Scientific Meetings

Enzymes as Biological Units

There can be few better bargains in research-foundation investments than those meetings that bring specialists into communication at the intersections of knowledge. The fourth Henry Ford Hospital Symposium, in the arrangement of which staff members of the Edsel B. Ford Institute took a very active part, was held in Detroit from 1 to 3 Nov. 1955 under the title *Enzymes: Units of Biological Structure and Function.* This meeting provided, in the scope of its program and in its distinguished attendance, an admirable setting for the most ambitious attempt that has so far been made to explore aspects of enzyme research that bear on problems in cell physiology. The proceedings of the symposium will be published by Academic Press.

Some 550 persons attended the symposium, of whom 42 participated in the formal program. The goals of the symposium were formulated by Bernard Davis (New York University), who opened the scientific sessions. Davis pictured current studies of isolated enzymes as so successful that traditional enzymology is now rapidly consuming its own substrate. In contrast, enzymatic approaches to the larger events of genetics and cell physiology are in their infancy; these newer aspects of enzyme studies comprised the major theme of the meeting. In this report, the papers that were presented are reviewed under the headings of the six sessions that composed the 3-day symposium period.

Origin of enzymes. The first session dealt with enzyme formation and the relationship between nucleic acids and protein fabrication. Jacques Monod (Pasteur Institute) described evidence for the existence in *Escherichia coli* of a specific inducible system that can concentrate the inducer intracellularly. Although this transport system and the enzyme, β-galactosidase, can both be induced by the same galactosides, the two mechanisms can be clearly separated in mutants with the capacity to form one or the other system independently.

Another aspect of protein synthesis was developed by Ernest Gale (Cambridge University), whose work dealt with sonically disrupted cells of *Staphylococcus aureus.* Ribonucleic acid (RNA) was required for the synthesis of catalase, as was demonstrated after removal of endogenous RNA with ribonuclease; significantly, only homologous RNA from staphylococci was effective. In contrast to this constitutive enzyme, the formation of an induced enzyme such as β-galactosidase required the addition not of preformed RNA but of purine and pyrimidine bases. Gale's data also suggested a possible role for desoxyribonucleic acid (DNA) in reactivating enzyme synthesis.

S. Spiegelman (University of Illinois) also considered the relationship of nucleic acids to protein synthesis, after he had reviewed data that favor the formation of proteins by simultaneous assembly from a free amino acid pool. Spiegelman, considering the alternative template structures as either DNA or RNA, presented data comparing the relative effects of desoxyribonuclease and ribonuclease on enzyme synthesis. Altered cells, used to permit the access of nucleases, were *Bacillus megatherium* protoplasts—that is, bacteria stripped of their cell walls by the action of lysozyme. Such preparations show inhibition of protein synthesis by partial RNA removal but not by almost complete DNA removal.

The enigma of cell differentiation was the subject of a general introduction by Boris Ephrussi (University of Paris). Although many of the fundamental questions in this area have not been dealt with experimentally, Ephrussi referred to recent observations by Briggs and King on the effect of nuclear transplantation at various stages of differentiation. While the cytoplasm has generally been considered to be the seat of the hereditary changes of differentiation, this work opens the possibility that these changes may depend on alterations, too subtle for cytologic detection, of the nuclear genes.

In the formal commentary following these papers, Melvin Cohn (Washington University) reported that, in *Escherichia coli,* glucose fails to inhibit completely the induction of β-galactosidase if the inducing galactoside is permitted to act on cells for a few minutes before glucose addition; when glucose and the inducer are added simultaneously, essentially no enzyme synthesis is observed. This phenomenon could involve the inducible concentrating mechanism that was studied by Monod in the same system. The second commentator of this session, Sidney Velick (Washington University), referred to studies indicating that in mammalian muscle also proteins are fabricated directly from an amino acid pool.

Gene-enzyme relationship. The second session was begun by A. D. Hershey (Carnegie Institution, Cold Spring Harbor), who provided evidence that phage DNA can be synthesized under conditions that prevent the formation of phage protein.

Rollin Hotchkiss (Rockefeller Institute) reviewed some provocative features of the phenomenon of inheritable transformations in pneumococci by DNA. In particular, he presented evidence for the linked introduction of different characters and a discussion of possible mechanisms by which transforming DNA is inserted into the genetic material of the recipient cell.

The commentator following, M. Demerec (Carnegie Institution), presented fresh experimental information of possibly far-reaching significance. In *Salmonella,* the successive reactions of histidine biosynthesis match a corresponding linear arrangement of the gene loci concerned with each enzymatic step. Certain other metabolic sequences in microorganisms, however, have failed to show this linear array of the genes for related functions. Demerec also reported that in *Salmonella* a genetic alteration affecting the synthesis of a given enzyme can occur at any of a large number of positions, distinguished from each other by recombination, within the locus of a single functional genetic unit.

Citing the particulars of earlier criticisms, Norman Horowitz (California Institute of Technology) reviewed the history and status of the one gene-one enzyme hypothesis, which should perhaps more accurately be called the multiple gene-one enzyme hypothesis. More specifically, Horowitz discussed the genetic determination of a qualitative enzyme alteration that affects the heat-lability of tyrosinase in *Neurospora.*

The final paper of this session, by Charles Yanofsky (Western Reserve University), exemplified the power of combined genetic, immunologic, and enzymatic analysis in clarifying complex relationships between suppressor genes and a gene locus controlling tryptophan synthetase formation in *Neurospora.* Genetic differences in a series of otherwise indistinguishable mutants were first indicated by qualitatively different responses to a group of suppressor genes. Further investigation of extracts revealed that certain tryptophan auxotrophs possess an enzymatically inactive protein that resembles active tryptophan synthetase in solubility behavior and serologic properties. The

immunologically related protein may be converted to active enzyme in the presence of effective suppressor genes.

The final formal speaker of this session, Joshua Lederberg (University of Wisconsin), ranged over the papers of both previous sessions, descended on factually infirm or logically attenuated assertions, and generally set a high standard of discrimination and clarity for other scheduled commentators.

Enzymes and cell structure. For much of the audience, the most novel material of the symposium was presented in this session, which dealt with the detailed internal structure of the cell. Here the potentialities of electron microscopy, cytochemistry, and cell fractionation methods were revealed, together with their prospect of returning morphology to its former eminence in biology.

George Palade (Rockefeller Institute) surveyed current information concerning cellular structures. A series of remarkably detailed electron micrographs revealed the intricate pattern of intramitochondrial architecture, nuclear membrane structure, and endoplasmic reticulum—the pervasive fabric of vesicles and tubules that occupy the hyaloplasm.

Following the introduction of the mitochondrion as a morphologic unit, subsequent papers dealt with aspects of its physiology. Albert Lehninger (Johns Hopkins University) discussed mitochondria as units that are capable of carrying out many coordinated biochemical functions, among them oxidative phosphorylation. Oxidative phosphorylation as the primary site of action of thyroid hormones has been postulated for some time, for there is direct evidence for the *in vitro* uncoupling of oxygen uptake from phosphate esterification in the presence of thyroxin. Lehninger reported, however, that mitochondrial fractions could be obtained in which thyroxin, in contrast to dicumarol and 2,4-dinitrophenol, no longer uncoupled oxidative phosphorylation. Furthermore, thyroxin promoted water imbibition by isolated mitochondria. Lehninger therefore proposed that thyroxin action may not be directly via one of the reactions of coupled phosphorylation but primarily on the mitochondrial membrane.

Edward Kuff and George Hogeboom (National Institutes of Health) described physical techniques for measuring and fractionating distributions of particles that were derived from tissue homogenates by ultracentrifugation through a density gradient.

Following a comment by Van Potter (University of Wisconsin) on the barriers to communication between the biological specialties, Daniel Mazia (University of California) described experiments with amebas that were designed to explore nuclear-cytoplasmic interrelationships. The technique of nucleus transplantation was used to show that RNA can be transferred from nucleus to cytoplasm, but not vice versa. In addition, the introduction of a label into the DNA of plant chromosomes revealed occasional instances of unequal segregation of label into daughter cells at mitosis: this result excludes certain possible models of DNA replication.

Daniel Arnon (University of California) reviewed recent work of his group on the reactions of photosynthesis as catalyzed by isolated whole chloroplasts and by broken chloroplast preparations. These preparations carry out not only the familiar Hill reaction but also the reactions of photosynthetic phosphorylation and photosynthetic CO_2 fixation. Light-dependent phosphorylation can be made independent of molecular oxygen by adding certain cofactors and is therefore pictured as utilizing rather directly the energy of recombination of photolysis products. The scheme presented also defines the liberation of O_2 as a process secondary to CO_2 fixation rather than as the direct product of photolysis.

Enzymatic basis of some physiologic functions. W. Mommaerts (Western Reserve University) reviewed some problems in the physiologic significance of the actomyosin-ATP reaction and described an assay system that is capable of sensitive responses to many variables influencing the hydrolysis of ATP by myosin. Manuel Morales (Naval Medical Center) presented arguments that oppose the contention that there is an immediate dependence of myosin contraction on the hydrolysis of ATP. An alternative hypothesis links the contraction of myosin to an association with intact ATP, following which hydrolysis occurs.

An area far less thoroughly investigated from an enzymatic viewpoint is the renal control of specific secretion and reabsorption of plasma components in the formation of urine. John Taggart (Columbia University) presented an interesting analysis of the stimulation by acetate of *p*-amino hippurate concentration by kidney slices. This effect appears to result not from a direct role of acetate or acetyl coenzyme A but rather from the formation of acetyl glycine. The latter compound is formed at the expense of other acylglycines which, if present, would competitively inhibit *p*-amino hippurate transport.

Gilbert Mudge (Johns Hopkins University), in discussing the papers presented, made some observations on the properties required of active transport systems and emphasized our fundamental ignorance of these mechanisms.

Among the more successful applications of enzymatic analysis to major physiologic problems, the emergence of a chemical theory of retinal vision ranks high. George Wald (Harvard University), to whose efforts much of this success is due, presented a concise résumé of the status of the rhodopsin-retinene system, together with some rather suggestive speculations concerning certain recent observations, such as the requirement of a relatively strained and unstable geometric isomer of vitamin A for rhodopsin synthesis and its conversion to another isomer in the course of rhodopsin bleaching. Although considerable enzymatic detail is known concerning the cyclic bleaching and reconstitution of the retinal pigments, Wald emphasized that these reactions are only peripheral to the crucial question of the transduction of light energy to nerve impulses in the optic nerve.

William McElroy (Johns Hopkins University) surveyed the reactions that are known to be involved in the bioluminescence of the luciferin-luciferase system of the firefly and *Cypridina,* as well as recent work on bacterial luminescence. The firefly reactions are complex, involving postulated inhibitors and counter inhibitors. In a final comment on the photobiochemical papers of this session, Bernard Strehler (University of Chicago) reported his recent observation that briefly illuminated green plant material emits light whose spectrum seems compatible with an excited state of chlorophyll or a flavin semiquinone.

Cellular energy sources. Biochemists and general physiologists have long been concerned with electron transfer to oxygen through the chain of respiratory enzymes and the utilization of energy released by these reactions. Elmer Stotz (University of Rochester) reviewed recent methods developed by his group for the purification from heart muscle of several components of the cytochrome system and presented characterizations of the distinct hemes.

Recent advances in the purification of succinic dehydrogenase from beef heart were described by Thomas Singer (Edsel Ford Institute for Medical Research). The enzyme appears to be a flavoprotein containing four atoms of nonhemin iron per mole. The flavin-containing fragment, liberated by proteolysis, behaves differently from flavin adenine dinucleotide (FAD) or flavin mononucleotide; Singer considers this fragment as FAD bound to a peptide.

Eric Ball (Harvard University) discussed the nomenclature of preparations of succinic dehydrogenase and problems arising from the fact that the preparations of three groups of investigators differ in their requirement for certain dyes as electron acceptors.

Two papers representing complementary approaches to the physiology of electron transport were presented by

Britton Chance (University of Pennsylvania)and David Green (University of Wisconsin). Chance's work concerned spectrophotometric observations on components of the intact system in isolated mitochondria. Such observations have the unique value of permitting quantitative estimates of major components under quasi-physiological conditions. Green described successive fractionation of mitochondria into fragments that carried out increasingly limited series of reactions in the over-all chain.

Some speculations concerning the role of heme proteins in bacterial photosynthesis were registered by Martin Kamen (Washington University). A comprehensive study of the cytochrome compounds of photosynthetic bacteria having revealed considerable differences from their mammalian counterparts, theoretical account must be taken of the function of these compounds in bacteria that photosynthesize as obligate anaerobes. Kamen proposed that these heme proteins are obligatory intermediates in chemical conversions by light quanta. In anaerobes, cytochrome photooxidases couple electron transfer to the oxidized photolytic product, [OH]; in facultative aerobes, either oxygen or the photolysis product may be the ultimate electron acceptor. The photosynthetic release of oxygen may also be mediated through bacterial cytochrome compounds.

Regulation of enzyme activity. Bernard Davis (New York University) discussed the physiologic implications of selective transport across cellular and subcellular membranes and presented some examples of the use of microbes to study such problems. The ability of certain bacteria to take up citrate was found to be adaptive, and this adaptation was inhibited by glucose—an observation that is strikingly parallel to the work reported by Monod on the uptake of inducers of β-galactosidase synthesis. Evidence was presented that these cases, and similar ones involving amino acids, are based on osmotic work performed by specific enzymelike mechanisms in the membrane rather than on stoichiometric fixation of the concentrated material at intracellular sites.

The direct medical applicability of certain of the symposium topics was apparent in the discussions of J. H. Quastel (Montreal General Hospital) and Arnold Welch (Yale University). Quastel reviewed certain historical aspects of drug action in terms of enzyme inhibition and summarized recent work of his laboratory on the mechanism of action of narcotics and local anesthetics. These drugs have been found to inhibit the respiration of brain slices, but they inhibit more profoundly the increased respiration that results from stimulation by potassium ions or electric current.

After a useful concise summary of nucleotide biosynthesis, Welch discussed the action of specifically designed nucleic acid antimetabolites, a class of drugs that at present offers considerable hope for the rationally directed control of malignant disease in human beings. Earl Sutherland (Western Reserve University), a commentator on this portion of the program, described the stimulation by glucagon and epinephrine of phosphorylase activity. The epinephrine effect appears to be stimulation of a kinase that resynthesizes active phosphorylase from its inactive dephosphorylated form.

The final paper of the symposium, by Carl Cori (Washington University), presented anaerobic muscular contraction as a problem in the kinetic regulation of glycolysis. Thus, electric stimulation can in a fraction of a minute increase by 1800 times the rate of glycogen breakdown over that of the resting state, followed by equally rapid restoration. Cori considered the question of which enzymatic step is limiting and how its rate is so rapidly and smoothly adjusted to physiologic requirements. The observations presented suggest that the level of active phosphorylase may be a crucial factor.

Henry Lardy (University of Wisconsin), as a final commentator, proposed another mode of regulating reaction rates, exemplified by inhibition of the phosphohexokinase reaction by high ratios of ATP to Mg^{++} ion. Teleologically, this has been interpreted as a mechanism for conserving ATP, which might otherwise be wasted through the action of phosphatase on hexose diphosphate.

The general discussion following formal presentations will be fully included in the published proceedings, which should greatly enrich the value of the book. An analyst of scientific fashion could perhaps infer many foci of future interest from a record of this discussion. Certain questions of particular interest that arose in the discussion can be cited as random examples: a lively debate on protein turnover in animal and bacterial cells, the relationship of ATP hydrolysis to muscle contraction, the adequacy of the detailed reaction schemes that were offered for photosynthesis and electron transport, and, in the final session, the presentation of various impromptu models for the mechanism of active transport across biological membranes.

Two additional formal portions of the program must be mentioned—the Edsel B. Ford lecture that was presented on the first evening by Linus Pauling (California Institute of Technology) and a talk on the second evening by Albert Szent-Gyorgyi (Marine Biological Laboratory, Woods Hole). Both presentations were general and speculative in nature and served as agreeable carminatives after the concentrated fare of the daily sessions. Pauling discussed molecular specificity and structural complementarity in reactions by biological importance, exemplified by his work on antibody reactions and on the "molecular disease," sickle cell anemia. Szent-Gyorgyi, in generalizing from the reactions of myosin and ATP, speculated that the past successes of biochemistry—in his image, the bright spots in the chiaroscuro of biological understanding—have dealt with systems that can be adequately treated in terms of classical molecular models. He surmised that the problems that are still fundamentally obscure, such as the transduction of chemical to mechanical and electric energy in muscle and nervous tissue, may require the additional sophistications of quantum chemistry.

Finally, it is interesting to consider the profits of a meeting such as this. For the most part, the papers presented were general reviews of the status and problems of major sectors of research in genetics, metabolism, cytology and cell physiology, particularly as these interpenetrate and overlap. It would seem that the outstanding value of such a symposium is mutual education via the authoritative presentation of problems and approaches across adjacent lines of inquiry. The ultimate success of the symposium as an agency of cross-fertilization is incalculable; as a stimulating intellectual and educational experience, its immediate success was pronounced by a number of the participants and undoubtedly by most of those in attendance.

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Meeting Notes

■ Fatigue of metals, increasingly important in the design and construction of modern aircraft for safety and performance, will be discussed by 125 invited delegates at a 3-day International Conference on Fatigue in Aircraft Structures at Columbia University, 30 Jan.–1 Feb. The meeting, under the auspices of the Columbia School of Engineering's department of civil engineering and engineering mechanics and its Institute of Flight Structures, is jointly sponsored by the Office of Scientific Research, U.S. Air Force.

It is believed that fatigue of materials has been responsible for about 20 percent of aircraft failure, including the two British jet-transport Comet disasters. Much attention has been given to strengthening alloys and structures without significant regard for fatigue performance.

The purpose of this international conference on fatigue will be, according to

Alfred M. Freudenthal, chairman of the organizing committee, "to increase the scope of basic research in fatigue in this country; to exchange information on research here and abroad in order to advance present researches and stimulate new ones and to provide, in published proceedings, a source of up-to-date information on fatigue for wider use."

Authorities in the field from England, Scotland, West Germany, Sweden, Australia, and the United States will present the principal aspects of the problem under three general headings: "Physical theories of fatigue"; "Prediction of fatigue life and fatigue strength"; and "Prevention of fatigue failure."

■ The AAAS Southwestern and Rocky Mountain Division will meet from 29 Apr. to 3 May at Las Cruces, N.M. Frank E. E. Germann, executive secretary of the division, has announced that the date for final submission of title with detailed statement of problem, or title with a 200-word abstract, is *1 Mar.*

During the meeting the AAAS Arid Lands Committee will conduct a half-day symposium reviewing the work of the International Arid Lands Symposium that took place last spring in Albuquerque and Socorro under the sponsorship of the division, the AAAS, and UNESCO. Marlowe G. Anderson, chairman of the local committee, is planning a series of social and general sessions. Participants will enjoy the hospitality of the New Mexico College of Agriculture and Mechanic Arts.

The 1956 section officers to whom titles are to be sent are as follows:

Botanical sciences. Chairman, Earl D. Camp, Texas Technological College, Lubbock; secretary, J. L. Gardner, Box 35, State College, N.M.

Physical sciences. Chairman, Marvin H. Wilkening, New Mexico Institute of Mining and Technology, Socorro; secretary, E. E. Burgoyne, Arizona State College, Tempe.

Social sciences. Chairman, Sophie D. Aberle, University of New Mexico, Albuquerque; secretary, Stanley S. Newman, University of New Mexico, Albuquerque.

Zoological sciences. Chairman, Rex Allen, New Mexico College of Agriculture and Mechanic Arts, Las Cruces; secretary, Roy E. Gilmore, New Mexico College of Agriculture and Mechanic Arts, Las Cruces.

■ The fifth annual symposium on blood was held at the Wayne University College of Medicine on 21 Jan. under the chairmanship of Walter H. Seegers, physiology professor at Wayne. Some 200 scientists from throughout the United States and Europe attended the meeting, where 15 papers dealing with fundamental problems and research in blood composition, hemophilia, and thrombosis were presented. Presiding with Seegers was Elwood A. Sharp, medical assistant to the president of Parke, Davis and Company. Calvin H. Hughes, biologist on the research staff of the General Motors Corporation, served as a member of the organizing committee.

A paper was presented on the practical problems of blood freezing and preservation by Harold T. Meryman, now at Yale University School of Medicine. Another paper, by Frank Monkhouse of the University of Toronto, dealt with the effects of severe irradiation on the blood.

A paper by three scientists from the University of Zurich, Switzerland, discussed a new clotting factor in the blood stream. The new serum factor, factor X, was described by François Duckert, P. Fluckinger, and Fritz Koller. Duckert at present is conducting research at Wayne.

Four other papers, including one by Seegers and Shirley A. Johnson of Wayne University, dealt with various types of hemophilia. Other papers on that subject were delivered by participants from Columbia University, Stanford University, and Harvard University.

Three papers on thrombosis were presented by research men from Purdue University, the Naval Medical Research Institute, and Washington University. The formation and construction of thrombin was discussed in three other papers prepared by specialists from the New York State Health Department, the Army Research Laboratory at Ft. Knox, Ky., and Chicago's Presbyterian Hospital.

John W. Rebuck, from Henry Ford Hospital, Detroit, Mich., discussed the formation of red corpuscles in the bone marrow. A report on the chemical reactions of white blood cells was presented by William N. Valentine and John S. Lawrence of the University of California, Los Angeles.

Society Elections

■ American Chemical Society: pres., John C. Warner, Carnegie Institute of Technology; pres.-elect, Roger J. Williams, University of Texas; exec. sec., Alden H. Emery, ACS Bldg., 1155 16 St. NW, Washington 6, D.C.; treas., Robert V. Mellefont, ASC Bldg., 1155 16 St. NW, Washington 6, D.C.

■ American Microscopical Society: pres., R. W. Pennak, University of Colorado; 1st v. pres., C. O. Berg; 2nd v. pres., W. C. Frohne; sec.-ed., C. J. D. Brown, Montana State College; treas., L. O. Nolf. Representatives to the AAAS Council are Ralph V. Bangham and Horace W. Stunkard.

■ Poultry Science Association: pres., J. H. Quisenberry; 1st v. pres., T. B. Avery; 2nd v. pres., H. R. Bird; sec.-treas., C. B. Ryan, Texas A. & M. College.

■ Society for the Scientific Study of Religion: pres., Richard V. McCann, Harvard University; v. pres., Werner Wolff; sec., Walter Houston Clark, Hartford Seminary Foundation; treas., Jacqueline Y. Sutton.

Forthcoming Events

February

19–23. American Inst. of Mining and Metallurgical Engineers, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

19–23. Soc. of Economic Geologists, New York, N.Y. (O. N. Rove, Union Carbide and Carbon Corp., New York 17.)

20–22. American Educational Research Assoc., annual, Atlantic City, N.J. (F. W. Hubbard, AERA, 1201 16 St., NW, Washington 6.)

23–25. National Soc. of College Teachers of Education, Chicago, Ill. (C. A. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

24–25. American Physical Soc. Houston, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27.)

27–2. American Soc. for Testing Materials, Buffalo, N.Y. (ASTM, 1916 Race St., Philadelphia 3, Pa.)

26–29. American Inst. of Chemical Engineers, Los Angeles, Calif. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

28–29. Scintillation Counter Symposium, 5th, Washington, D.C. (G. A. Morton, RCA Laboratories, Princeton, N.J.)

March

2–4. National Wildlife Federation, New Orleans, La. (C. H. Callison, 232 Carroll St., NW, Washington 12.)

3–4. National Conf. and Workshop on Radio and Television Weather Presentation sponsored by American Meteorological Soc., Hartford, Conn. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

9–10. Midwest Conf. on Theoretical Physics, Iowa City, Iowa. (J. M. Jauch, Dept. of Physics, State Univ. of Iowa, Iowa City.)

12–16. National Assoc. of Corrosion Engineers, 12th annual, New York, N. Y. (Secretary, NACE, Southern Standard Bldg., Houston 2, Tex.)

14–17. National Science Teachers Assoc., Washington, D.C. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

15–16. Food Physics Symposium, 1st international, San Antonio, Tex. (C. W. Smith, Southwest Research Inst., San Antonio.)

15–17. American Orthopsychiatric Assoc., 33rd annual, New York, N.Y. (M. F. Langer, AOA, 1790 Broadway, New York 19.)

15–17. American Physical Soc., Pittsburgh, Pa. (K. K. Darrow, APS, Columbia Univ., New York 27.)

15–17. Kappa Delta Pi, annual, Stillwater, Okla. (E. I. F. Williams, 238 E. Perry St., Tiffin, Ohio.)

16–18. International Assoc. for Dental Research, St. Louis, Mo. (D. Y. Burrill, 129 E. Broadway, Louisville 2, Ky.)

17–18. National Soc. of Professional Engineers, annual spring, Washington, D.C. (K. E. Trombley, NSPE, 1121 15 St., NW, Washington 5.)

18–24. American Soc. of Photogrammetry, annual, joint meeting with American Cong. on Surveying and Mapping, Washington, D.C. (ACSM–ASP, Box 470, Washington 4.)

19–21. Div. of Fluid Dynamics, American Physical Soc., Pasadena, Calif. (F. N. Frenkiel, Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.)

19–22. American Acad. of General Practice Scientific Assembly, 8th annual, Washington, D.C. (AAGP, Broadway at 34th, Kansas City 11, Mo.)

19–22. Inst. of Radio Engineers National Convention, New York. (E. K. Gammett, IRE, 1 E. 79 St., New York 21.)

19–23. American Soc. of Tool Engineers, Chicago, Ill. (H. C. Miller, Armour Research Foundation, 35 W. 33 St., Chicago 16.)

21–22. National Health Forum, New York, N.Y. (T. G. Klumpp, National Health Council, 1790 Broadway, New York 19.)

21–23. American Power Conf., 18th annual, Chicago, Ill. (R. A. Budenholzer, Illinois Inst. of Technology, Chicago 16.)

21–24. American Astronomical Soc. Columbus, Ohio. (J. A. Hynek, McMillin Observatory, Ohio State Univ., Columbus.)

23–24. Eastern Psychological Assoc., Atlantic City, N.J. (G. G. Lane, Univ. of Delaware, Newark.)

24–25. American Psychosomatic Soc., 13th annual, Boston, Mass. (T. Lidz, APS, 551 Madison Ave., New York 22.)

24–31. Perspectives in Marine Biology, La Jolla, Calif. (A. A. Buzzati-Traverso, Scripps Institution of Oceanography, La Jolla.)

25–28. American Assoc. of Dental Schools, annual, St. Louis, Mo. (M. W. McCrea, 42 S. Greene St., Baltimore 1, Md.)

25–29. American College Personnel Assoc., Washington, D.C. (Miss C. M. Northrup, Univ. of Denver, Denver, Colo.)

28–3. Colloquium on Frontiers in Physical Optics, Boston, Mass. (S. S. Ballard, Visibility Laboratory, Scripps Institution of Oceanography, San Diego 52, Calif.)

(See issue of 20 January for comprehensive list)