The energy of the hard quanta emitted by Ga^{72} has been measured by semicircular focusing of Compton recoils,[4] photoelectric lines in a magnetic lens spectrometer,[5] photoneutron scattering cross section,[6] and coincidence absorption.[1] The values obtained were 2.65, 2.25, 2.50, and 2.4 Mev. The data for coincidence absorption of Compton recoils of the gamma-rays from radioactive gallium are given in Fig. 2. The end point taken from the curve is 1.00 g/cm². This corresponds to a quantum energy of 2.29 Mev.

* Supported by the Office of Naval Research.

[1] A. C. G. Mitchell, E. T. Jurney, and Margaret Ramsey, Phys. Rev. **71**, 324 (1947).
[2] L. M. Langer, A. C. G. Mitchell, and P. W. McDaniel, Phys. Rev. **56**, 422 (1939); J. V. Dunworth, Rev. Sci. Inst. **11**, 167 (1940); F. Norling, Arkiv. f. Mat. Astr. och Fysik **B27(3)**, 9 (1941).
[3] B. W. Sargent, Can. J. Research **17A**, 82 (1939).
[4] C. E. Mandeville, Phys. Rev. **64**, 147 (1943).
[5] L. C. Miller and L. F. Curtiss, Phys. Rev. **70**, 983 (1946).
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Proceedings of the American Physical Society

Minutes of the Meeting of the New England Section at Amherst, Massachusetts

May 31, 1947

THE twenty-eighth meeting of the New England Section of the American Physical Society was held at Fayerweather Laboratory of Physics of Amherst College in Amherst, Massachusetts, on Saturday, May 31, 1947. Ninety-seven members of the Section registered. The programme included a symposium of five invited papers on the subject of nuclear physics. There follow the titles of the invited papers and the abstracts of the ten-minute papers relating to research. Abstracts of ten-minute papers relating to the teaching of physics will appear in the American Journal of Physics.

GORDON F. HULL, JR.
Secretary-Treasurer

Symposium on Nuclear Physics

Invited Papers

Plans for Brookhaven National Laboratory, P. M. MORSE, *Brookhaven National Laboratory.*

Recent Results in Nuclear Magnetic Resonance Absorption, E. M. PURCELL, *Harvard University.*

Inelastic Scattering of Protons, C. B. COLLINS, *University of Rochester.*

Beta- and Gamma-Ray Level Schemes, M. D. DEUTSCH, *Massachusetts Institute of Technology.*

Proton Groups in Transmutations, E. POLLARD, *Yale University.*

Contributed Papers

1. The Calculation of Thermodynamic First Derivatives by use of Jacobians. F. H. CRAWFORD, *Williams College.*—Starting with the generalized Clausius equation for dU for a system of n degrees of freedom, it is possible to determine any desired first derivative directly in terms of a standard set of first derivatives. The procedure is essentially a generalization of results obtainable from a treatment given by Shaw[1] for the case of $n=2$. Maxwell's equations, $n(n-1)/2$ in number, are written in a concise Jacobian form. Then the desired derivative is expressed directly as a ratio of two nth-order Jacobians which involve partial derivatives of the dependent variables concerned with respect to a selected set of independent variables. Provided this set contains no conjugate pairs (i.e., such as T and S or p and V, etc.) the Jacobians involve only symmetric or anti-symmetric terms and are particularly simple to handle. It is shown that the number of independent first derivatives in the standard set for the general case is always $n(n+1)/2$. Thus for $n=2$ we have the well-known result that 3 first derivatives must be measured while for a single crystal of the least symmetric type under homogeneous strain, with $n=7$, the set contains 28 first derivatives.

[1] Shaw, Phil. Proc. Roy. Soc. (London) **A234** (1935).

2. Binding Energy of the Quadrielectron. AADNE ORE, *Yale University.*—An attempt has been made to determine the energy of a compound consisting of two electrons and two positrons with greater accuracy than in previous calculations. For this purpose a variational function has been used which is similar to the linear combination of "atomic" and "ionic" functions with adjustable screening constants taken by Weinbaum[1] to approximate the hydrogen molecule. Our function may be written $\Psi=\Psi_\beta+c\Psi_\alpha$ where Ψ_β is the generalized "atomic" function used previously,[2] whereas

$$2\Psi_\alpha=\exp-\tfrac{1}{2}[(1+\alpha)(r_{1a}+r_{2a})+(1-\alpha)(r_{1b}+r_{2b})]+\exp-\tfrac{1}{2}[(1-\alpha)(r_{1a}+r_{2a})+(1+\alpha)(r_{1b}+r_{2b})]+\exp-\tfrac{1}{2}[(1+\alpha)(r_{1a}+r_{1b})+(1-\alpha)(r_{2a}+r_{2b})]+\exp-\tfrac{1}{2}[(1-\alpha)(r_{1a}+r_{1b})+(1+\alpha)(r_{2a}+r_{2b})].$$

While Ψ_β alone yielded the value 0.11 ev for the binding

energy,[2] Ψ gives roughly 0.135 ev when $\alpha=\beta=(0.5)^{\frac{1}{2}}$ and $c=0.052$. In previous calculations considerable improvement in the energy of the quadrielectron could be obtained by slight improvement in the functions. Since this is no longer true we may be near the convergence limit.

[1] S. Weinbaum, J. Chem. Phys. **1**, 593 (1933).
[2] E. A. Hylleraas and A. Ore, Phys. Rev. **71**, 493 (1947).

3. Microwave Spectra of Several Polyatomic Molecules, B. P. DAILEY AND E. B. WILSON, JR.,[1] *Harvard University.*—The microwave spectrograph using Stark-effect modulation, recently described,[2] has been employed to study the absorption spectra in the region from 20,000 to 30,000 megacycles of a number of polyatomic molecules. For SO_2, lines were found at 20,421, 22,064, 22,225, 22,475, 22,735, 22,904, 22,934, 23,033, 23,419, 23,738, 24,037, 24,083, 24,342, 25,047, 25,170, 25,392, 26,550, 29,000. For nitromethane lines were found at 20,385, 23,250, 24,047, 24,320, 24,603, 25,400. A complex methanol spectrum was observed with lines at 20,898, 20,989, 21,551, 22,095, 23,033, 25,385, 24,040, 24,081, 24,317, 25,050, 24,928.8, 24,954.6, 25,017.8, 25,132.0, 25,300.3, 25,546, 25,796, 25,898, 26,310, 26,562, 23,121, 23,415, 23,450, 23,861, 26,854, 27,450, 28,550, 28,500, 29,950. Mr. R. H. Hughes and Mr. R. Karplus have aided greatly in the course of this investigation.

[1] The research reported in this document was made possible through support extended Harvard University jointly by the Navy Department (Office of Naval Research) and the Signal Corps, U. S. Army under Office of Naval Research, Contract N5ori-76.
[2] R. H. Hughes and E. B. Wilson, Jr., Phys. Rev. **71**, 562 (1947).

4. New Techniques in the Measurement of the Capacity of the Electrical Double Layer, D. C. GRAHAME, *Amherst College.*—A minimum in the amplitude of a sinusoidal signal, whose intensity varies only slowly with time, can be timed with good precision by the use of a long-persistence oscilloscope screen punctuated by markers from a high speed electric clock. This fact has been used to improve the accuracy of a technique previously described for the measurement of the capacity of the electrical double layer between mercury and various electrolytic solutions. Circuits have been devised which permit measurement of this quantity with a consistency of 0.1 percent although the absolute accuracy may be a little less good and is limited by mechanical and chemical considerations rather than by the accuracy of the electrical circuits. The relatively high precision now obtainable makes it possible to measure with adequate accuracy the small changes of capacity accompanying changes of concentration, which in turn lead to thermodynamic information concerning the concentration of ions in the electrical double layer. It is found that in most cases positive ions accumulate in the double layer regardless of whether the metal is positively or negatively charged. Applications of this type of information to problems in several fields of science will be discussed.

5. Apparatus for the Study of Bridges and Arcs Between Metallic Contacts. G. F. HULL, JR., W. BAER, AND H. SALTZMAN, *Dartmouth College.**—When metallic contacts carrying a current are separated, the contact may be bridged by a very small globule of metal or an arc may be formed. The metallic bridges under observation vary from 10^{-4} to 10^{-2} cm in length. For investigating bridges in air a cantilever bar[1] is used for producing the required contact separations, while for studying their properties in vacuum, the contact electrodes are mounted inside a cylinder, part of which is a sylphon bellows. One end of the cylinder can be moved with a micrometer screw coupled to a 10 to 1 reduction gear. Contact separations of 10^{-4} cm can be produced. To study transient arcs in air between separating contacts, a lever is used. This lever can be displaced by means of a micrometer screw producing contact separations of 3×10^{-4} cm, or by means of a motor-driven cam, which gives constant velocity of separation of the contact. A commutator with adjustable brushes is attached to the cam to synchronize the transient arc currents and voltages with the sweep of an oscillograph.

* Assisted by the Office of Naval Research under Contract N6ori-219.
[1] G. F. Hull, Jr., Rev. Sci. Inst. **15**, 340 (1944).

6. The Vacuum Properties of Some Synthetic Dielectrics. BENJAMIN G. HOGG, *Wesleyan University.*—An investigation has been carried out to determine the vacuum properties of some of the more recently developed dielectrics. Among these dielectrics are a number of plastics. An ionization-gauge method was used similar to that described by Zabel.[1] The research was initiated to determine the suitability of these new materials for use in the vacuum system of a mass spectrograph now under construction at Wesleyan University. The result should prove useful as a guide in the selection of materials when high vacuum is desired.

[1] R. M. Zabel, Rev. Sci. Inst. **4**, 233 (1933).

7. Use of Magnetic Amplifiers in Computing Circuits.* ROBERT T. BEYER, *Brown University.*—Magnetic amplifiers have been designed with matched pairs of Permalloy-core transformers as the basic elements. These transformers are driven into the region of saturation by an audiofrequency voltage on the primary winding. The addition of a d.c. bias to one or more of several secondary windings produces a second harmonic signal. This signal is then amplified and phase-detected, and the resultant d.c. is used as negative feedback on one of the secondaries. Circuits embodying these magnetic amplifiers have been used for the algebraic addition of several direct currents ranging from 100 μa to 5 ma, with an accuracy of ±0.1 percent of the maximum sum. These circuits have low input impedance, high stability, and also have the advantage that the input levels of the various currents can be independent of each other and of the output level. By using appropriate feed-back methods, the result of a computation may be expressed as a direct current, a d.c. potential, or a mechanical shaft rotation. Application of these magnetic amplifiers has also been made to the differentiation of slowly varying voltages, using a condenser as the differentiating element.

* This paper is based on a Ph.D. thesis done at Cornell University as part of Contract OEMsr-768 with the Office of Scientific Research and Development. A full report of this research will appear in a forthcoming issue of the Proc. I.R.E.