Meetings and Societies

Nuclear Structure

On 8–14 September 1957 an International Conference on Nuclear Structure was held at the Weizmann Institute of Science in Rehovoth, Israel. Approximately two hundred physicists, representing 15 different countries, attended this conference, which was sponsored by UNESCO, the International Union of Pure and Applied Physics, the Israel Atomic Energy Commission, and the Weizmann Institute of Science. The excellent organization of the conference by the secretary, A. de Shalit, and by the staff of the Weizmann Institute was an important factor which contributed greatly to its success.

The half-day sessions consisted of two or three invited lectures followed by discussion periods or by presentations of short (sometimes very short) contributed papers, or by both. In view of the wealth of material presented, only a limited number of papers can be discussed here in detail. A comprehensive report of the conference will be published in the near future as the "Proceedings of the Rehovoth Conference on Nuclear Structure, 1957" (North-Holland Publishing Company, Amsterdam).

The first two days of the conference were devoted to discussions of the theory of nuclear models, to the interpretation of nuclear spectroscopy data in the light of the different models, and to considerations of effects of the finite nuclear size. After informal discussions (for which ample time was provided by a sight-seeing trip to Jerusalem, through the courtesy of the Hebrew University, and a reception by the President of the State of Israel, I. Ben-Zvi), the conference continued with a somewhat more diversified program. A whole day's program was concentrated on discussions of the subject of nonconservation of parity and beta-decay in theory and experiment. Sessions devoted to discussions of extranuclear effects, on angular correlation, to the description of nuclear spectroscopy instruments, and to measurements of very short nuclear lifetimes concluded the official part of the conference.

Nuclear models. In the first lecture of the opening session on shell model evidence in nuclei, R. J. Eden (Cambridge) discussed the theoretical foundations of the nuclear shell model. The methods of K. Brueckner (Philadelphia) and his collaborators can be used to study many particle systems in which there are strong two-body forces. The extension of these methods provides a form of perturbation theory which is applicable to low-lying states of nuclei. In the case of a closed shell nucleus, the independent particle model potential can be determined from given two-body forces on the basis of self-consistent equations. Due to degeneracy problems, the formalism is considerably more complicated for nuclei that correspond to a closed shell plus several nucleons.

In the discussion, Brueckner mentioned attempts to understand the collective properties on the basis of an electron gas approach. Also, calculations on the basis of nonlocal interactions are being made at present. B. H. Flowers (Harwell) communicated his calculations of properties of the lithium-7 nucleus, adjusting the parameters of his theory to agree with the observed data of lithium-6. The agreement between the predicted and observed data of lithium-7 is fair. I. Talmi (Weizmann Institute) emphasized the need for a better understanding of the effective two-body forces between nucleons, which are very different from the interactions between free nucleons. Even if these forces were known, the lack of detailed knowledge of the single nucleon radial functions would interfere with any attempt to obtain quantitative results. It is possible, however, on the basis of general assumptions (effective two-body forces, j-j-coupling, no change of radial functions going from one nucleon to another) to impose consistency relations on the data and, in this way, to obtain indications whether the assumptions are reasonable. In several cases in which it was possible to analyze the data, quantitative agreement was obtained.

The unified model of the nucleus was the subject of a lecture by B. R. Mottelson (Copenhagen). While many main features of the classification of low-energy nuclear data follow simply from the symmetry properties of the nuclear shape, a more detailed description requires a better understanding of the nature of the correlations involved in the collective motion. R. E. Peierls (Birmingham) presented a discussion on the foundations of the collective model, in which he pointed out that the method developed by Wheeler and Griffin, Peierls and Yoccoz, Skyrme, and others, when applied to the problem of center-of-mass motion, does not automatically give the correct answer for the translational energy. This method can be considered the first step in an expansion in which higher terms represent the difference between the correct two-body forces and the well potential used in the shell model. Higher terms must be taken into account to correct the values of the translational energy as well as the moments of inertia calculated in the rotational case. Unfortunately no numerical results are as yet available.

The main lecture of an evening session of the first day of the conference was given by G. Racah (Hebrew University), who discussed the seniority number and its application to nuclear spectroscopy. The seniority number is the number of particles in a nuclear system which are *not* coupled together with antiparallel angular momenta (nonsaturated particles). The seniority number gives the smallest number of particles needed for building a state with the same properties, and it therefore characterizes the simplest configuration which contains such a state. Certain properties of nuclear states, such as the angular momentum and the magnetic dipole moment (but not the energy), depend essentially on the number of nonsaturated particles (the seniority number), since the "saturated" pairs of particles are spherical symmetric and do not contribute to the above-mentioned nuclear properties.

Electromagnetic transitions and heavy nuclei. The morning session of the second day was opened with a paper by D. Wilkinson (Cambridge) on radiative transitions in light nuclei. Dipole transitions, electric as well as magnetic, seem to follow the general trend expected from the independent particle model. Electric quadrupole transitions, however, show very clearly the effects of collective motion. Effects of isotopic spin selection rules on electric dipole transitions were also discussed by the speaker. No evidence is found for departures from charge independence of the specifically nuclear forces.

In the next lecture, on effects of configuration interaction on electromagnetic transitions, A. de Shalit (Weizmann Institute) pointed out that corrections of higher order must be considered before

discrepancies between the zeroth-approximation shell-model predictions and experimental data are studied. The contributions of configuration interaction to transition probabilities as well as the possibility of interference between different contributions must be taken into account. On this basis a fair enhancement of electric quadrupole transition probabilities can be understood, even within the framework of the shell model.

I. Bergstrom (Nobel Institute) presented a survey of experimental data on energy levels and multipole transitions in heavy nuclei ($Z = 74$ to $Z = 84$). Regularities in the appearance and separation of certain levels can be understood on the basis of predictions of the single-particle shell model. Also, a comparison between observed transition probabilities for multipole gamma transitions and those calculated from the single-particle model was presented. An influence of the magic numbers $Z = 82$ and $N = 126$ is obvious.

Effects of the finite size of the nucleus. The next session was devoted to effects of the finite size of the nucleus. M. E. Rose (Oak Ridge) presented an excellent review of all the phenomena in low-energy nuclear physics which are affected by the finite nuclear size. The internal conversion of gamma rays can be strongly influenced by the finite size of the nucleus by virtue of two effects: (i) the finite charge distribution of nuclei modifies the wave function of the electron as compared to the case of a point nucleus (static influence), and (ii), due to the penetration of the atomic electrons into the nucleus, the conversion is affected by the actual shape of the charge distribution (dynamic influence). The effects are particularly large (up to 50 percent) for dipole radiation and for very heavy nuclei.

In the following lecture, A. H. Wapstra (Amsterdam) discussed the methods for and the difficulties in obtaining precise experimental values of the probability of internal conversion. According to the speaker, the most precise method consists of a comparison of beta spectra and conversion line intensities. Measurements were presented which clearly showed evidence of the influence of the finite nuclear size on the probability of internal conversion. Other effects of the finite nuclear size include the influence on beta-decay phenomena, in particular on the electron-capture to positron-branching ratio. This latter aspect was discussed by P. F. Zweifel (General Electric).

Parity nonconservation in beta-decay. The sessions on parity nonconservation and beta-decay in theory and experiment were held on 12 September (these sessions were postponed two days because of travel delays of one of the main speakers). The morning session was opened by E. I. Konopinski (Indiana) with an outstanding clear summary of what can be learned about the beta interaction by means of the "classical" experiments—that is, experiments which do not give evidence of parity nonconservation. The classical experiments are, in principle, suited to measure the relative proportions of the Fermi and Gamow-Teller couplings. The electron-neutrino correlations in particular should determine whether the tensor (T) or the axial-vector (A) coupling is responsible for the Gamow-Teller component, and whether the scalar (S) or vector (V) coupling is responsible for the Fermi component. At present, it is not possible to reconcile all experimental data on electron-neutrino-angular correlations with one particular choice of coupling. So far, the contradictions in the different experimental values cannot be resolved by any conceivable generalization of the theory. Clearly, better and more of the "classical" electron-neutrino correlation measurements are needed before a final answer as to the beta coupling constants can be given.

The theoretical implications of parity violation in beta interactions were discussed by T. D. Lee (Columbia). The fact that now all experimental data on the longitudinal polarization of electrons emitted in a beta-decay process are compatible with a polarization of $-v/c$, whereas data on positrons agree with a longitudinal polarization of $+v/c$, gives strong support to the two-component theory of the neutrino. The physical aspect of this theory is that the spins of all neutrinos are parallel to their momentum, whereas the spins of all antineutrinos are in a direction opposite to their momentum. On the basis of this theory, the neutrino is defined as a particle with a right-hand helicity

$$\mathcal{H} = (\sigma \cdot p) = +1;$$

the antineutrino as a particle with a left-handed helicity

$$\mathcal{H} = (\sigma \cdot p) = -1.$$

The two-component theory introduces certain relationships between the coupling constants of the beta interaction. As far as nuclear beta-decay phenomena are concerned, the two-component neutrino theory gives a picture which is consistent with all the experimental evidence on parity nonconservation. Konopinski also discussed the problem of lepton conservation in beta-decay. It seems that this conservation law is not violated. One of the most important questions which now remains to be answered by experiments is the problem of invariance of the weak interaction Hamiltonian under the time-reversal operation.

The experimental evidence of nonconservation of parity and charge conjugation in beta-decay was the subject of the next lecture, which was given by C. S. Wu (Columbia). The lecture comprised a survey of the experimental development concerning parity nonconservation. Ever since the historic investigation of Wu *et al.* (January 1957) which established the fact that parity as well as charge conjugation is not conserved in beta-decay, data have been amassed at a tremendous rate.

The original experiment of Wu *et al.*, which was performed at the National Bureau of Standards, consisted of polarizing the electron emitter cobalt-60 by means of low-temperature techniques and observing the intensity of beta radiation in the direction of the spin vectors of the polarized cobalt-60 nuclei and in the opposite direction. A large asymmetry of the beta ray intensity was observed; only about half as many electrons were found to be emitted in the direction of the nuclear spin as in the direction opposite to the spin vector. The presence of this asymmetry gave conclusive proof of the violation of parity conservation (P), and the magnitude of the effect also indicated that invariance under charge conjugation is violated (C).

Similar experiments with the positron emitter cobalt-58 showed the same result, except that the asymmetry is positive—that is, more positrons are emitted in the direction of the nuclear spin vector. In addition, it was verified that the asymmetry of the beta emission for electrons as well as for positrons is essentially proportional to $\beta = v/c$ (v = velocity of the beta particle). This experimental result is in agreement with the predictions of the two component neutrino theory. A very accurate determination of the momentum dependence of the beta asymmetry could, in principle at least, resolve the question of whether the beta interaction violates invariance under time reversal (T). If T is conserved, then CP is conserved on the basis of the Schwinger-Luders-Pauli theorem (TCP theorem).

Shortly after the nuclear polarization experiments, the observation of the circular polarization of the gamma radiation following beta-decay and the longitudinal polarization of electrons and positrons emitted in beta-decay corroborated the failure of parity conservation in weak interactions. Although some early experiments seemed to indicate a small longitudinal polarization of the beta particles in some cases, all the more recent measurements agree with a longitudinal polarization of degree $-v/c$ for electrons and $+v/c$ for positrons.

M. Deutsch (Massachusetts Institute of Technology) discussed the experimental methods which are being used to study the longitudinal polarization of

positrons. All these methods make use of the dependence of the annihilation properties of the positron-electron pair on the state of the polarization of the positron. The angular correlation of the annihilation radiation of positrons stopped in magnetized iron can be employed to establish the longitudinal polarization of positrons, or a method can be used which is based on the difference which exists in the annihilation-in-flight rates for the $M=0$ and $M=1$ magnetic substates formed by the incident longitudinally polarized positron and the polarized electron partner in magnetized iron. Deutsch also discussed his and his collaborators' method of observing the circular polarization of annihilation radiation emitted by longitudinally polarized positrons which annihilate in flight.

A very elegant method of observing the longitudinal polarization of positrons is based on the measurement of the preponderance of $1^3S_{1,0}$ states of positronium over $1^1S_{0,0}$ states formed in a gas in a magnetic field. This observation yields directly the excess of positron spins opposed to the magnetic field over those parallel to it.

The various methods which are being applied to determine the longitudinal polarization of electrons were discussed by H. Frauenfelder (Illinois). The circular polarization of the bremstrahlung of electrons stopped in matter gives direct evidence of their longitudinal polarization.

In a quite different approach to the problem, use is made of the strong dependence of the electron-electron (Møller) scattering cross section on the relative orientation of the spins of the incident and target electron. At all energies, the cross section for such a scattering process is much smaller in the case where the two electron spins are parallel than in the case of antiparallel spins. Again, polarized electrons are available in magnetized ferromagnetic material, and the measurement of the longitudinal polarization of an electron beam consists in observing the intensity difference in the scattering of electrons on a magnetized iron foil for different directions of the magnetization. Also, various methods have been employed to convert a longitudinally polarized electron beam into a transversely polarized one (deflection in electric fields, scattering at 90°). The transverse polarization of the electrons can then be detected by elastic scattering on a thin foil of a high Z material (Mott scattering). A series of contributed papers on details of the above-mentioned measurements comprised the principal part of the remainder of this session.

A lecture on the measurement of beta spectra given by L. M. Langer (Indiana) closed the session. In his discussion, Langer presented evidence of slight anomalies in the spectra of indium-114, phosphorus-32, and yttrium-90. It is very unlikely that these deviations are attributable to Fierz type interference terms.

Angular correlation of nuclear radiations. The program of the next session consisted of papers on angular correlations of successive nuclear radiation. In the first lecture, R. M. Steffen (Purdue) presented experimental results on beta-gamma angular correlations. Ordinary beta-gamma directional correlation experiments on first-forbidden beta transitions (for example, potassium-42, gold-198) show an appreciable anisotropy, although the spectra were found to be of allowed shape. Precise beta-gamma directional correlation measurements on allowed beta transitions made it possible to give an upper limit for the pseudoscalar coupling constant C_P in terms of the tensor coupling constant C_T: $C_T:C_P<5$ C_T.

Beta-polarization gamma-directional correlation experiments, in which the transverse polarization of the beta particle with respect to the propagation directions of the gamma radiation and the beta radiation is measured, were described. Such a very small transverse polarization was observed in the decay of gold-198. The implications of this result for the invariance of the beta interaction Hamiltonian with respect to time-reversal was discussed.

Steffen also presented results of beta-directional gamma-polarization correlation experiments in which the circular polarization of the gamma radiation is observed. The circular polarization of gamma rays can be observed by studying the transmission through or the scattering on magnetized iron. The results of some of these measurements require the presence of appreciable interference terms (such as scalar-tensor or vector-axial vector interference, or both) in the beta-decay interaction.

Extra nuclear effects on angular correlations were the subject of the next two papers. A. Abragam (Saclay) presented a review of the general theory, using the density matrix formalism. The influence of the static interactions between external magnetic fields and magnetic moments of the nucleus or electric field gradients, or both, and the nuclear quadrupole moment were discussed. Nonstatic interactions can arise in liquids where the environment of a nucleus is continually changing and also as an aftereffect of the emission of nuclear radiation during the recovery of the electron shell from the preceding decay process. Abragam also considered the perturbation of a nuclear angular correlation by the application of radio-frequency fields.

In the next lecture H. Frauenfelder (Illinois) pointed out how quantitative measurements of the influence of extranuclear fields on angular correlations can be used to determine magnetic and electric moments of excited, short-lived nuclear states. The application of an external magnetic field causes a rotation of the angular correlation pattern. From the degree of rotation observed and from the known strength of the magnetic field, the magnetic moment of the intermediate nuclear state can be extracted. Experiments on electric quadrupole moments are much less informative, since no artificial electric field gradients of sufficient magnitude are available and since the field gradients in crystals must therefore be used.

Nuclear instruments and short lifetime measurements. The session on instruments of nuclear spectroscopy was opened with a survey by T. R. Gerholm (Uppsala) on applications of magnetic spectroscopy and coincidence techniques. Of particular interest was the description of a multichannel goniometer for making measurements of angular correlations. T. W. M. Du Mond (California Institute of Technology), in his talk on gamma ray measurements by means of crystal diffraction, discussed details of gamma ray spectrographs and the experimental methods used in the precise determination of gamma ray energies.

The last session of the conference was devoted to measurements of very short nuclear lifetimes. The subject of the first talk, presented by S. Devons (London), was the techniques involved in the measurement of lifetimes shorter than 10^{-10} second. Recoil methods are particularly successful in this range. In such methods the excited nucleus is produced with an appreciable recoil velocity (of the order of 10^8 to 10^9 centimeters per second), and the lifetime is related to the time scale determined by this recoil velocity and by the physical arrangements, such as distance moved by the recoiling nucleus or the Doppler shift in the energy as the recoiling nucleus is retarded in some stopping material.

In many cases the observation of nuclear resonance fluorescence provides quantitative information about the width, and consequently about the lifetime, of nuclear levels. The use of this latter method was presented by F. Metzger (Bartol Research Foundation). When using radioactive isotopes as the sources of the exciting gamma radiation, one has to compensate for the losses in recoil energy which occur in the emission and the absorption processes. Instead of the narrow gamma lines from radioactive sources, the wide Doppler-broadened gamma rays from charged particle reactions can be employed. The integrated cross section for resonance fluorescence, and with it the lifetime of a transition,

can be determined in a scattering experiment or in a self-absorption experiment. In the next paper, S. G. Cohen (Hebrew University) reported on lifetime measurements of excited states produced after alpha decay, in which the recoil shifts of conversion electrons are used.

A garden party given by M. W. Weisgal, the chairman of the Weizmann Institute, provided a very pleasant conclusion of the official part of this most successful and enjoyable conference.

Many participants of the conference were impressed by the great interest displayed by the officials as well as by the population of Israel in matters concerning science. Not only was the conference broadly and prominently covered in the local press but there were always a considerable number of autograph-seeking youths waiting outside the conference halls. The fact that the delegates were invited to a banquet with David Ben-Gurion, the prime minister, and that a reception was given for them by the President of the State gave evidence of Israel's interest in the conference.

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Society Elections

■ American Association of Physics Teachers: pres.-elect, Francis W. Sears, Department of Physics, Dartmouth College; pres., Clarence J. Overbeck, Department of Physics, Northwestern University; past pres., Vernet E. Eaton, Wesleyan University; sec., Frank Verbrugge, University of Minnesota; treas., Sanborn C. Brown, Massachusetts Institute of Technology.

■ Society of American Foresters: pres., George A. Garratt, School of Forestry, Yale University; v. pres., Henry J. Malsberger, Southern Pulpwood Conservation Association, Atlanta, Ga.; exec. sec., Henry Clepper, 715 Mills Bldg., Washington 6, D.C. The representative to the AAAS Council is Paul M. Dunn, St. Regis Paper Company, New York, N.Y.

■ Astronomical League: pres., Russell C. Maag, Sedalia, Mo.; v. pres., Chandler H. Holton, Atlanta, Ga.; sec., Gene L. Tandy, 1805 North River, Independence, Mo.; exec. sec., Wilma A. Cherup, Pittsburgh, Pa.; treas., Norman C. Dalke, Seattle, Wash. The representative to the AAAS Council is Armand Spitz, Spitz Laboratories, Elkton, Md.

■ The Metric Association: pres., J. T. Johnson, Claremont, Calif.; exec. v. pres., Paul H. Bolton, Public Relations Foundation, Washington, D.C.; sec.-treas., Vincent G. Shinkle, 915 West End Ave., New York 25, N.Y.. The vice presidents are Theo. A. Seraphin, Philadelphia, Pa., Aubrey Drury, San Francisco, Calif., C. J. Arnold, Mankato, Minn., Theo. H. Miller, Poughkeepsie, N.Y., Louis Elliott, New York, N.Y., Chester Naramore, Bronxville, N.Y., Robert P. Fischelis, Washington, D.C., Mrs. William Dick Sporborg, New York, N.Y., Howard I. Smith, Washington, D.C. The representative to the AAAS Council is J. T. Johnson.

■ Kresge-Hooker Science Library Associates: pres., Sereck H. Fox, College of Pharmacy, Wayne State University; v. pres., Harold A. Beatty, Detroit, Mich.; sec.-treas., Byron A. Soule, Route #2, Dexter, Mich.; exec. sec., Wendell H. Powers, Department of Chemistry, Wayne State University. The representative to the AAAS Council is Byron A. Soule.

■ Instrument Society of America: pres., Robert J. Jeffries, Data Control Systems, Inc., Danbury, Conn.; past pres., J. T. Vollbrecht, Energy Control Company, New York, N.Y.; pres.-elect, and sec., Henry C. Frost, Corn Products Refining Company, 201 N. Wells St., Chicago 6, Ill.; treas., Howard W. Hudson, Skokie, Ill.; exec. dir., W. H. Kushnik, ISA, 313 6th Ave., Pittsburgh, Pa. The vice presidents are Edward C. Baran, Philip A. Sprague, John Johnston, Jr., Ralph H. Tripp. The representative to the AAAS is William A. Wildhack, National Bureau of Standards, Washington, D.C.

■ The Mathematical Association of America: pres., G. B. Price, University of Kansas; sec.-treas., H. M. Gehman, University of Buffalo, Buffalo 14, N.Y.; associate sec., Lloyd J. Montzingo, Jr., University of Buffalo. The vice presidents are G. B. Thomas, Massachusetts Institute of Technology, and B. W. Jones, University of Colorado.

■ Society of Economic Paleontologists and Mineralogists: pres., Gordon Rittenhouse, Shell Development Company, Houston, Tex.; past pres., R. V. Hollingsworth, Paleontological Laboratory, Midland, Tex.; v. pres., W. M. Furnish, Iowa State University; sec.-treas., Raymond E. Peck, University of Missouri, Columbia, Mo.

■ Soil Conservation Society of America: pres., Russell G. Hill, Michigan State University; exec. sec., H. Wayne Pritchard, 838 Fifth Ave., Des Moines, Ia.; treas., H. F. Barrows, Hinsdale, Ill. The vice presidents are Alvin C. Watson, Soil Conservation Service, Washington, D.C., and E. L. Sauer, University of Illinois. The representative to the AAAS Council is Donald A. Williams, Soil Conservation Service, USDA, Washington, D.C.

Forthcoming Events

April

8–10. Electronic Waveguides Symp., New York. (J. Fox, Microwave Research Inst., Polytechnic Inst. of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y.)

9–12. National Council of Teachers of Mathematics, Cleveland, Ohio. (M. H. Ahrendt, NCTM, 1201 16 St., NW, Washington 6.)

9–14. Applied Psychology, 13th internatl. cong., Rome, Italy. (L. Meschieri, National Inst. of Psychology, Rome.)

10–11. American Inst. of Chemists, annual, Los Angeles, Calif. (L. Van Doren, AIC, 60 E. 42 St., New York 17.)

10–12. Biometric Soc., ENAR, Gatlinburg, Tenn. (T. W. Horner, General Mills, Inc., 400 Second Ave. South, Minneapolis 1, Minn.)

10–12. National Speleological Soc., annual, Gatlinburg, Tenn. (G. W. Moore, Geology Dept., Yale Univ., New Haven, Conn.)

10–12. Ohio Acad. of Science, annual, Akron, Ohio. (G. W. Burns, Dept. of Botany, Ohio Wesleyan Univ., Delaware.)

11. Vitamin B-12 Symp., New York, N.Y. (Miss J. Watson, 451 Clarkson Ave., Brooklyn 3, N.Y.)

11–12. Eastern Psychological Assoc., annual, Philadelphia, Pa. (G. Lane, Dept. of Psychology, University of Delaware, Newark.)

11–12. Montana Acad. of Sciences, annual, Missoula. (L. H. Harvey, Montana State Univ., Missoula.)

11–18. Horticultural Conf., 15th internatl., Nice, France. (Secretariat General, 84, rue de Grenelle, Paris 7e, France.)

12. Society for the Scientific Study of Religion, New York. (L. Whitman, 297 Fourth Ave., New York, N.Y.)

13–14. American Soc. for Artificial Internal Organs, Philadelphia, Pa. (G. Schreiner, Georgetown Univ. Hospital, Washington 7.)

13–18. American Chemical Soc., 133rd, San Francisco, Calif. (R. M. Warren, ACS, 1155 16 St., NW, Washington 6.)

13–19. Federation of American Societies for Experimental Biology, annual, Philadelphia, Pa. (M. O. Lee, FASEB, 9650 Wisconsin Ave., Bethesda 14, Md.)

14–16. Automatic Techniques Conf. Detroit, Mich. (J. E. Eiselein, RCA, Bldg. 10–7, Camden 2, N.J.)

14–18. American Assoc. of Clinical Chemists, annual, Philadelphia, Pa. (M. M. Friedman, Lebanon Hospital, New York 57.)

14–18. American Assoc. of Immunologists, annual, Philadelphia, Pa. (F. S. Cheever, Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh 13, Pa.)

14–18. American Soc. for Experimental Biology, annual, Philadelphia, Pa. (J. F. A. McManus, Univ. of Alabama Medical Center, Birmingham.)

14–18. American Soc. of Biological Chemists, annual, Philadelphia, Pa. (P. Handler, Dept. of Biochemistry, Duke University School of Medicine, Durham, N.C.)

15–17. Gas Measurement, 34th annual conf., Norman, Okla. (M. L. Powers, Ex-

tension Div., Univ. of Oklahoma, Norman.)

16–25. Instruments, Electronics and Automation Conf., London, England. (Industrial Exhibitions Ltd., 9 Argyll St., London, W.1.)

17–18. Environmental Engineers, 2nd annual institute, New York. (Institute of Environmental Engineers, 9 Spring St., Princeton, N.J.)

17–18. Midwest Benthological Soc., annual, Madison, Wis. (K. M. Mackenthun, 453 State Office Bldg., Madison 2.)

17–19. Association of Southeastern Biologists, annual, Tallahassee, Fla. (J. C. Dickinson, Jr., Dept. of Biology, Univ. of Florida, Gainesville.)

17–19. Eastern Colleges Science Conf., 12th annual, Wilkes-Barre, Pa. (Mrs. E. Stevens, Wilkes College, Wilkes-Barre.)

18. Iowa Acad. of Science, annual, Des Moines. (C. H. Lindahl, Dept. of Mathematics, Iowa State College, Ames.)

18–19. Arkansas Acad. of Science, annual, Little Rock. (L. F. Bailey, Botany Dept., Univ. of Arkansas, Fayetteville.)

19–20. Eastern Sociological Soc., 28th annual, Philadelphia, Pa. (A. Van der Slice, School of Social Sciences and Public Affairs, American Univ., 1901 F St., NW, Washington 6.)

19–21. American College of Apothecaries, Los Angeles, Calif. (R. E. Abrams, Hamilton Court, 39th and Chestnut St., Philadelphia, Pa.)

19–25. Industrial Health Conf., Atlantic City, N.J. (IHC, Room 1313, 28 E. Jackson Blvd., Chicago 4, Ill.)

20–22. American Assoc. of Colleges of Pharmacy, annual, Los Angeles, Calif. (G. L. Webster, College of Pharmacy, Univ. of Illinois, 808 S. Wood St., Chicago, 12.)

20–22. American Soc. of Hospital Pharmacists, Los Angeles, Calif. (Mrs. G. N. Francke, 1812 Norway Rd., Ann Arbor, Mich.)

20–23. Chemical Engineering Conf., Canada-United States, Montreal, Quebec, (H. R. L. Streight, DuPont Company of Canada, P.O. Box 660, Montreal.)

20–23. Numerical Approximation Symp., Madison, Wis. (R. E. Langer, Mathematics Research Center, U.S. Army, Univ. of Wisconsin, 1118 W. Johnson St., Madison 6.)

20–25. American Pharmaceutical Assoc., annual, Los Angeles, Calif. (R. P. Fischelis, APA, 2215 Constitution Ave., NW, Washington 7.)

21–22. National Assoc. of Boards of Pharmacy, Los Angeles, Calif. (R. P. Fischelis, 2215 Constitution Ave., NW, Washington 7.)

21–23. American Oil Chemists' Soc., Memphis, Tenn. (Mrs. L. R. Hawkins, AOCS, 35 E. Wacker Dr., Chicago 1, Ill.)

21–28. American Industrial Hygiene Assoc., annual, Atlantic City, N.J. (G. D. Clayton, George D. Clayton and Associates, 14125 Prevost, Detroit 27, Mich.)

22–24. Electronic Components Symp., Los Angeles, Calif. (E. E. Brewer, Convair, Inc., Pomona, Calif.)

23–26. Internal Medicine, 5th internatl. cong., Philadelphia, Pa. (E. R. Loveland, 4200 Pine St., Philadelphia 4.)

23–27. American Assoc. of Bioanalysts, natl., New York, N.Y. (L. D. Hertert, AAB, Suite 1049, 490 Post St., San Francisco 2, Calif.)

24–25. Eastern States Health Education Conf., New York (I. Galdston, New York Acad. of Medicine, 2 E. 103 St., New York 29.)

24–25. Nutrition Conf., 4th annual, Detroit, Mich. (J. M. Orten, Dept. of Physiological Chemistry, Wayne State Univ., College of Medicine, 1401 Rivard St., Detroit 7.)

24–26. International Scientific Radio Union, spring, Washington, D.C. (J. P. Hagen, National Acad. of Sciences, 2101 Constitution Ave., NW, Washington 25.)

24–26. West Virginia Acad. of Science, annual, Morgantown. (M. Ward, Glenville State College, Glenville, W. Va.)

24–26. Wildflower Pilgrimage, 8th annual, Gatlinburg, Tenn. (A. J. Sharp, Dept. of Botany, Univ. of Tennessee, Knoxville.)

25–26. American Assoc. of University Professors, annual, Denver, Colo. (R. K. Carr, 1785 Massachusetts Avenue, NW, Washington 6.)

25–26. Georgia Acad. of Science, annual, Emory Univ., Emory. (M. T. Clark, Chemistry Dept., Emory Univ., Emory, Ga.)

25–26. Louisiana Acad. of Sciences, annual, Shreveport. (H. B. Boudreaux, Louisiana State Univ., Baton Rouge 3.)

25–26. South Dakota Acad. of Science, annual, Rapid City. (J. M. Winter, Botany Dept., Univ. of South Dakota, Vermillion.)

27–1. American Ceramic Soc., 60th annual, Pittsburgh, Pa. (C. S. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

27–1. Electrochemical Soc., spring, New York. (H. B. Linford, ES, 1860 Broadway, New York 23.)

27–1. Society of American Bacteriologists, 59th annual, Chicago, Ill. (E. M. Foster, Univ. of Wisconsin, Madison 6.)

27–1. Southwestern and Rocky Mountain Div., AAAS, annual, Las Vegas, N.M. (M. G. Anderson, New Mexico A.&M. College, Las Cruces.)

28–29. Automatic Control in the Petroleum and Chemical Industries, 3rd annual conf., Norman, Okla. (M. L. Powers, Extension Div., Univ. of Oklahoma, Norman.)

28–3. Engineering Societies of Western Europe and the United States, conf. (closed), New York. (C. E. Davies, American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18.)

May

1–3. American Physical Soc., Washington, D.C. (K. K. Darrow, APS, Columbia Univ., New York 27.)

1–3. Kansas Acad. of Science, annual, Ottawa. (C. T. Rogerson, Dept. of Botany, Kansas State College, Manhattan.)

1–3. Midwestern Psychological Assoc., Detroit, Mich. (D. W. Fiske, Dept. of Psychology, University of Chicago, Chicago 37).

1–8. American Soc. of Tool Engineers, 26th annual, Philadelphia, Pa. (ASTE, 10700 Puritan, Detroit 38, Mich.)

(See issue of 21 February for comprehensive list)

LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see Science **124**, *249 (1956) and* **125**, *16 (4 Jan. 1957).*

Training of Science Teachers

In the December issue of *The Scientific Monthly* [**85**, 320 (1957)], Fletcher G. Watson advances a plan for the training of science teachers that may be suitable for teachers of physical science but is very inadequate for prospective teachers of biology. He proposes that the "biology teacher" have general inorganic chemistry (with qualitative laboratory), organic and quantitative chemistry, mathematics through the calculus, and introductory and atomic physics, plus geology and astronomy and probably meteorology, but only one year of introductory biology plus a semester of vertebrate physiology and one of plant physiology.

It does not seem to bother Watson that his "biology teacher" will have no intensive courses in botany and zoology and interrelated fields other than the two years mentioned. It bothers me very much. He thinks "Geology is important for considerations of paleontology and evolution, while astronomy involves atomic and nuclear physics and the 'big questions' of cosmogony." One can hardly deprecate these aims, but surely it would be more useful for our "biology teacher" to be well informed with regard to plant and animal biology and the integrating disciplines, so that he might consider the "big questions" of *biology.*

Watson thinks "genetics, cytology, and biochemistry are desirable but might be delayed to a fifth year or summer school." He seems to think that these are less relevant to the preparation of a biology teacher than astronomy, atomic physics, or geology. He does not even mention microbiology, morphology, or taxonomy.

It is not uncommon for physical scientists to lack appreciation of the scope of the biological sciences, but it seems doubtful that many would plan so scant a biology major. The de-emphasis of biological science has been so consistently practiced that, in the popular mind, the biological sciences are seldom thought of when the word *science* is used. Biologists have been especially lax in correcting the imbalance, as well as in pointing out to their colleagues in the physical sciences that the biological sciences are at least as broad in scope and as detailed in depth as the physical sciences.