to live together and to cooperate and to communicate. Scientists are themselves sometimes excellent ambassadors.

Eighty-two years ago when this Association met here in Montreal, young William Osler was professor of the Institutes of Medicine at McGill. He reported his early work on blood in three short papers. No one, in his generation, did more than he to draw three great nations together—Canada, United States, and Britain.

Like Osler, the physicist Ernest Rutherford moved through the English-speaking world. He received his early education in New Zealand; began his research on the atom at McGill University; and then sailed away to carry on his epoch-making investigations at Manchester and Cambridge Universities. His disciple, Peter Kapitza, today works in the Soviet Academy of Sciences. Kapitza is director of the Moscow Institute of Problems of Physics, Academy of Sciences, U.S.S.R. Lev Landau and others interested in the properties of substances at low temperature work under his direction.

You and I and all men of science, except the few involved in defense research, are communicating constantly with scientists in every land. The flow to mainland China is voluminous. They will soon be reciprocating. Pray God the peoples of this world will learn, before it is too late, to be friends and exchange information and thought on every level of society. Only thus will all men come to know and understand their counterparts, their opposite numbers, on every side of every barrier and boundary. When that day dawns, peace will be secure.

Reports of Symposiums

Hydrogen Bonding

Hydrogen bonds are as common in nature as ordinary chemical bonds, and it may be stated with but slight exaggeration that they are equally important. They hold together the molecules in ice and in liquid water. They often provide the greater part of the forces that act on molecules dissolved in a solvent. They are present in electrolytes and in many crystals and rocks. There are billions of them in every living organism including our own bodies, and they are most important for the basic mechanisms of life. Thousands of research papers have been devoted to hydrogen bonding.

A well-remembered symposium on problems related to hydrogen bonding took place in 1957 in Ljubljana, Yugoslavia. The aim of another one-day symposium, part of the annual congress of the American Association for the Advancement of Science (Montreal, 29 December 1964), was to point up new developments in the field since 1957.

A review concerning wave-mechanical treatments of hydrogen-bonded systems was presented by S. Bratoz (Centre de Mécanique Ondulatoire Appliquée, Paris). The most reliable detailed calculations made recently are related to the $(FHF)^-$ system. The hydrogen bond holding this ion together is the strongest known hydrogen bond; it is of fundamental importance because of the relative simplicity of the system. There are "only" 20 electrons in this ion and it is now possible to include all of them explicitly in the calculations. Such "exact" calculations were made (among others) by Clementi and MacLean and by Bessis and Bratoz. The former computed the total energy of the ion with good accuracy; the latter, its dissociation energy in fair agreement with experiment. They have shown also that only the ground state is stable; it is characterized by diminution of the electronic charge density around the proton as a consequence of the formation of the hydrogen bond and by a corresponding increase around the fluorine atoms. In the first excited state, the electronic charge would increase around the proton, a fact connected with the instability of this state. Bratoz pointed out that such exact calculations are now possible for somewhat more complex systems.

For rough purposes, fragmentation of the hydrogen-bond energy into electrostatic, delocalization, repulsive, and dispersion contributions seems still to be admissible, although, as Bratoz has shown, the importance of the electron migration which is consecutive to the hydrogen-bond formation should be stressed much more. There is a similarity between hydrogen-bond forces and charge-transfer forces which offers a useful new way of looking at hydrogen-bonded systems.

Much of our knowledge of hydrogen bonding is based on spectroscopic and other measurements on solids or liquids in which we actually observe cooperative effects between many hydrogen bonds or one hydrogen bond perturbed by strong environmental effects. Therefore study of hydrogen bonding in the gas phase is of fundamental importance if we require knowledge of just one hydrogen bond; such work was reported by H. J. Bernstein (National Research Council, Canada).

Bernstein and his collaborators measured the infrared spectra of systems like methanol + triethylamine which, under adequate circumstances, remain hydrogen bonded in the gas phase. They used the results of their measurements at various temperatures and pressures for determining the energy (enthalpy) of the hydrogen bond ΔH. Using thermochemical cycles, Bernstein derived relations between ΔH and $\Delta\nu$, the difference of the X—H stretching frequency of the free and associated species. These relations involve the dissociation energy of the H—A radical (A being the proton acceptor) which can be computed from the data. An interesting result is that species like the neutral NH_4 radical are predicted to be stable.

Another remarkable result of Bernstein's gas phase studies is that although $\Delta\nu$ in the gas is essentially the same as in the condensed phases the bandwidth is much less.

There was animated discussion of possible explanations of the breadth

problem, that is, of the fact that the infrared X—H stretching frequency gives, in most cases, an extremely broad band. Much of this breadth is due to overtones and combination tones of lower-frequency vibrations of the molecules which are involved, their intensities being often enhanced by Fermi resonance with the X—H vibration. Another part of the breadth comes from combination tones between the X—H frequencies and low-frequency vibrations of the bridge itself which are coupled to the X—H vibration by a fair amount of anharmonicity. In condensed phases a part of the anharmonicity may come from coupling with intermolecular vibrations. It appears to be a most important quantity for understanding the phenomena related to hydrogen bonding. Double well-shaped potential surfaces are possible in certain cases; these may cause splitting of the bands but would not explain the broadening of them.

Recent progress has been great in x-ray and neutron-diffraction structure determinations on molecules containing hydrogen bonds. R. Pepinsky (Florida Atlantic University) rather impressively reviewed work done in his own and in other laboratories. X—A distances are known with great accuracy in many cases, but the position of the proton determined by x-ray techniques is still quite uncertain. The departure from linearity is accurately known for a number of bonds: for example, the XHA angle is 140 deg in nickel-dimethylglyoxim. No good relations exist between distances and hydrogen-bond energies. Among the interesting cases studied by Pepinsky were a number of hydrated and glycine or glycinium derivatives. In water, hydrogen bonds appear to be bent; in KD_2PO_4, the bond is slightly longer than in KH_2PO_4.

E. D. Becker (NIH) reviewed applications of high-resolution nuclear-magnetic resonance (NMR) spectroscopy to the study of hydrogen bonding. The NMR technique has certain unique advantages for studies of hydrogen bonding: the sensitivity of the chemical shift to hydrogen-bond formation; the dependence of spin–spin coupling upon hydrogen-bond formation; and the possibility of using various solvents, especially deuterated ones. At the same time certain shortcomings should be recognized: with NMR we measure only the *average* chemical shifts and coupling constants due to rapid formation and breaking of hydrogen bonds; and there are the low sensitivity of the method and the sensitivity of the observed phenomena to small amounts of water. Much is to be gained by using NMR in conjunction with infrared and ultraviolet spectroscopy.

Spin–spin coupling constants increase on hydrogen bonding. Becker reported on his new results obtained with aniline-N^{15}: the N^{15}—H coupling constant increases by about 5 percent on hydrogen bonding; and the O—H . . . $N^{15} \rightleftarrows$ O . . . H—N^{15} tautomerism also can be studied and information on the potential well can be obtained.

Becker's other experiments included investigation of the interaction of a highly hindered alcohol with dioxane, both in CCl_4 and in cyclohexane-d_{12}; results in the two solvents differ appreciably. Discussion of work in other laboratories referred to studies of hydrogen-bonded complexes formed by $CHCl_3$, CHF_3, and CDF_3.

D. W. Davidson (National Research Council, Canada) treated the dielectric aspects of hydrogen bonding in solids. His talk mainly concerned recent studies of dielectric relaxation in nine forms of "ice," including the high-pressure ices of Bridgman and the clathrate hydrates. The water molecules are rotationally disordered in all of these forms with the exception of ice II. Among the other ices proper, molecules tend to reorient more readily as the density of the phase increases; this may well be associated with increasing departure from tetrahedral coordination and "weakening" of the hydrogen bonding. In the clathrate hydrates the relaxation of molecules in the water lattice is only slightly affected by the nature of the encaged molecules; the latter change from one preferred orientation to another within the cage over barriers of a few tenths of a kilocalorie per mole. Davidson suggested that the departures from simple Debye relaxation behavior noted in most "ices" are related to the presence of nonequivalent sites of water molecules in the crystals.

The symposium left the impression that although there have been no spectacular new developments in the field of hydrogen bonding since 1957 there has been much clarification of general ideas, with much new, accurate knowledge.

C. SANDORFY
Université de Montréal

Cytoplasmic Units of Inheritance

A symposium on cytoplasmic units of inheritance was held 27 December 1964 in Montreal as part of the AAAS meetings. The symposium was organized for the American Society of Naturalists.

Sam Granick, in opening the meeting, pointed out that although Mendel's classic paper was published almost 100 years ago, the science of genetics of the nucleus may be considered to have arisen at the beginning of this century when the hypothetical Mendelian factors of inheritance were found to be localized in chromosomes. These factors of inheritance, or genes, reside in the chromosomal filaments of double-stranded DNA.

During the early part of this century hypothetical factors of inheritance were ascribed also to the cytoplasm. It is only within the last few years, however, that evidence has been obtained that some of these factors of inheritance reside in filaments of double-stranded DNA in cytoplasmic organelles.

This symposium may be considered to have ushered in a new science, that of the genetics of the cytoplasm. Evidence was presented for the presence of DNA and for its coding activity in the cytoplasmic organelles of the plastids, mitochondria, centrosomes, and kinetosomes. Also, evidence was presented for a messenger-RNA molecule which replicates itself in the cytoplasm of a protozoan.

What may be the practical significance of these findings? Plant and animal breeders have been able to select appropriate nuclear genes to provide desirable characters. It may be envisioned that they will now more earnestly consider the possibilities of incorporating cytoplasmic organelles with specific properties into cells. Will it be possible, for example, to change the characteristics of a plant toward different light and temperature conditions by incorporating different kinds of chloroplasts? Similarly, will it be possible to change the rate of respiration of an animal by incorporating different kinds of mitochondria? In the case of the replicating messenger-RNA one may ask: Does this molecule of the cytoplasm, which is the simplest infectious nucleic acid known, provide a model for the origin of new disease-inducing agents?

Hewson Swift presented evidence

based on electron microscopy that filamentous DNA and granular ribosomal RNA are contained in young plastids of Swiss chard and bean leaves as well as in the mitochondria of young red cells and a protozoan, *Tetrahymena*. The ribosomes of plastids are smaller and less dense than those in the cytoplasm. In the root of Swiss chard four DNA components have been observed. One has a density of 1.724 with highest combined guanine-cytosine content; its source is unknown. The second has a density of 1.705 and is presumably derived from mitochondria. The third has a density of 1.700 and is derived from proplastids. The fourth has a density of 1.69 and is derived from the nucleus.

Aharon Gibor reviewed the extensive literature on chloroplast inheritance which indicates that plastids with their DNA do not arise de novo but from pre-existing proplastids or plastids. From his ultraviolet microbeam experiments in which he irradiated the nucleus alone or the cytoplasm alone, it is deduced that the DNA of plastids does not arise from the DNA of the nucleus. Also in the case of *Acetabularia*, a large unicellular alga from which the nucleus can be excised, preliminary evidence suggests that the DNA of the plastids may be synthesized in the absence of the nucleus. Ultraviolet light selectively damages or mutates nucleic acids of the plastids; these mutations are inherited. This fact indicates that the coding for some biochemical properties of the plastid resides in the nucleic acids of the plastid.

David Luck, scheduled to discuss the heredity of mitochondria, was unable to attend because of weather conditions. According to his abstract, he would have shown that the mitochondria of a mold, *Neurospora*, do not arise de novo but increase by division from pre-existing mitochondria. The DNA of the mitochondria has been found to differ markedly in base composition from nuclear DNA, another indication that mitochondrial DNA does not arise from nuclear DNA. The functioning of DNA to make messenger RNA requires a DNA-dependent RNA-polymerase enzyme. This has been found in mitochondria.

Piotr Slonimski was also unable to attend. He would have reviewed the basic genetic work on mitochondrial inheritance in yeast. According to his abstract, electron microscope studies show the differentiation of yeast promitochondria into mitochondria; these changes are correlated with changes in respiratory enzymes during differentiation.

William Trager discussed the structure and heredity of the kinetoplast of trypanosomes. Whereas the DNA of mitochondria of most cells comprises about 1 percent of total cell DNA, the kinetoplast of a trypanosome may represent up to 20 percent of total cell DNA. In the vertebrate host, the parasite may be present in an intracellular anaerobic stage, the "leishmania form." In this form the cell contains an active lactic dehydrogenase and lacks cytochrome *c*. The kinetoplast is present as a small spherical body containing a dense clump of DNA. When this cell is transferred to the insect host, it becomes an extracellular parasite, the "leptomonad form." The kinetoplast then becomes transformed into an enlarged branched mitochondrial structure with numerous cristae; cytochrome *c* arises, an aerobic metabolism predominates, lactic dehydrogenase activity disappears, and the clump of DNA disperses as one might expect of DNA engaged in forming RNA. Trypanosomes which have a diminished clump of DNA in the kinetoplast, "dyskinetoplastic," can survive in the bloodstream of the mammal but cannot grow in the insect host. Apparently, a defect in the kinetoplast DNA prevents differentiation to a mitochondrial form active in oxidative metabolism.

A. Cecil Taylor reviewed the structure, function, and inheritance of centrioles and microtubules. Centrioles function in connection with the formation of mitotic spindles during mitosis, or with the formation of flagellae. The basic plan of a centriole is that of a cylinder with a diameter of 150 $m\mu$ and length of 500 $m\mu$. The wall of the cylinder is opaque and the center less dense. Embedded in the wall are nine clusters of three microtubules. Centrioles, when seen in pairs, are oriented at right angles to each other. In anaphase the base of the centriole produces a minute ring 70 $m\mu$ in diameter which represents the beginning or germinal bud of a new centriole. In the next prophase it will grow to size and from its new end will produce the microtubules of the aster, or the microtubules of the cilium. Glutaraldehyde fixation has permitted a detailed study of the structure of the microtubules. These are cylindrical fibers 15 to 25 $m\mu$ in diameter. (The variation may depend on fixation techniques.) The wall of the microtubule in cross section consists of about ten closely packed filaments each 6.5 $m\mu$ in diameter. Microtubules are also seen in the cytoplasm surrounding phagocytic vesicles, or close to the surface membrane, or protruding from the cell surface. It is not known whether all the microtubules are products indirectly resulting from the action of centriole DNA, or formed in part from the action of kinetochore DNA, or perhaps from similar bodies in the cytoplasm. Nor is it known what function these tubules play, although it is suspected they have to do with cytoplasmic movements.

Gerald R. Seaman discussed the kinetosomes of ciliated protozoa. These are granules at the basal end of ciliary shafts which replicate during cell division. They resemble centrioles of higher organisms. The kinetosomes have been found to incorporate tritiated thymidine. The kinetosomes have been isolated in the following manner. The cells are fixed in 40 percent ethanol and then treated with 1 percent digitonin in 0.4*M* KCl. The pellicle with its kinetosomes is removed by centrifugation and ground with quartz to release free kinetosomes which are then fractionated with ammonium sulfate. Kinetosomes contain 50 percent protein, 3 percent DNA, 2 percent RNA, 5 percent lipid, and 6 percent carbohydrate. The isolated kinetosomes incorporate labeled amino acids into protein. They will make two times their own protein in 3 to 4 hours. All of these facts may be considered as evidence that kinetosomes are self-duplicating cytoplasmic units.

Tracy M. Sonneborn told of a different kind of cytoplasmic inheritance not connected with any cytoplasmic organelle. This is the inheritance of a single RNA gene called a "metagon." A metagon is a messenger-RNA unit which is produced by a nuclear gene "M" in a paramecium. The metagon can be extracted and can infect a strain of *Didinium*, another protozoan. In the latter it can multiply indefinitely with a division time of 4 hours as if it were a virus. In the cytoplasm of paramecium the metagon multiplies very slowly. Thus there is a control of replication of the metagon in parameciums and a release from control in didiniums. The significance of this finding in terms of cytoplasmic

inheritance is: (i) there may be hereditary units in the cytoplasm that are not necessarily connected with organelles; (ii) these hereditary units may consist of only a single gene; (iii) the gene may consist of DNA or of RNA; and (iv) viruses with protein coats have been considered the simplest infectious agents. The metagon may be an example of the simplest infectious nucleic acid known, and its properties suggest a new area for investigation of disease-inducing agents.

In addition to the symposium lectures, the American Society of Naturalists was addressed at a luncheon by its president, Albert Tyler, on the topic "biology and chemistry of fertilization." This comprehensive review, illustrated by excellent electron microscope pictures of the steps in the penetration of the sperm into the egg and including a discussion of the biochemical sequences that occurred, was a fitting climax to a day replete with the revelation of new findings and ideas.

The symposium was a success as judged by the large audience and the active discussion that followed each of the papers presented. It is hoped that the symposium will appear in press in about 4 months in a monograph published by the American Society of Naturalists.

S. GRANICK, *Program Arranger*

Vertebrate Color Receptors

The Montreal meetings of the AAAS included reports (29 December 1964) of rapid progress in four laboratories toward the solution of the age-old problem of color vision. A key feature of the new work is the measurement of the effects of light on individual receptor cells. Paul Liebman (University of Pennsylvania Medical School) contributed the first paper on "Detection of color-vision pigments by single cell microphotometry—the method and its efficiency." He described incredibly sensitive recording techniques that have enabled the symposium participants to identify individual blue-sensitive, green-sensitive and red-sensitive cone cells of the kind predicted by Young, Helmholtz, and other 19th-century theorists. He made no attempt to minimize the difficulty of these methods. They require, first, that the cone receptor cell be separated from neighboring retinal units and placed in a favorable position to receive a test beam of light. This beam must come to a focal point less than one micron in radius in order to absorb the number of photons necessary for a rapid measurement of relative spectral sensitivity. The light-receiving element is a specially sensitive photomultiplier unit that permits a comparison of the beam traversing the cell with a reference beam nearby. The entire microspectrophotometer must scan the cell at a rate of about 10 mμ per second in order to avoid artifacts due to pigment bleaching or to uncontrolled movements of the cell. Some of the more successful experiments on goldfish cones reveal three basic classes with peak sensitivities in the blue, green, and red regions of the spectrum. Experiments on other receptor cells, including those of humans and infrahuman primates, have been carried out by P. K. Brown (Harvard), W. B. Marks (Johns Hopkins), and other investigators. With minor variations they also support the hypothesis of three classes of color receptor.

Edward F. MacNichol, Jr. (Johns Hopkins University) carried the analysis of color vision one step further. He reported on "Neural coding of color information in the retina." He and his associates have penetrated individual retinal cells with microelectrodes and recorded their activity in relation to colored light. An important feature of these experiments is the fact that the electrode location is pinpointed by the use of a dye-marking technique. In this way they have localized a region close behind the cone receptors in which diverse electrical responses result from stimulation by various colors of light. The response waves in this region are the S-potentials originally thought by Svaetichin to lie within the cone cells themselves. Even at this early stage in the color information channels it is found that complementary colors often produce potential waves of opposite electrical sign. This sort of color opposition was in fact predicted by Ewald Hering—and found unacceptable by other physiologists—nearly a century ago.

David H. Hubel (Harvard Medical School) described experiments conducted with Torsten N. Wiesel on "Interrelation of form and color in lateral geniculate cells of the rhesus monkey." Their microelectrodes also revealed opponent color responses, but these responses took many forms depending on the particular cell and the nature of the stimulus pattern. Their findings, all the more interesting because of the similarity of the rhesus to the human visual system, showed extremely complex interactive effects among cells in the "way station" between retina and cortex.

Finally, "An analysis of human color vision and color blindness" was presented by George Wald (Harvard University). He told of a kind of temporary color blindness that can afflict a normal human after exposure to intense light of certain wavelengths. He said a strong mixture of blue and red light, for example, has the effect of bleaching out the photosensitive pigments in the retina that are normally sensitive to these colors, so that only the third (green-sensitive) pigment remains active. The color vision that remains can be measured, and this gives a quantitative description of the green color mechanism of the normal eye. Intense lights of other colors can similarly be used to isolate the red or the blue color mechanism, and these results can be compared with the light absorption measurements on single cone cells. The various forms of color blindness can be understood as forms of dichromatism or two-color vision in which there is either a loss (achromia) of one of the three types of color mechanism or a fusing (dyschromia) of two of them.

Clarence H. Graham (Columbia University) was chairman. He closed the symposium by pointing out that the new techniques for measurement of color responses have emphasized the wisdom of the old "zone" or "stage" theories. These theories maintain that no single concept accounts for color discrimination but that selective absorption by particular pigments at the receptor level is followed by processes of opposition and enhancement at higher levels. The successful measurement of single-unit activity at all levels has provided a new understanding of the phenomena of human color vision.

Immediately before the symposium, Lorrin A. Riggs (Brown University; vice president of the AAAS and chairman of the Psychology Section) described his experiments in which electrical records were made of the ways in which the human eye responds to different forms and colors.

LORRIN A. RIGGS, *Program Arranger*

Cognitive Processes and Psychopathology

The Academy of Psychoanalysis held its second joint meeting with the AAAS in Montreal, 26–27 December; the meeting was cosponsored by the American Psychiatric Association and section N, Medical Sciences. The impetus for this symposium arose from the upsurge of interest in cognitive processes, the greater knowledge available from diverse sources of investigation, and the implications of such knowledge for the theory and practice of psychotherapy.

Harley Shands (Downstate Medical Center) stressed the timeliness of this endeavor. A signal achievement of Freud was to point out that the processes of human intellectual functioning are as subject to basic involuntary regularities as are the processes of physiology. His emphasis upon the unconscious was part of a general movement that reached another high point in Cannon's concept of the "wisdom of the body"; both these systems emphasize the adaptive nature of automatic processes characterized by regularity, with emphasis upon the very slight degree of conscious control that the human being can exert over his own "machine."

The psychoanalytic movement has tended to emphasize the affective component of these processes much more than the intellectual one, following an outbreak of anti-intellectualism early in this century. This trend concerned itself with the demonstration of deterministic movements in many fields of science, with the complete dismissal of teleology and the triumph of cause-effect thinking.

In recent years there is much evidence of cyclical movement in the other direction, which is apparent in the development of computers. The communications engineer now embraces the concept of purpose in the design of his machine; many apparently affective processes of decision-making can be imitated by efficient use of the purely "intellectual" potentials of the computer. Evolutionary trends in biology are further enlivened by the demonstration that even a simple data-processing instrument like Walter's *Machina speculatrix* can show unpredictable behavior.

From a totally different source, Shands continued, Piaget has demonstrated that a purely cognitive system of "genetic epistemology" can be constructed which has remarkable implications for the understanding of sequential changes in human development. In marked contrast with most psychological systems, Piaget's relies upon a conception of adaptation borrowed from biology; this concept is entirely divorced from the central notion of motivation which afflicts most psychological systems with a voluntarism that entirely contradicts the basic idea of the unconscious. Using the idea of motivation introduces an insoluble contradiction into psychological theory in somewhat the same way that the idea of creation introduced an insoluble conflict into biology.

All of these considerations have obviously important implications for psychotherapy, the concept of thought-disorder as the pathognomonic feature of schizophrenia, the use of computer technology, and the influence of computer theory on psychiatry, as well as the nature and structure of psychoanalytic theory itself.

The program that followed was built around four main presentations highlighting contributions from psychoanalytic theory (Silvano Arieti, New York Medical College), holistic theories of psychopathology (Eugenia Hanfmann, Brandeis), information theory (J. G. Miller, University of Michigan), and genetic psychology (Barbel Inhelder, University of Geneva). These subthemes were further developed by panels representing many behavioral disciplines.

Arieti reviewed the contributions of Freud and of the Freudian school and went on to consider more recent psychoanalytic contributions. Despite the historical importance of Freud's discovery of two modes of thought, further progress toward the understanding of cognitive processes was blocked by concern with primary process as an expression of unconscious motivation. Subsequent studies were conducted within a framework of energetics rather than cognition; this also appears true for the more recent contributions to ego psychology which tend to bypass a direct concern with cognitive forms and mechanisms. Arieti stressed the importance of the microgenetic (Werner) dimension (the immediate sequence of necessary steps inherent in the occurrence of a psychological process) and the prior apprehension of objects in terms of parts rather than as wholes.

In discussing preverbal levels of cognition, he outlined the stages from exocept (sensorimotor thinking) to the image (early symbolization) and the endocept (imageless thought or preconscious thinking). Thinking at this stage is characterized by adualism (Baldwin), the inability to distinguish between inner and outer reality. With the acquisition of language, the jump to paleologic or prelogic occurs and is organized along the lines of establishing identity upon the basis of identical predicates rather than on the basis of identical subjects. On conceptual thinking, Arieti emphasized the degree to which cognition has been underestimated as a psychodynamic factor owing to emphasis on the primitive and the unstructured.

The panel focused on the historical relevance of Sullivan's contribution to cognitive theory (Rose Spiegel, William Alanson White Institute), the importance of the work of Sapir and Langer in understanding the hierarchic structure of cognitive processes (M. R. Green, William Alanson White Institute), and the need to consider the totality of the cognitive situation in its motivational, social, and communicative aspects as well as in its logical and perceptive aspects (J. P. Spiegel, Harvard Medical School). Also discussed was the danger of developing theories of human behavior based on an objective zoomorphism, that is, a point of view that overlooks the manifest differences between subhuman and human behavior, minimizing the role of symbolic activities in the life of man in favor of emphasis on the gratification of primary drives (Ludwig von Bertalanffy, University of Alberta).

Eugenia Hanfmann's paper outlined the contribution to cognitive theory of a holistic viewpoint, as exemplified in the work of Andras Angyal. This work further developed the concepts of autonomy and homonomy (mastery and love), the biosphere (the totality of subject-object interactions), the logical properties of systems, and the understanding of part functions in the light of organizational principles governing the whole. A neurosis itself is a system, a complete way of life, an organization with its own vitality. Basic to the neurosis is the state of partial isolation from the world. "The world that can be neither mastered nor communicated with remains alien and threatening." Growth potential becomes diverted to the maintenance of the iso-

lation, said Dr. Hanfmann. Health and neurosis are viewed as two dynamic *Gestalts* organizing the same material, each according to its own system principle and each competing for dominance. The possibility of each personal event having a double meaning, depending on whether it takes place within the *Gestalt* of health or of neurosis, is referred to by Angyal as the principle of universal ambiguity. The intraorganismic struggle is not between ego and id but between two incompatible orientations, two major ways of adapting to life, Hanfmann continued. Cognitive incapacity in the child leads to failure in differentiating appropriate distinctions concerning traumatic stimuli, and hence predisposes the child to premature and ill-adaptive generalizations.

E. A. Weinstein (Washington School of Psychiatry) took as a point of departure the importance for any study of behavior of defining the relations between language and the physical world. Dynamic psychiatry, with its own unifying tendency to connect words with things or events, often bypassed the more appropriate search for meaning within the current context. Weinstein drew attention to the congruence of Angyal's thought with that of Mead and Sapir, all of whom regarded perception and emotion as cognitive processes; both Sapir and Angyal believed that it is not drives and wishes of which one is aware but of the organizing principles. Another approach to an evaluation of holistic theory was made by Joseph Barnett (William Alanson White Institute), based on examination of the conceptual structure of psychoanalytic theories through consideration of their definitional bias: atomistic theories define segmental entities, for example, they define drives as causes (Freud); holistic theories define global entities (Angyal, Horney, Adler); experiential theories define action and process (Sullivan). Holistic theories tend to reveal a consistent cognitive bias; they emerge in a terminology emphasizing the cognitive posture and style (life style, character armor, identity, *Gestalt*) and cognitive operations (abstraction, generalization, learning). Clinical studies were introduced by D. A. Bloch (Jewish Board of Guardians), illustrating how cognitive processes as a kind of "permissible calculus" define and structure the permissible world of the child.

Computer analogies as well as the relevance of general-systems theory and of information theory were introduced by Miller in a comprehensive historical survey and contemporary review of both lines of investigation. The validity of a general-systems approach rests on the sharing of a common environment, a genetic chemical source in protein, and the existence of formal identities indicating similar functional arrangements. Miller then dealt more specifically with the concept of information as the nonrandom patterning of matter and energy. He outlined the lines of congruence between the many categories of information-processing subsystems (input transducer, channel, decoder, learner, memory, decider, encoder, output transducer) and the subsystems involved in the general processing of matter-energy. He introduced the concept of information-input overload and the various adjustments that can be made to overload (omission, queuing, filtering, approximation, multiple channels, escape), and described some of the suggestive analogies to mechanisms of defense.

Joseph Jaffe (Columbia University) confined his remarks to systems at the level of small groups, the chief concern of the clinical psychiatrist. He outlined an area of psycholinguistic research in which redundancy estimates of verbal coding are utilized as an index of relatedness (cognitive congruence, social distance) between interacting speakers. Ulric Neisser's (Brandeis) discussion raised questions concerning the adequacy of the computer model to deal with the problem of motivation. He suggested that, in cognitive theory and information theory, motives arise only to explain a state of input, whereas in dynamic theory one starts with motives and purpose and then studies their vicissitudes. Seymour Papert (Massachusetts Institute of Technology), dissenting, dwelt on the role of the computer in suggesting certain ways of thinking and in uncovering the processes involved in the operation of intelligence. Papert suggested that questions of motivation cannot in principle be set apart from investigative work with computers, and that the proper role of cybernetics will be to provide the kind of abstract and formal framework out of which a greater abundance of useful models will emerge. Shands emphasized the contextual, transactional, and developmental aspects of the transfer of information. Information is always contained in a context and the amount transferred always relates with a given transactional background; he referred to the treatment process as "enhancing colinguisticity."

In the final session on developmental aspects of the problem, Inhelder described new directions taken by the Geneva School in studies of the reasoning of mental retardates, of cases of senile dementia, of children and adolescents of the "pre-psychotic" type, and of dyspraxic, dyslexic, and dysphasic children. She reviewed the basic contributions of Piaget and his collaborators on the evolution of cognitive activity in ordered stages, an evolution manifested in the formation of operations of thinking. These operations originate in the sensorimotor activity of the infant and culminate at adolescence in integrated structures which are partially isomorphous with formal logic.

An operation is defined as an action capable of occurring internally and of being reversible. Notions of conservation (for example, the invariability of quantity of matter) can develop only on the basis of such reversibility. Inhelder differentiated the operative aspects of thought from the figurative aspects which pertain to symbolic imagery and language. In the interplay between these two aspects, cognitive operativity influences the formation of symbolic imagery by establishing meaning; once the figurative signifiers have been developed, they in turn favor the acquisition and fixation of further information. Reproductive imagery is transformed into anticipatory imagery by virtue of the mobility achieved under the influence of operative thought. Experiments clearly indicate the close parallel between the use of language and the operational behavior of the child in conservation tasks. Just as images become mobile and adequate, language becomes economical and structured under the impact of operational progress.

Brief reference was made to current investigations of pathological phenomena. In the case of retardates, reasoning is characterized by the blocking of operational activity at different stages of development; sequences in development occur at a slower pace and traces of previous levels remain.

The deterioration of thought processes seen in patients with senile dementia corresponds with those of children at certain levels of development,

ranging from some impairment in formal reasoning to the more severe breakup of operativity. On the basis of observations of prepsychotic children and their tendency to assimilate stimuli in an egocentric manner, it becomes obvious that development of operativity depends not only on internal regulations, but requires a motivational force directed toward the adaptation to reality. These studies have supported the general dictum that pathological phenomena of thought become more comprehensible when analyzed in developmental perspective. They have shown that operational construction, although it directs the progress of symbolism, is relatively independent of its symbolic support. The fact that cognitive operations disintegrate in an order that inverts their evolution suggests that development of operativity is an integrational process.

Certain difficulties in relating the Piaget system to clinical problem areas were explored by E. P. Dulit (Albert Einstein College of Medicine). The two specific issues he raised had to do with: the relative lack of emphasis in Piaget's work on the concept of heterogeneity, that is, the coexistence at one time of functions on more than one level; and the need to differentiate between the static imagery of which Piaget speaks and the creative role of imagery in the life of the adult. Both issues appear to derive from Piaget's primary interest in genetic epistemology, rather than from totality of the child's experience. Dulit took exception to Piaget's analogy of motivation as the motor which runs a movie camera; he pleaded for understanding of the kind of model that would enable us to understand more adequately how motivational and cognitive processes interdigitate.

E. H. Auerswald (Wiltwyck School for Boys) spoke of the relevance of the conceptual scheme of Piaget and Inhelder to the dysocial behavior traditionally considered as disorders of ego: crime, delinquency, alcoholism, and drug addiction. One prominent finding from studying the families of delinquents was the very striking deficit in conceptualization common to all members of a family. Parents were often unable to express well-differentiated concepts of space, weight, size, volume, or shape; they were equally lacking in concepts that allow for the organization of time into sequential events. The children in turn live in the actions of the moment, not in thought, as if they had failed to develop the cognitive tools to enable them to reason before acting; they also appear to lack capacity to generalize experience by analogy and to categorize past experience in a way that makes meaningful the relations between past, present, and future. This appears to be a situation in which social phenomena account for the deficit in operativity.

B. Kaplan (Clark University) briefly compared the genetic psychology of Piaget and the comparative developmental approach of Werner, emphasizing the latter's early interest in psychopathology and his search for underlying archetypal patterning that applies to the pathological as well as to the normal. Multiple modes of personality organization are comprehended under a unitary principle, and pathology may be ultimately resolvable into two archetypal forms: a pathology of the understanding and a pathology of the imagination.

Shands, despite admiration for the Piaget system, also indicated its shortcomings in terms of meaning to the clinician. He referred to it as an ice palace of marvelous theoretical insights which manages to freeze the people out rather comprehensively. Piaget's studies are specifically oriented along developmental lines, whereas the problems confronting the clinician involve understanding of the particular maneuvers into the future that characterize the behavior of patients.

MONTAGUE ULLMAN,
Program Chairman

Pest Control: Chemical, Biological, Genetic, and Physical Means

The 1964 meeting sponsored by Section O (Agriculture) of the American Association for the Advancement of Science was held on 27, 29 and 30 December 1964. Because of continued public interest in pest-control problems, a symposium consisting of six half-day sessions was developed so that leading authorities in the field could discuss the merits and potentialities of the various means whereby pests, both invertebrate and vertebrate, might be controlled. Of the various methods currently employed for the control of pests, conventional type pesticides constitute the chief means for controlling pests of agricultural importance.

The problem we face in the use of pesticides for the control of the many pests that affect our economy, our health, and general well-being can be briefly stated by quoting a paragraph from a special address delivered by Nyle C. Brady (U.S. Department of Agriculture):

> We cannot live without pesticides in this intensely developed man-made society of ours. We could not maintain our agriculture, our health, or our present high levels of comfort and living. But, we are finding it increasingly difficult to *live* with pesticides.

The recognition that we must maintain effective pest-control procedures and at the same time strive to achieve control with a minimum of adverse side effects to man and his environment has led to an intensification of research efforts on more selective chemical pesticides and on various other approaches to pest control. Such research emphasizes the development of procedures that will avoid or minimize certain risks and side effects that are inherent in the use of broad spectrum pesticides.

It is generally recognized that biological agents, including parasites, predators, and disease organisms, play major roles in keeping many potential pests under natural control. How to use these natural control agents more effectively was the subject of discussion in two of the six sessions in the symposium. The application of genetic principles in the breeding and selection of crop varieties which resist or tolerate attack by pests represents another of the important means of pest control, especially diseases of agricultural crops. Accordingly, several topics dealing with breeding of plants and animals for resistance to pests and diseases were included. Suitable equipment is an essential part of the effective and efficient use of pesticides, and for applying cultural measures for the control of weeds and other pests. Thus engineering principles play a vital part in the application of pest control measures. Insects and other pests respond to various physical phenomena, such as light, other electromagnetic radiations, and sounds, thereby offering opportunities for pest control by such physical forces. One of the six sessions was devoted to a consideration of physical means for pest control.

The symposium brought together outstanding scientists having competence in several broad scientific dis-

ciplines. The scientists included entomologists with different areas of specialization, plant physiologists, chemists, plant and animal pathologists, nematologists, plant and animal geneticists, wildlife biologists, and agricultural engineers. The problems of pest control are so varied and complex it is essential that there be interdisciplinary cooperation and coordination of efforts by scientists in the different disciplines and in various agenices in order to obtain the information required to develop and put into practice effective and acceptable pest control measures. This was pointed out in a special address delivered by Robert Glen (Canada Department of Agriculture, Ottawa).

In considering the role that pesticides will play in the future and the kinds of pesticides that will meet requirements for both effectiveness and safety, members of the panel on chemical means of pest control, led by A. W. A. Brown (University of Western Ontario, Canada) were in full agreement that pesticides of the future must possess a high degree of selectivity in action against the target pest species. This was the central theme of the reports by R. L. Metcalf (University of California) who discussed insecticides; W. C. Shaw (U.S. Department of Agriculture) who discussed requirements for herbicides of the future; and W. W. Dykstra (U.S. Department of the Interior) who spoke on the role of chemicals for the control of vertebrate pests. Selectivity in action might be achieved by developing chemicals that possess a high degree of specific action on the part of the toxicants for pest species to be controlled or by achieving a high degree of selectivity in the placement and use of the chemicals employed. As pointed out by W. M. Carleton and R. D. Brazee (U.S. Department of Agriculture), more basic information on the behavior of particles and improvements in equipment for efficient application of pesticides could contribute materially to safer use of pesticides. G. L. McNew (Boyce Thompson Institute for Plant Research) emphasized the need for basic research on the mode of action of chemicals in the plants so that materials will be more versatile and adroit in their effect in the control of plant diseases than those now in use. D. E. Howell (University of Oklahoma), an authority on external parasites of livestock, pointed out the need for selectivity in action of insecticides against the parasite without harming the host or without leaving residues in the animal tissues. The importance of nematodes in plant production was related by J. M. Good (U.S. Department of Agriculture). He reviewed the progress that has been made in the development of nematocides that will effectively control those pests, the importance of which are just now being fully recognized.

R. L. Doutt (University of California) presided over the two sessions devoted to a consideration of pest control by biological means. Insect parasites and predators play major roles in regulating the abundance of pest species. B. P. Bierne (Canada Department of Agriculture) outlined ways in which the natural biotic agents might be made more useful. The great potential that microbial agents, especially the viruses, can play as highly effective and safe ways to control insects was discussed by A. M. Heimpel (U.S. Department of Agriculture). According to G. C. Papavizas (U.S. Department of Agriculture) biological agents might also be expected to play more important roles in the future for controlling plant diseases and nematodes. L. A. Andres (U.S. Department of Agriculture) discussed the role that insects and other natural enemies can play in the control of certain noxious weeds.

The session on genetic means of pest control was led by M. G. Weiss (U.S. Department of Agriculture). The substantial progress made over the years in meeting plant disease problems through the efforts of plant breeders and plant pathologists was discussed by R. M. Caldwell (Purdue University), one of the leading authorities in this field. He reviewed the progress in plant disease control by genetic means, which has resulted in savings of hundreds of millions of dollars annually to our agricultural industry. The opportunities for further progress in this desirable approach to plant disease control was stressed. R. H. Painter, the nation's leading authority on plant resistance to insect damage, shared the enthusiasm of Caldwell and cited examples of outstanding progress in the development of plant varieties which resist damage by insects. A. E. Kehr (U.S. Department of Agriculture) also cited a number of successes in meeting plant nematode problems through plant breeding for resistance or tolerance to these destructive pests.

The many factors that must be considered and weighed in determining the role that animal breeding for resistance to diseases and parasites might play in meeting disease and pest problems was discussed by James Smith, who delivered the paper on this subject prepared jointly with R. E. McDowell (U.S. Department of Agriculture).

The symposium on the various means of dealing with pest problems in the future included reports of recent progress on various new and novel ways to control or regulate pest populations. Morton Beroza (U.S. Department of Agriculture) cited examples of recent success in employing naturally occurring or synthetic attractants that are highly specific in attracting insects. Many insects produce natural pheromones that attract one sex to the other for reproduction. Recent advances in chemical technology offer new opportunities for extracting and identifying and eventually synthesizing these natural, highly active and highly selective materials for use in insect detection and control. The sterility principle of pest control offers a new approach that could lead to practical ways to control certain insects. The progress that has been made and the opportunities for the future in applying this principle for insect control or eradication was discussed by L. D. Christenson (U.S. Department of Agriculture). This new principle of pest control may also have application in regulating the abundance of vertebrate pests. D. K. Wetherbee (Massachusetts Cooperative Wildlife Research Unit) discussed the progress in developing geneticides and other reproductive inhibitors as a means of regulating the rate of reproduction in populations of birds, mammals, and other vertebrates that may become pests in various situations.

Electromagnetic energy is now playing only a minor role in pest control. However, as brought out in the session on physical means of pest control, led by Ronald Paugh (General Electric Company), the use of sound, especially the use of recordings of distress calls, is being employed for repelling certain birds from specific areas. This was brought out in the paper presented by S. O. Nelson (U.S. Department of Agriculture). He also discussed the role that gamma and other radiation might play in the future for destroying insect pests in stored products. The role of light ra-

diations for insect detection and control was reviewed by F. R. Lawson, who also reported on research conducted by him and his associates of the U.S. Department of Agriculture. The highlight of this report was the success achieved in reducing populations of the tobacco hornworm by large-scale trapping experiments in which several hundred black light traps were used over an area of more than 100 square miles (260 km^2). Another observation reported by Lawson which may have great significance was the marked increase in catch of male hornworm moths in light traps when unmated female hornworm moths were caged in close proximity to the light traps. Electromagnetic radiations in the infrared and far red regions of the spectrum may provide the chief means of communication between insects of a given species in connection with reproduction, according to a theory advanced by P. C. Callahan (U.S. Department of Agriculture). He also expressed the view, with supporting data, that radiations given off by host plants or animals may represent the means whereby certain insects locate their host plants or animals. The theories advanced by Callahan should stimulate research on the influence of electromagnetic radiations on insect responses and behavior.

The symposium on pest control by chemical, biological, genetic, and physical means was broad in scope. Twenty-four topics were presented. These topics encompassed the research efforts now under way to develop almost every conceivable approach to the control of pests. The material presented clearly showed the desire of scientists with many agencies to obtain new information which will serve as a basis for maintaining and improving on the great advances that have already been made in meeting pest problems and at the same time assuring the achievement of this objective without undue risks to man and his environment. There is reason for optimism that significant progress can be expected in the practical development of various alternate ways to control pests. In all probability many major pest problems will also be met more effectively and safely in the future by properly integrating different systems of pest control.

E. F. KNIPLING, *Chairman*

Reports of Sections and Societies

General Sessions

Possible Meteoric or Lunar Influences on Meteorological Phenomena

The interdisciplinary symposium on possible meteoric or lunar influences on meteorological phenomena (sponsored not only by the Physics (B) and Astronomy (D) Sections of the AAAS but also by the American Geophysical Union, the American Meteorological Society and the American Astronomical Society) advanced convincing evidence that (i) active freezing nuclei, with important meteorological consequences, are present in the lower atmosphere in spectacularly varying quantities, and they descend to the lower atmosphere from space or at least from an abundant reservoir at heights above 25 km, and (ii) lunar tide-producing forces manifest themselves as small but statistically significant changes in heavy rainfall frequencies at widely separated terrestrial stations.

E. Keith Bigg described experiments to ascertain the origin and properties of freezing nuclei important in many cloud physical processes. The original "Bowen hypothesis" on the influence of meteoric dust on rainfall called for 10-μ particles capable of falling from high to low levels of the atmosphere in about 30 days. Bigg's work on actual particle collection reveals, instead, particles largely of submicron size which vary abruptly in concentration by factors of as much as 1000 times. The "ice nucleus storms" show no simple or consistent relation to local dust sources or small-scale surface weather conditions, nor are there decreases in numbers of freezing nuclei evident at greater heights. In fact, there is some evidence for substantial increases in volumetric concentrations above 27 km, and thus above the "ammonium sulfate layers" of Junge where freezing nuclei appear likely to be coated over with the soluble sulfate, and rapidly destroyed in freezing effect unless they can be transported rapidly downward.

Recent Australian experiments seem to suggest that just such rapid vertical transport may indeed be responsible for the large pulses of freezing nuclei often found at lower levels.

Glenn W. Brier presented results of work done in collaboration with Donald A. Bradley and Max A. Woodbury which convincingly demonstrates a small but real influence of lunar tides on the frequency of occurrence of heavy rainfall. Using data from 1871 to the present, these painstakingly careful studies seem, on very conservative statistical grounds, to confirm the reality of an effect tending to produce greater frequency of heavy rainfall a few days after new moon and full moon in the lunar month—for all months and locations. Brier cautioned, however, that the effects involved represent only small perturbations on the average variability of rainfall. Thus, no matter how well established, they cannot at present add more than a minor additional factor to the prediction, for any given day, of the prospect of rainfall or for the magnitude of the expected fall. They are, however, of great significance to the understanding of the mechanism of large scale meteorological phenomena.

WALTER ORR ROBERTS,
Program Chairman

Symposium on Medical Geology and Geography

Seldom can five people with such different backgrounds enjoy exchanging their experiences and points of