change is a common mechanism for the action of catalysts in oxidation-reduction reactions. It is thought that this idea may account for the necessity for certain catalysts in biological oxidations; it appears to give new significance to the property of "two-step" oxidation-reduction possessed by various respiratory pigments, the theoretical analysis of which has been given by Michaelis.

Solutions of the wave equation in spheroidal coordinates: J. A. STRATTON (introduced by John C. Slater). It has been shown that the Schrödinger equation, including the wave equation as a special case, is separable in eleven systems of coordinates only. Of these eleven systems, three alone have been investigated with a thoroughness sufficient to meet all the demands of physical problems. Of those remaining, three more are of outstanding practical importance. The functions of the elliptic cylinder, the prolate spheroid and the oblate spheroid include as special cases the functions of the sphere and the circular cylinder, and are adapted to problems involving slits and flat strips, circular disks and rods of finite length. It is the object of the present investigation to establish the properties of these functions in a detail approaching that known for the Bessel and Legendre functions. On separation of the wave equation in any of the three coordinate systems named it appears that both angular and radial functions satisfy a differential equation of the type $(1-z^2) w'' - 2(a+1) zw' + (b - c^2z^2) w = 0$, wherein the separation constant b is restricted to characteristic values such that one particular solution exists which is finite at the regular points $z = \pm 1$. Asymptotic solutions appropriate to the region of large values of z are defined and normalized in the manner most convenient for physical problems. In diffraction problems, an expansion of a plane wave in terms of the functions of the elliptic cylinder or spheroid is required, and this, as well as the nature of the usual boundary conditions, necessitates a knowledge of the behavior of the functions of both the first and second kind in the neighborhood of $z = 0$. The analytic continuation of both asymptotic solutions into the origin is attained by means of contour integrals and thus expansions of the two independent solutions appropriate to all regions of the z-plane are available, together with their analytic connections.

Arc spectra of hydrogen and deuterium: R. W. WOOD and G. H. DIEKE. It was shown many years ago by Kiuti that in the secondary or molecular spectrum of a hydrogen arc between tungsten electrodes, many of the strong lines obtained with the hydrogen vacuum tube were missing, and others were relatively strong. The matter has now been more fully investigated with higher dispersion, and is discussed from the theoretical standpoint.

Remarks on the measurement of the magnetic moment of the proton: OTTO STERN (by invitation). *Spectroscopic method.* By measuring the frequency change of a spectral line in the magnetic field, the energy change of the atom $\Delta E = \mu H = h\Delta\nu$ is determined. In fact, only the difference in the energy changes of two states of the atom can be measured in this way. At least one of the two states must be an excited one. The *molecular ray method,* on the contrary, allows the measurement of the magnetic moment of a single state, the normal state of the atom. This is valuable not only for the treatment of some fundamental problems (space quantization, etc.), but also for the problem of measuring very small moments. Therefore, it is possible to measure the magnetic moment of the proton ($\mu \approx 10^{-23}$ e.s.u.), a problem not yet solved by the spectroscopic method. The reason for this is a fundamental one, the uncertainty principle of the wave mechanics.[1] This principle stipulates that the uncertainty δE of the measurement of the energy is connected with the length of time of the measurement δt by the relation $\delta E . \delta t \approx h$. Since the lifetime of an excited state of the H-atom is less than 10^{-8} seconds, the uncertainty of the energy measurement is $\delta E \approx \frac{6.10^{-27}}{10^{-8}} = 6.10^{-19}$ erg. The energy change in the magnetic field, due to the magnetic moment of the proton, is $\Delta E = \mu H \approx 10^{-23} . 6.10^{4} = 6.10^{-19}$ erg in a field of 6.10^{4} gauss. This means that even in such a strong field $\Delta E \approx \delta E$, or the uncertainty in the measurement is as large as the quantity to be measured. Under the conditions of the molecular ray method, δt corresponds to the time during which the atom is in the magnetic field, at least 10^{-4} seconds under the usual conditions. This means that in this case the uncertainty of the measurement δE is only 10^{-4} of the quantity itself ΔE. The actual measurements, carried out first in the Hamburg Institute of Physical Chemistry, fell very much short of this limit of error. Nevertheless, the measurements gave a very interesting result, about $2\frac{1}{2}$ nuclear magnetons. Dirac's theory, very well confirmed in the case of the electron, predicts a value of 1 nuclear magneton for the proton.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SIMPLIFIED EQUIPMENT OF SMOKING KYMOGRAPH DRUMS

WHERE no separate room can be set aside for smoking kymograph drums, both the experimenter and the instructor is confronted with the necessity of smearing the paint and equipment of the laboratory as well as the clothing of the students with the excess soot. The former difficulty is also one of the frequent and serious

[1] For the spectroscopic problem, *cf.* W. V. Houston and Y. M. Hsieh, *Phys. Rev.*, 45: 263, 1934.

objections raised to psychological work in state hospitals and institutions. The equipment described in this note obviates both of these objections and its simple construction commends it for general use. A line drawing of it is shown in Fig. 1.

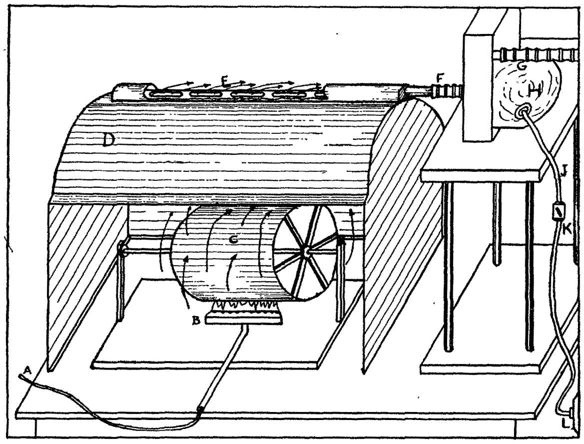

FIG. 1. Drawing of a simple form of equipment for smoking kymograph drums.

The essential parts of the equipment consist of a hood (D) made of about 22 gauge tin and a vacuum sweeper motor (H) mounted on a stand of suitable height and equipped with extension hose (G) which is furnished with the motor. The hood is made large enough to accommodate the drum on its stand (C). In the top are draught vent holes (E) through which the excess soot is drawn away from the flame (B). The soot from the hood is drawn into the intake of the motor by means of a short length of extension hose (F). It is then passed on through to the outlet of the motor and into the hose (G) which replaces the usual bag. The extension hose (G) can then be placed out through a convenient window and all excess soot is taken outside. No changes are made in the electrical connections of the motor (J), except to place a line switch (K) at a convenient place. The height of the motor stand and of the top of the hood depends on the height of the drum stand to be used.

The motor is obtained at any store dealing in used vacuum sweepers. They will also furnish, usually without extra charge, any reasonable length of hose. If carefully and competently chosen, the motor can be expected to give unlimited service after reconditioning. The model outlined here has been in use over three years without any expense for upkeep.

The entire equipment can be secured locally at a cost of about $10.00 to $12.00. The only objection that has appeared in three years of use is the noise made by the motor. This is, of course, similar to that made by a sweeper in ordinary household use. This particular model also works better when the gas is not previously passed through benzine, as is done in some laboratories. It has proved completely satisfactory as far as its main purpose is concerned, and is readily portable either from one room to another or from the laboratory to an outside institution.

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A PARAFFIN BLOCK COOLER FOR USE WITH THE MICROTOME[1]

IN the preparation of serial sections, it is desired to obtain paraffin ribbons that show little or no compression. Such a result with small blocks of tissue facilitates the enumeration of sections when this is a necessary prerequisite to mounting, and also greatly decreases the time entailed in spreading. When only a few sections are necessary, cooling the block on ice previous to cutting is the usual procedure, but for superior results in a long series a continuous supply of cold air is desired.

Foot and Strobell[2] in sectioning eggs of Allobophora devised an apparatus quite comparable to an air-conditioned room. The microtome is placed on a rubber sheet. The cooler, a double-chambered copper box, is superimposed, thus utilizing the rubber sheet as the bottom of the compartment. By means of a glass top that forms the upper surface of the inner chamber and arm holes in the side, one can operate the microtome *in situ* with full view of his movements. A freezing mixture of ice and salt placed between the two compartments allows for a reduction of temperature to twenty-five degrees Fahrenheit.

Grave and Glaser[3] utilized an apparatus that "is essentially a hollow truncated pyramid, open at both ends, and suspended in an inverted position from a standard, so adjusted that the lower end of the chute is at a convenient distance above the knife. At the upper end of the inverted pyramid, and surrounded by it, is a tray whose dimensions are less than those of the base of the chute. This tray is filled with crushed ice, and from one corner of it a drain leads the water to the escape from the lower end of the air channel."

With the idea of utilizing the principle of Grave and Glaser[2] but controlling the cold air supply, a cooler has been devised. The cooling chamber consists of a tin receptacle six inches in diameter and eight and one fourth inches in height. Copper tubing, one fourth inch in diameter, coiled within from the air inlet A, to the outlet B, serves as a medium for the passage of

[1] From the Department of Anatomy, The University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

[2] K. Foot and C. Strobell, *Biol. Bull.*, 9: 281–286, 1905.

[3] C. Grave and O. C. Glaser, *Biol. Bull.*, 19: 240–242, 1910.