we *fight* in the midst of applied science, and with the tools and weapons which applied science has given us. This is certainly not the *fault* of science; neither does the responsibility for correcting the situation lie solely at the door of science. It is a problem as broad as society itself, and while the scientist very assuredly ought to have helpful suggestions which he can offer, he ought for his own sake to be cautious in delivering himself of panaceas. Perhaps our position is somewhat analogous to that of the chemist who synthesizes a new narcotic—he stands ready to advise regarding its making and its properties but leaves the matter of control in the hands of society through its appointed agents. To push the analogy farther than this would, I am afraid, be to risk the danger of overworking it. The narcotic problem is absurdly simple compared to that involved in the wise assimilation of science; more particularly the beneficent uses of the narcotic may be vanishingly small compared to its potentialities for harm, whereas we hope—perhaps we are incorrigible optimists in such hoping—that the contrary is true of science.

It is quite apparent that the administration of science has two very distinct aspects—one the national, the other the international—and that no competent agencies exist for dealing with either. This situation would on the whole appear to be a fortunate one. Certainly nothing could be more inimical with respect to future progress than an over-developed administrative agency which is insufficiently guided by wisdom, experience and accurate analysis of the problems to be met. Fortunately the affair is still largely fluid and such attempts at crystallization as have been made have as yet had little effect. But let us not drop into a state of indifference as a result of this. While we need scarcely fear that we are confronted at the moment with a condition of supersaturation or of supercooling, we must not forget that the National Academy bears a double responsibility. It is at the same time spokesman for the sciences collectively and the chief scientific adviser to the government. This, in itself, makes our position one calling for careful study. In the words of Pooh-Bah, the Lord High Everything Else, we may, as official representative of American science, declare in favor of untrammeled liberty for fundamental and applied research; or we may, as Lord High Councilor on Science to a Government which for a complex assembly of reasons and motives is drifting in the direction of socialization, make suggestions which might urge on the present drift.

Now, when I say that *we may* do these things, do not misunderstand me. I do not wish to imply that we ought to feel a special urge to do them now or even within perhaps the coming decade, nor do I mean to imply that we will so soon as this be asked for our advice upon this exceedingly complex matter. My thought is one solely of preparedness. There is abundant evidence that for a considerable period of time the tide has been drifting in the direction of increased intermeshing of social forces and increased centralization of control, and that the causes for the tide appear such as to suggest that as yet we have by no means reached the high-water mark. If this hypothesis is true—or, better, if it is not definitely known to be untrue—then I suggest that it is incumbent upon us, both because we are scientists and as such are eager to preserve the liberties of science, and because we are chief scientific adviser to the Federal Government and, therefore, in duty bound to give unprejudiced advice to this agency of the people as a whole, to give heed to the tide. In some way we must merge our collective talents so that to whatever extent is humanly possible, we will arrive at a long-range broad-visioned forecast of the sociological significance of our specialities when taken collectively and when integrated—as is steadily being done—into the fabric of our daily lives.

Let me caution again that I do not visualize this task as one which we can assume at a given moment and conclude at an equally definite but later moment. It is one with which, as I see it, we must be reconciled to living through the years to come. The objective of the present day will have been achieved if we accept the reality of the problem and regard it as one demanding conscious analysis and constructive thought to a degree greater than we as a body have accorded it in the past.

In conclusion, I return again to the adage of the shoemaker. We are all specialists and each must stick to his last. At the same time, as an Academy we are a single, although composite, expert, and as such we should be in possession of faculties at least as comprehensive as are anywhere else attainable. The future, even more than the present, promises to require cooperative effort—and in this problem, which we might denote as the socialization of science, we meet in transcendent form a challenge to our collective talents.

FRANK B. JEWETT

ABSTRACTS OF PAPERS

The sensory cortex of the chimpanzee's brain: J. G. DUSSER DE BARENNE (introduced by W. R. Miles). Local strychninization, *i.e.*, strychninization of a few square millimeters, of the sensory cortex of an anesthetized animal results in typical changes of the electrical activity of this cortex, *i.e.*, the appearance of large and rapid voltage fluctuations, *strychnine-spikes*, in its electrocorticogram. These spikes not only appear in the electrogram taken at the site of strychninization but also in the electrograms from areas functionally related to the strychninized area. In this way it is possible to delimit the sensory cortex in the anesthetized animal. Thus, in collaboration with Dr. W. S. McCulloch, the location and extent of the chimpanzee's sensory cortex was determined. It proved to be a very large region, located both in front and behind the

fissura centralis and subdivided in three major subdivisions: a face-, and arm- and a leg-area.

Rhythmic electrical discharges from nerve cells in relation to their respiration: HUDSON HOAGLAND (introduced by W. S. Hunter). Most nerve centers of both vertebrates and invertebrates show rhythmic voltage fluctuations at frequencies ranging roughly between one and thirty per second. The regular sinusoidal "alpha" brain waves (Berger rhythms) of about ten per second recorded from large areas of the human cerebral cortex furnish an outstanding example of the phenomena. It is probable, from what is known of other cells, that brain cells produce potential gradients as a by-product of their respiratory metabolism. These may be of the nature of diffusion potentials across the cell membranes which possess definite electrical impedance and which discharge when the potentials reach a critical value. In such a system the discharge frequency would depend on the speed with which the metabolic factor can load the capacities of the cell walls to their critical firing potentials. The absolute frequency would thus be determined by the rate of cellular respiration *and* by the electrical impedance of the cell walls. If this last be statistically constant for a particular group of cells under the conditions of the experiments the *frequency* should parallel and be a measure of changes in cortical respiration. To test this hypothesis of the mechanism of brain waves a number of studies have been carried out by the writer and his collaborators. Metabolic stimulants such as dinitrophenol and thyroxin increase the frequencies of alpha waves. Markedly lowering blood sugar, thus depriving the brain of its principal fuel, or markedly lowering the brain's oxygen consumption slows alpha frequencies. Studies of the effect of temperature on the frequencies of brain waves and, *in vitro,* temperature studies of the kinetics of simple enzyme systems known to be functional in brain respiration have furnished information as to how one or the other of the links in the chemical chain constituting cortical respiration may act as chemical pacemaker or master reaction. Under certain conditions, for example, we have been able to show that the dehydrogenation of succinate may be the pacemaker step; in other conditions it may be the cytochrome oxygen activating link. This work has been applied specifically to the analysis of chemical pacemaker changes in advancing brain syphilis (general paresis).

The acquisition, extinction and spontaneous recovery of a conditioned operant response: C. H. GRAHAM and R. M. GAGNÉ (introduced by W. S. Hunter). This study has been concerned with an analysis of the changes in strength of a conditioned operant response which occur as functions of reinforcement, non-reinforcement and spontaneous recovery. The apparatus consists of a simple runway, at one end of which is a starting-box and at the other end a food-box. The measure of response which we have used is termed the latent period. This is defined as the time taken by the animal to leave the starting-box before traversing the runway to food. The latent period for twenty-one male white rats was measured in fifteen reinforced trials, with a constant interval of 75 seconds between successive trials. A curve of acquisition is presented, revealing a response which begins with a log latent period value of 1.85 (corresponding to 71 seconds) and falls off with negative deceleration to reach a log value of 0.45 (2.8 seconds) at the fifteenth trial. The curve exhibits a nine-fold change in latent period from the second to the fifteenth trial. Changes in the latent period of response during extinction were recorded in forty-one rats, the trials being spaced at the same constant 75-second interval as in acquisition. The process of extinction is depicted in a curve showing the change in latent period of response during five unreinforced trials. This curve begins at a log latent period value of about 0.40 (2.6 seconds) and rises with negative acceleration to a log value of 1.33 (21 seconds). Thus during extinction the magnitude of the latent period increases in the ratio of nine to one. Spontaneous recovery of the response was measured after extinction had proceeded to a criterion of a 3-minute latent period. Recovery was tested in twenty rats, five at each of four recovery intervals of no stimulation. The intervals used were 1 minute, 3 minutes, 6 minutes and 10 minutes. The progress of spontaneous recovery in these intervals is shown in the form of a graph. Recovery is rapid during the first three minutes, but after 6 minutes the rate decreases rapidly. The recovery after 10 minutes is not complete, as indicated by the fact that latent period is still of the order of 35 seconds. A theoretical discussion of the results is presented. This considers changes in an internal condition of excitation which may account for a number of the processes involved in conditioning.

Experimental modification of the polarity potential of the human eye: WALTER R. MILES. The steady potential existing between the anterior and posterior poles of the eyeball has been measured by means of electrodes applied to the skin on either side of the eye. When the eye is turned the cornea is brought nearer to one electrode, which then becomes positive, while the other is negative. The potential registered under standardized objective conditions shows a rather steady value for a given individual but is influenced somewhat by the subjective factors of apprehension and relaxation. The present report considers the possibility of temporarily modifying the steady potential of the eye. For this purpose small amounts of sodium chloride solution were instilled into the conjunctival sac. Shortly after this application of hypertonic solution to the anterior portion of the eye a marked increase in the eye potential was found present and persisted for several minutes. The change, studied on 18 young women, showed an average increase which amounted to two times the standard deviation of the pre-salt mean value and is thus a highly reliable indication of an induced modification of the polarity potential. In some instances the hypertonic salt solution gave rise to a second phenomenon which may be interpreted as a "diffusion potential." This occurred when the eye was turned 30° laterally from the primary line of regard, and a part of the salt-soaked sclera thus came into contact with tissue of lower salt content. Diffusion potentials of this character were also found in rare cases (out of a population of 200 examinations) occurring spontaneously without the experimenter having instilled hypertonic solutions.

The theory of the visual threshold. W. J. CROZIER (introduced by W. S. Hunter). The physical interpretation of data of sensory excitability necessarily implies a theory of the nature of the effects responsible for threshold discrimination. The common assumption, sometimes only implicit, has been to the effect that in visual performance, for example, threshold effects are equal or equivalent. That they are really equivalent in any meaningful sense has never been demonstrated. A detailed examination of human visual thresholds ("absolute" and relative) shows that the interrelationships among the effects due to such variables as area, exposure time, intensity and wavelength, at a number of retinal locations, are such as to demonstrate that in homogeneous data the form of the quantitative dependence of the threshold intensity upon any one of the other variables depends upon the magnitudes of the rest. Before it can be attempted to provide a coherent account of the nature of the neural disturbance at the discriminatory threshold, means must be found for analytically separating the specifically statistical properties of the relevant elements of neural action from those which may reveal the physico-chemical character of the excitatory and discriminative processes. Indications can be given as to the directions which such analysis may take. The interrelations of time and intensity provide one illustration of the role of purely statistical considerations. It does not seem profitable to regard the data of intensity discrimination under fixed conditions as in general resulting from a physically fixed quantity of sensory disturbance.

Localization of response in the cochlea as determined by electrical recording: E. H. KEMP and PARKER JOHNSON (introduced by W. S. Hunter). Electrical responses from the cochlea of the guinea pig were studied by means of an amplifier, a cathode-ray oscillograph and a wave-analyzer. The guinea pig was anesthetized with dial and urethane, put under artificial respiration and placed in a "sound-proof" room. A beat-frequency oscillator, attenuator and speaker provided tones which were delivered to the ear of the guinea pig through a rubber tube and a speculum which had been sewed into the external meatus. The cochlear response to frequencies of 100, 200, 400, 600, 1,000, 2,000, 4,000 and 6,000 cycles per second was recorded from selected positions on each turn of the cochlea. For each frequency a series of intensities was used and a log response—log relative sound intensity curve obtained. From these curves the relative intensity of sound of each frequency necessary to elicit a response of three microvolts was determined for each recording position. The data obtained make it possible to construct a map of the cochlea which meets the requirements of the place theory of audition, and which confirms a map of the cochlea previously constructed by Culler from data obtained by a somewhat different method.

The effect of direct current stimulation on the contractions and the electrical behavior of the oyster heart: IVON R. TAYLOR and EDWARD M. WALZL (introduced by C. A. Kraus). The makes and breaks of a direct current (4–13½ volts), applied to the ventricle of the excised, perfused oyster heart, were timed to occur at certain phases of the cardiac cycle as the mechanigrams and electrograms were recorded simultaneously. An action potential, due to a propagated wave, was produced when the break of the current occurred at full systole or later in the cardiac cycle, but no such effect was produced, in any phase of the cycle, due to the make. A slow electrical wave, probably due to local polarization of the tissues, was sometimes observed on the make. During contraction of the ventricle, a make caused a decrease in the amplitude and duration of systole, and a break produced the reverse effects. During relaxation, a make favored relaxation, but a break caused a contraction with amplitude and duration greater than normal. The above and additional results lend support to a previous report by Walzl to the effect that the make and the passage of a direct current cause inhibition but the break, excitation of the oyster ventricle. During the constant passage of the direct current, the spontaneous action potentials were markedly increased in amplitude, usually, although the ventricle was in a partly inhibited state. This effect is probably due to an increased polarization of the surface of the tissue. The amplitude of the spontaneous action potential appeared to vary parallel with the initial length of the ventricular tissue.

The effects of biologically conditioned medium on the growth rate and population yield of certain ciliated protozoa: GEORGE W. KIDDER (introduced by W. S. Hunter). Three species of holotrichous ciliates were used in this study, *Colpidium campylum*, *C. striatum* and *Glaucoma pyriformis*. They were grown in bacteria-free, particulate-free culture and tested as to growth rate and population yield in fresh broth (proteose-peptone), broth from which a previous population had been removed by centrifugation and broth from which a previous population had been removed by filtration. No significant difference was observed between the growth phases of the three species, but large and significant differences occurred between the different types of media. In fresh broth (control) growth proceeds logarithmicly for about 36 hours (initial inoculum of 100 to 150 cells) then levels sharply and continues in the stationary phase for weeks. When the same number of cells are inoculated into conditioned broth (from which a previous population has been removed by centrifugation) there is a significant acceleration of growth during the early periods with a gradual slowing of the growth rate. The maximum population yield is always lower than the control. When the same number of cells are inoculated into filtered conditioned broth (the previous population having been removed by a Seitz filter) there occurs a significant lag period with a final population yield similar to that of the conditioned broth. Both the accelerative and the depressive effects are destroyed by heat and the accelerative effect is decreased in direct proportion to the length of time the conditioning is carried out. We may postulate the elaboration of two substances within the culture medium as a result of the population growth, one an accelerator to growth which appears to be adsorbed on a negative filter and the other a depressor which, when allowed to act independently of the accelerator, produces

a pronounced lag in the growth rate of a second population of ciliates. These two substances are thought of as being produced simultaneously but at different rates during any population growth.

Analysis of variance applied to human genetics: C. B. DAVENPORT. The analysis of variance as developed by "Student" and R. A. Fisher has been used hitherto to differentiate races of animals and plants but apparently not to compare intrafamilial with interfamilial difference to get a measure of the importance of heredity in human family traits. In 7 families containing 5 to 3 Nordic boys each, at age of 16 years at time of observation, the variation between families and within families of 14 dimensions was computed. The results are as follows: In all 14 cases, with degrees of freedom of 6 for the greater mean square and 17 for the less the F value ranges from 2.40 to 2.65 (2 cases), through 2.96 and 3.86 (2 cases) to over 4.10 (10 cases). The ratio that may be exceeded by chance 5 times in 100 trials is 2.70; by chance once in 100 trials is 4.10. Accordingly, the adjusted ratio of intrafamilial to interfamilial variation may be given, by chance, slightly more than 5 times in 100 trials in 2 cases; between 5 times and 1 time in 100 trials in 2 cases; and less than 1 time in 100 trials in 10 cases. Thus, in all families variation within families is significantly less than between families. The difference is much more significant (perhaps because the genetical factors are stronger) in the various head widths than in the elements of facial height.

Bodily constitution and longevity: RAYMOND PEARL and W. EDWIN MOFFETT. There were observed and measured 2,332 adult white males falling in six series on the basis of the eventual causes of their deaths. All were in a state of sound health when observed. In each cause-of-death series there were two groups of individuals separated upon the basis of duration of life. The Longevity (+) group in each series contained every individual in our total material for that series, without other selection, whose survival after observation was *greater* than the expectation of life for his age when observed as given by the Dublin and Lotka 1929–31 life table. The *average* ages at death of the Longevity (+) groups ranged from 75.0 years in the cancer series to 77.2 years in the nephritis series. The Longevity (−) group in each series contained the shortest-lived individuals to be found in that series who were, individual for individual, of the same age in years at observation and measurement as the individuals in the Longevity (+) series with whom they were paired. Their average ages at death ranged from 40.2 years in the accident series to 54.7 years in the diabetes series. The Longevity (+) group outlived the Longevity (−) by average amounts varying from about 21 years in the diabetes series to about 36 years in the accident series. The Longevity (+) group was not significantly differentiated from the Longevity (−) group in any series in respect of mean *stature* or in mean *chest expansion* at the time of disease-free observation. The same was true of mean *body weight* in the pneumonia series and in the accident series. But in the heart disease, and the nephritis series, the mean *body weight* and mean *chest girths* were significantly greater in the Longevity (−) group than in the Longevity (+) group. Mean *pulse rate* was higher in the short-lived (−) groups in all cause-of-death series, but not significantly so in the accident or pneumonia series. Further details regarding other constitutional differentiations between the long-lived and short-lived groups are given in the complete paper.

Inheritance of internal morphological characters: PAUL B. SAWIN (introduced by W. S. Hunter). Irregularities in the number of pairs of ribs and of presacral vertebrae and of other internal morphological structures are anomalous variations described in numerous species and in all classes of tetrapods. Evidence of inheritance has been presented by several investigators as the result of study of corresponding variations in the domestic fowl, the rabbit, mouse and man, but in none is a simple mendelian interpretation adequate to explain all the facts. In the rabbit our extensive breeding within three closely bred families shows that by selection in two of them (IIc and III) the proportion of 13-ribbed progeny has been increased from 86.6 per cent. and 76.3 per cent. to 94.7 per cent. and 97.7 per cent., respectively, whereas random mating within a third family (V) has induced but minor change over seven generations. Crosses of the two 13-ribbed families with the same 12-ribbed family reveal tendencies for the 12-ribbed type to dominate in the first generation and to segregate in subsequent backcross generations in expected mendelian manner but with aberrant proportions of 12- and 13-ribbed progeny roughly corresponding to the respective disproportion existing in the parental families. This is indicative of minor genetic differences between these two 13-ribbed families, although crosses between the two have produced only 13-ribbed young. A cross between one of the 13-ribbed families (III) and the 12-ribbed individuals of the unselected family V has produced 40 young, 66 per cent. of which are 13-ribbed, and which continue to breed as 13-ribbed. This could be explained on the basis of parental unifactorial hybridity of the family V parents. This interpretation is erroneous, however, since analysis of 134 matings within this family shows that segregation is neither unifactorial nor fortuitous. Similar studies of anomalies of the sternum and of the vascular branches arising from the aortic arch, dorsal aorta and inferior vena cava within the same families show patterns of incidence of anomalies typical for each family, but for which at present likewise no simple mendelian explanation is completely adequate. The author is inclined at present to consider a multifactorial explanation parallel to that suggested by several investigators for adult body size as the more likely, although body size itself is not directly correlated at least with the skeletal variations. The high familial incidence of these anomalies, which are associated with regions (branchial and urogenital) subject to great evolutionary vicissitudes, coupled with the regularity of their transmission in crosses, offers a new approach to problems in vertebrate evolution through the combined application of the principles of comparative anatomy and genetics.

A study relating to cytoplasmic effects of uniparental inheritance in Daphnia: A. M. BANTA and THELMA R.

WOOD (introduced by C. A. Kraus). In biparental inheritance reciprocal crosses between stocks of *Daphnia longispina* possessing either of the mutant characters studied, excavated head or sex intergradedness, it was found that when the eggs came from the mutant-bearing stock and the sperm from the normal (non-mutant-bearing) stock the sexually produced offspring, about 50 per cent. of which carried the character, produced a higher average manifestation of the character involved than when the cross was made in the reverse direction. The differences in reciprocal crosses appeared conclusive. Such a result may find explanation in that the factors for the mutant characters affect the cytoplasm of the egg previous to fertilization. Inasmuch as parthenogenesis in Daphnia is diploid, there theoretically being no opportunity for genie segregation during the one non-reductional maturation division of the eggs, all the parthenogenetic descendants of an individual should be genetically identical, except as a mutation occurs. However, with the two mutant characters studied, both of which are highly variable in their manifestation, there was strong presumptive evidence that even among parthenogenetically produced clutch mates, a mother phenotypically low for the character produced uniparental, diploid offspring with a slightly lower average manifestation of the character than did her clutch mates which themselves were phenotypically higher for the character involved. Only cytoplasmic influences would seem to account for such a result. In an attempt to get critical evidence concerning such cytoplasmic effects experiments were set up as follows: Clutch sisters having different grades of manifestation of the mutant character were reared in individual bottles of the same culture medium under as nearly identical conditions as could be provided. As many parthenogenetic young as possible were obtained from each mother. The offspring from each mother were graded with reference to the manifestation of the character. An average grade for all the offspring from each mother, in many cases 150 to more than 300 per mother, was thus obtained. The general average grade of offspring from mothers which were phenotypically of one grade of expression of the character was then compared with averages for offspring from mothers having other grades of expression of the character studied. The data thus obtained for the excavated head character reveal no evidence for a cytoplasmic effect in the inheritance of this character in parthenogenesis. On the other hand, extensive data (which will be presented) for the sex intergrade character appear to confirm the earlier evidence which suggested cytoplasmic effects in inheritance in parthenogenesis.

The effect of calcium on potassium retention in skeletal muscle: P. H. MITCHELL and L. SARIN (introduced by C. A. Kraus). Pairs of frog sartorius muscles were used as control and experimental material. They were immersed in Ringer solution or in Ringer modified as to its calcium concentration. The control was kept at rest; the experimental muscle was directly excited electrically to give tetanus contractions of one third second duration at intervals of 20 seconds. Confirmatory of previous work at this laboratory and elsewhere, potassium losses were noted from stimulated muscles only. If stimulation was continued during two hours, large potassium losses, amounting to about 30 per cent. of the total muscle potassium, were observed when the muscles were in Ringer solutions containing 12 to 24 milligrams per cent. of calcium chloride. With 36 milligrams per cent., the potassium losses fell to about 15 per cent. of the total muscle potassium. If stimulation was continued during only one hour the potassium losses became smaller as the calcium chloride concentration was increased. In the presence of 36 milligrams per cent. of calcium chloride, the losses were too small to be detected by the method of chemical analysis employed. It is suggested that increase in calcium concentrations may so affect the muscle cell surfaces as to alter the normal permeability relations and check or even prevent loss of potassium during excitation and contraction.

The isolation, constitution and synthesis of Vitamin K_1: E. A. DOISY, D. W. MACCORQUODALE, S. A. THAYER, S. B. BINKLEY and R. W. MCKEE. Evidence of the existence of an anti-hemorrhagic factor was first obtained by Dam in 1929; in 1935, he suggested the term Vitamin K for this factor. The difficult and laborious tasks of developing satisfactory bioassay procedures and of devising methods for purification of the vitamin were undertaken mainly by Dam and his collaborators in Europe and by Almquist and his co-workers at the University of California and by our group at the St. Louis University School of Medicine. Dried alfalfa leaf meal and putrefied sardine meal were found to be satisfactory sources of the vitamin. We have isolated an anti-hemorrhagic compound in a pure state from each source. Chemical reactions and ultra-violet absorption curves have indicated clearly that both of these compounds are derivatives of 1,4-naphthoquinone. By oxidation experiments it has been shown that Vitamin K_1 (alfalfa) is 2-methyl-3-phytyl-1,4-naphthoquinone. This structure has been confirmed by synthesis, and degradation experiments on the synthetic compound have given the same products that were obtained by oxidation of the natural compound. As soon as the quinonoid structure of Vitamin K was recognized various simple quinones were tested for Vitamin K activity. Only 1,4-naphthoquinones and compounds which upon oxidation in the organism might yield 1,4-naphthoquinones showed activity. 2-methyl-1,4-naphthoquinone is at least as active as Vitamin K_1. 1,4-dihydroxy-2-methylnaphthalene and 4-amino-2-methyl-1-naphthol possess approximately the same potency as Vitamin K_1. These two compounds are of great importance from a therapeutic standpoint, since they are soluble in aqueous media and therefore can be used for parenteral therapy. This is important because of the difficulty in securing absorption of the enterally administered natural vitamin, which because of its oily character can not be used intravenously.

The medical cyclotron of the William H. Crocker Radiation Laboratory: ERNEST O. LAWRENCE. The new 60-inch cyclotron of the William H. Crocker Radiation Laboratory, weighing over 220 tons, is the largest one yet built and has many important new features of design. The improvements have greatly increased the efficiency of the ap-

paratus over smaller models, as evidenced by the fact that 100 microamperes of 16 million volt deuterons and 1 microampere of 32 million volt helium ions are obtained with only 50 kilowatts input to the radiofrequency oscillator. The first experiments with these atomic projectiles of considerably greater energies than heretofore available have given extraordinarily interesting results. It has been observed, for example, that the neutron yield per microampere of deuterons is 5 times greater at 16 million volts than at 8 million volts, while the yield of radioactive iodine is 20 times greater at the higher voltage. Moreover, bombarding bismuth and lead with 32 million volt helium ions gives rise to large yields of new alpha particle emitting radioactive substances. The gratifying initial performance of the new cyclotron, which indeed has surpassed expectations, makes it certain now that it is entirely feasible to build a 120-inch (2,000 tons) cyclotron capable of producing atomic projectiles of energies above 100 million volts. The rapid and successful construction of the 60-inch cyclotron, which is of great importance for medicine as well as for the physical sciences, was made possible through the joint efforts of all the members of the Radiation Laboratory and through the active interest and generous support of the Chemical Foundation, the Rockefeller Foundation and the National Advisory Cancer Council.

Auditory patterns, a demonstration lecture: HARVEY FLETCHER. For many years physicists have been devising methods and apparatus for accurately measuring hearing, and it is now possible to describe the ear in physical terms much as other machines are described. In more recent years, auditory research has been directed more toward obtaining the relation between such a physical description and the character of the sensation evoked by a sound. Sound waves entering the inner ear set into vibration a relatively long flexible membrane, which has distributed along its length the endings of the auditory nerve fibers. These endings are sensitive to the vibrations, and initiate a series of nerve impulses or tiny electrical currents, which travel along the nerve fibers to the brain. Such nerve messages contain the information that is used in forming the sensation of sound. By utilizing the discovery that human nerve fibers behave like busy telephone wires, relations have been obtained between the physical characteristics of a sound and the pattern of the nerve messages which it produces. When a nerve fiber is busy carrying messages for one sound it is unable to carry messages for a second sound. In order to be heard, the intensity of the second sound must be increased until nonbusy fibers can be found. From such busy tests, the fibers at different positions on the membrane that are excited by a given sound can be charted. Such a chart is called an auditory pattern, and portrays to the eye the information that the brain must utilize in order to form sensation. By choosing a sound which renders the fibers at different positions on the membrane uniformly busy, relations have been obtained between the pitch of a sound and the position of the excited fibers, the intensity of a sound and the rate at which messages are evoked and the changes in position and rate which accompany just noticeable changes in pitch and intensity, respectively. In the demonstration lecture, this complicated process is vividly depicted by creating sounds and portraying the corresponding auditory patterns by means of animated charts. Deafness is artificially created and the audience sees and hears sound in the roles of both the normal hearing and the deafened.

A Raoult law study of chlorbenzene-symtetrachlorethane mixtures: JOHN R. LACHER (introduced by C. A. Kraus). An equilibrium still is described which permits a fairly rapid determination of vapor-liquid equilibrium. The apparatus is flexible and enables one to determine whether or not the steady state set up is independent of the factors required to bring it about. Pressure composition isotherms of chlorbenzene-symtetrachlorethane mixtures were determined at 75° and 100° C. The deviations from the ideal solution law are small and negative. The measurements satisfy the Gibbs-Duhem-Margules' equation within experimental error. That the solutions should be nearly ideal is indicated by the fact that the molar volumes of the two pure liquids differ by only 4 per cent. at 30° C. Density measurements of the liquid mixtures show that there is a small decrease in volume on mixing. This shows that the attractive forces between the unlike molecules should produce small negative deviations from the ideal solution law, as were observed.

Mixed copper-chromium oxide hydrogenation catalysts: V. N. IPATIEFF, B. B. CORSON and J. D. KURBATOV. Pure copper does not hydrogenate benzene at ordinary pressure and 225°, but the presence of chromium oxide enables it to do so. As chromium oxide is added to copper, the hydrogenating activity rises abruptly to a maximum at 5 per cent. of oxide, and then falls with continued addition. The same is true for the hydrogenation of isopentene at ordinary pressure and of benzene at superatmospheric pressure. We have called this mixture of maximum activity the "eucoactic mixture." The presence of 0.1 per cent. of chromium oxide lowers the temperature requirement for the hydrogenation of isopentene from 225° to 75°. Copper is very susceptible to activation by traces of nickel, and the 95 per cent. copper-5 per cent. chromium oxide catalyst is even more susceptible. For instance, copper containing not more than 0.001 per cent. of nickel does not hydrogenate benzene at ordinary pressure and 225° in 90 seconds, whereas the presence of 0.005 per cent. of nickel raises the hydrogenation to 4 per cent. On the other hand, the hydrogenating activity of the 95 per cent. copper-5 per cent. chromium oxide catalyst is raised from 4 per cent. to 16 per cent. by the addition of 0.005 per cent. of nickel. Also, copper containing 0.2 per cent. of nickel hydrogenates benzene 19 per cent. in 12 seconds' contact time, whereas the 95 per cent. copper-5 per cent. chromium oxide catalyst, to which 0.2 per cent. of nickel has been added, hydrogenates benzene 62 per cent. In the absence of nickel, the copper-chromium oxide catalyst hydrogenates benzene only 2 per cent. in 12 seconds.

Line absorption spectra of solid compounds: JOHN P. HOWE and W. S. HERBERT (introduced by C. A. Kraus). Neodymium acetylacetonate has been chosen as a com-

pound, the study of whose absorption spectra should give data bearing on the subject of energy levels in solids. It has been shown by various workers that the color of rare earth compounds is due to transitions between levels of $(4f)^n$ electronic configurations of the triply ionized rare earth ion. These levels being highly degenerate are split in the electric fields due to the charged groups surrounding the ion in a solid. The splitting pattern depends on the electronic level involved and the symmetry of the electrical field. The absorption spectrum of neodymium acetylacetonate has been photographed with the compound at 78°, 120°, 193° and 298° Kelvin. From the results, an energy level diagram has been constructed which is consistent with the assumption of a field of nearly octahedral symmetry about the rare earth ion. A small axial field is indicated. In addition, it was necessary to assume that a molecular vibration frequency couples with the electronic transitions. The splitting pattern of the ground state is similar to that observed in other neodymium salts. All the observed lines are accounted for except one group which appears to rise from transitions to two electronic states lying close enough together to mix up.

Work functions of different faces of silver single crystals: H. E. FARNSWORTH and RALPH P. WINCH (introduced by C. A. Kraus). The work required to transport an electron through the (100) and (111) faces of silver single crystals has been determined by a photoelectric method after extended outgassing of the crystals. The equilibrium value of this work function for the (100) face is $4.81 \pm .01$ electron volts. This value was obtained after 2,283 hours of heating at temperatures up to about 700° C; 356 hours of additional heating did not change this value. After the crystal had subsequently remained at room temperature for 2,130 hours, at a pressure of 1 to 3×10^{-8} mm Hg, the work function decreased to 4.65 e.v. After 100 hours of additional heating of the crystal the work function increased to 4.79 e.v., and after an additional 118 hours of heating it returned to the equilibrium value of 4.81 e.v. The equilibrium value of $4.75 + .01$ e.v. for the (111) face was obtained after 1,227 hours of heating at temperatures similar to those above. This crystal had been outgassed in two previous experiments so that a much shorter time was required to reach the equilibrium value of the work function than for the (100) face. The above equilibrium value was not changed by 407 hours of additional heating. At this time the crystal became slightly contaminated while heating a tantalum plate near it. The effect of the contamination was to cause a failure of the experimental results to fit the Fowler theoretical curve. Measurements on the contact potential difference between the two crystal faces by the Kelvin null method agreed with the difference of the photoelectric work functions to within $+.01$ volt until the results for the (111) face failed to fit the Fowler theoretical curve. We believe that these values are the best that can be obtained by heating, since silver crystals etch rapidly, thus exposing other faces, when heated at temperatures where appreciable evaporation occurs. The above values may be compared with 4.74 e.v., previously obtained by Winch (*Physical Review,* 37: 1269, 1931; 38: 45, 1931), for polycrystalline silver after heating for 1,200 hours with short intervals at temperatures as high as 850° C. where evaporation is rapid.

The filtration of sound in non-homogeneous media: R. B. LINDSAY (introduced by C. A. Kraus). Previous work (*e.g.,* Lindsay, Lewis and Albright, *Jour. Acoustical Soc. Amer.,* 5: 202, 1934) has indicated that when periodic compressional elastic waves pass through a stratified medium consisting of a series of alternating layers of two different substances, which may be either fluid or solid, not all frequencies are transmitted. In other words, the medium acts as an acoustic filter with alternate transmission and attenuation frequency bands. This analysis of the transmission characteristics of the medium was based on the assumption that the transition in acoustical properties (*i.e.,* density and sound velocity) from each layer to the next is *abrupt* and effectively discontinuous. The purpose of the present investigation is to examine the consequences of assuming that the transition in question is a *gradual* one. The interesting theoretical result is that for a gradual transition in which there are no discontinuous changes in either the acoustical properties or their gradients the stratified medium no longer acts as a filter but passes all frequencies equally well. In order to assure filtration for a gradual transition one must assume at least discontinuity in the gradients of the acoustical parameters. Certain special cases and their consequences are investigated.

Excitation of fractional multiplets by electron capture: GEORGE H. SHORTLEY and DONALD H. MENZEL (introduced by Harlow Shapley). Observations show that certain permitted multiplets of O III and N III are not completely represented in the spectra of gaseous nebulae. Some mechanism apparently acts to give selective excitation of some levels of a term without exciting the other levels. Bowen attributes the phenomenon to resonance absorption, principally of the ultimate line of He II, which happens to coincide with an ultimate line of O III. Certain questions and consequences of Bowen's mechanism are discussed. Another method of excitation of fractional multiplets, by direct electron capture by an ion in the ground level of a term (e.g., $^2P_{\frac{1}{2}}$ of O IV), is examined. The components predicted by quantum mechanics do not, however, agree with those observed in the nebulae. The conclusion is reached that Bowen is probably right, although a few discrepancies still remain unexplained. His method apparently requires inelastic electron impacts to be sufficiently frequent to maintain approximately a thermodynamic-equilibrium population of atoms in the levels of the ground term.

The coronaviser, an instrument for observing the solar corona in full sunlight: A. M. SKELLETT (introduced by F. B. Jewett). Special television apparatus has been developed to scan the region of the sky around the sun, to separate the component of the photoelectric current arising from the glare (mainly a d-c. component) from that arising from the scanning of the coronal features (mainly an a-c. component), and to amplify the latter component and to reproduce therefrom an image of the corona. The scanning follows a spiral path. The input

scanner is mechanical and works on the image at the focus of the 15-inch horizontal refractor of the Cook Observatory at Wynnewood, Pa. The reproduction is effected entirely by electrical means and appears on the screen of a cathode ray tube. Numerous images of prominences have been obtained, and a number of the images showed features that apparently were of coronal origin. On one particularly clear day a bright jet or flare in the corona was photographed a number of times over a period of several hours. This feature turned about the optic axis of the telescope with time at the correct rate for a coronal feature.

Southern clusters and galaxies: HARLOW SHAPLEY and JOHN S. PARASKEVOPOULOS. In reporting on the work of the galactic bureau at the Harvard Observatory the following specific projects and objects in the Southern Hemisphere will be discussed: (1) A photometric survey of two new groups of galaxies, each involving many hundreds of individual systems. Distances and dimensions of these supersystems will be estimated, and the luminosity law (distribution of brightness) will be evaluated. (2) Two spirals without nuclei, both large and one possibly within the local supergalaxy. (3) A new "Magellanic Cloud" in Cetus, possibly a member of the local group of galaxies also. (4) The distribution of the periods of classical Cepheid variables in the Magellanic Clouds. The peculiar concentration of the longer periods to regions of higher frequency of stars suggests that we may have in this newly found phenomenon an indicator of the distribution of potential throughout a galaxy.

The Egyptian picture of the sky: O. NEUGEBAUER (introduced by C. A. Kraus). Egyptian and Babylonian astronomy are usually quoted as equivalent foundations for Greek, and therefore medieval and modern, astronomy. But in spite of this fact only very little was known about Egyptian astronomy. Since Brugsch published in 1883 his fundamental collection of different inscriptions of an astronomical character, detailed studies on the history of astronomical concepts in Egypt have been made in only two fields, namely Borchardt's investigations on Egyptian sundials and waterclocks and Pogo's studies on the so-called Decan-starlists on coffin lids belonging to the period *ca.* 2000 B.C. This situation is the more remarkable because in the meantime the impressive structure of the Babylonian theoretical astronomy has become more and more unveiled, showing clearly that Greek astronomy was based on Babylonian knowledge, leaving practically no space for an Egyptian influence. This situation has now, in the meantime, become understandable by the investigation of different Demotic astronomical texts, showing that the Egyptian methods of treating the moon-phenomena and the movement of the planets were only very approximate and without any consideration of details. This picture of Egyptian astronomy is now completed by a Demotic text recently purchased by the Egyptological Institute in Copenhagen, which shows us how the aspect of the sky, the setting and rising of the stars, was connected with religious myths. This text explains the famous picture of the star-goddess Nut, who is represented as bending over the earth, touching with her feet and hands respectively the eastern and western borders of the earth. We learn from this text how the Egyptians interpreted mythologically the invisibility of shifting groups of stars, and how the discovery that this invisibility of stars is merely due to the vicinity of the sun deeply influenced these religious concepts. On the other hand, the close connection of religion, especially as far as the underworld is concerned, with the changing aspect of the sky during the year explains that the main interest of Egyptian astronomy was not a mathematically detailed description of very complex effects, but merely a rough scheme, just good enough to reflect the main traces of the observed facts.

On the decomposition of transitive permutation groups generated by the symmetric group: J. S. FRAME (introduced by C. A. Kraus). Every subgroup H of the symmetric group G of degree n generates a transitive permutation group G_H on the cosets HS_i of G with respect to H, which orders to an element R of G the permutation $HS_i \rightarrow HS_iR = HS_j$. If we restrict R to the elements of H, the cosets which are then permuted among themselves will form aggregates HS_iH called double cosets. Now if G_H is written as a group of permutation matrices and completely reduced, the sum of the squares of the multiplicities of the irreducible components is equal to the number of double cosets HS_iH. We show in this paper that the number of self-inverse double cosets, with respect to a subgroup H of G which is the direct product of symmetric groups, is equal to the sum of the multiplicities of the irreducible components of G_H. In the proof the double cosets are displayed in a series of squares each having a side equal to the multiplicity of an irreducible component of G_H and having inverse double cosets symmetrically placed with respect to the diagonal. This generalizes a diagram of G. deB. Robinson in a recent paper "On the Representations of the Symmetric Group," in which the elements themselves (double cosets with respect to the identity subgroup) are similarly displayed. Use is made of the theory of lattice permutations introduced by P. A. MacMahon and developed by D. E. Littlewood, A. R. Richardson and G. deB. Robinson.

On drawings composed of uniform straight lines: G. D. BIRKHOFF. The question considered is a curious one, dealing with the kinds of drawings in the plane which can be made by a pen or pencil which makes many uniform rectilinear strokes of very narrow width. For instance, the depth of blackness may vary inversely as the distance from a fixed point, tending from black through diminishing grayness towards whiteness at remote points. The mathematics involved leads to a generalization of an integral equation, due to Abel.

A new method in statistical mechanics: NORBERT WIENER and BROCKWAY MCMILLAN. The authors integrate the differential equations of motion of a system of similar particles acted on by central forces in such a way as to give symmetric functions of these particles in terms of the time and of symmetric functions of the initial positions and velocities of the system. They then introduce a process of averaging with respect to the initial

parameters which gives the averages of the symmetric functions in terms of the time alone. Finally they let the time become infinite and obtain asymptotic values of these averages. In this way they arrive at the equation of state of a gas. Similar methods can be used for liquids.

Respiratory metabolism of mammalian eggs and embryos: EDGAR J. BOELL and JOHN S. NICHOLAS (introduced by L. L. Woodruff). The respiratory metabolism of rat eggs and embryos during the earliest stages of development has been measured by means of a micromanometer based on the principle of the Cartesian diver in an attempt to discover possible relationships between morphological development and physiological activity. The delicacy of the method can be appreciated by the fact that the oxygen consumption of as few as six to ten eggs, corresponding to a dry weight of approximately 0.0002 milligram, can be measured with a fair degree of accuracy. The eggs were obtained by excising the oviducts of fertilized females at definite intervals after copulation. The oviducts, when cut into small pieces, extrude the ova by peristaltic activity. The embryos were obtained, by surgically freeing them from associated maternal and extra-embryonic structures within the uterus. The preparation of eggs and embryos for respiratory studies was performed under approximately sterile conditions, and, as a rule, approximately one hour elapsed between the administration of anesthetic and the beginning of readings on respiration. The oxygen consumption averages 0.00073 cu mm per egg per hour. No significant differences have so far appeared in the respiration of one-cell and eight-cell eggs, for development at this time involves merely the division of the egg into a number of smaller units with no perceptible increase in the actual mass of respiring material. When embryonic growth occurs, the oxygen consumed accurately reflects the increase in embryonic mass. On the eighth day of development the oxygen used per embryo amounts to approximately 0.01 cu mm per hour, and during the next two days, during which embryonic organization occurs, this figure is increased twenty times. The influence of various metabolites on the maintenance of embryonic respiration *in vitro* suggests that carbohydrate is easily utilized as a primary energy source during early mammalian development.

The eye in relation to chromatophoral color changes in animals: G. H. PARKER. As a rule fishes with only one eye respond by color changes to differences in their environment as successfully as do those with two eyes. In this respect the trout has long been known to be peculiar, for on the loss of one eye it darkens contralaterally. The common catfish, *Ameiurus nebulosus*, when deprived of one eye conforms neither to the general rule for fishes nor to the special one for the trout. A one-eyed catfish is at first very dark, after which it may change slowly in tint according to its environment, though without ever becoming fully pale. Such fishes may finally assume in the same environment somewhat different tints and retain these with considerable individual persistence. This diversity appears not to be due to variations in the irritability of the orbital wound which might influence to various degrees the stumps of the optic nerve. The cause of these more or less characteristic color differences is unknown. In these respects one-eyed catfishes are unlike any other fish thus far described. The fact that intermedin, the secretion from the pituitary gland, plays a very important part in the color changes in catfishes and that in this fish chromatophoral nerves, both dispersing and concentrating, are less significant than the pituitary gland, may be the occasion of the difference between Ameiurus and most other teleosts whose chromatophores are often under almost exclusively nervous control.

The effect of dissolved substances on regeneration in Planaria maculata: J. WALTER WILSON (introduced by W. S. Hunter). Flatworms with heads removed by a transverse cut and placed in four fifths Ringer's fluid, fail to close the wound but regenerate a head by producing two lateral half heads, which are later united by a bridge of tissue which grows forward ventral to the wound. The result is a head, at first notched at the tip, but later normal in shape, with an open wound just behind the eyes. This is of interest because of its bearing on three problems: (1) wound closure; (2) source of the cells of the blastema; (3) origin of organization in the blastema. The following experiments were performed in an attempt to discover how the four fifths Ringer's fluid acts: Worms were cut transversely and permitted to regenerate. (1) In six tenths-, seven tenths-, and eight tenths-Ringer's fluid. The wound closed in some worms in seven tenths and most of them in six tenths. Previous experiments had shown that closure occurs in all lower concentrations. (2) In similar solutions after three days in the same concentrations. This exposure previous to the cut did not change the result. (3) In separate solutions containing the individual salts of Ringer's fluid in concentrations that they occur in the four fifths. (4) In four fifths Ringer with KCl, $CaCl_2$ or both left out, and also with KCl, $CaCl_2$ or both doubled. (5) In glucose solution isosmotic with four fifths Ringer's fluid. In all solutions approximately isosmotic with four fifths Ringer's fluid, the wounds failed to close and, if the worms lived, regeneration like that in the four fifths Ringer's fluid occurred. In all more dilute solutions the wounds closed and regeneration occurred as in water unless the solution proved toxic. It is concluded that the effect is due to the osmotic pressure of the solution and not to its chemical nature. It is suggested that it is produced because the isotonic solutions have a weaker stimulating effect on the exposed tissues than the more dilute solutions and water.

Effect of induced polyploidy on doubleness and flecking in flowers of Portulaca grandiflora: A. F. BLAKESLEE and H. E. WARMKE. In *Portulaca* the gene for double flowers (D) is dominant to the gene for singles (d). Full doubles (D_2) do not set seed; semi-doubles (Dd), however, are fully fertile. In diploids there are two types of doubles (D_2 and Dd); in tetraploids there may be four. The two new double types are D_3d and Dd_3. The homozygous tetraploid (D_4) corresponds to the homozygous diploid (D_2) and does not set seed. The tetraploid D_3d type is fertile. The tetraploid D_2d_2 corresponds in double-

ness to the diploid Dd. The tetraploid Dd_3 has flowers with at most only a few extra petals. If segregation is in accord with random assortment of 4 chromosomes the plant-breeder could guarantee that all the seeds from selfing a D_3d parent would be high-grade doubles. If segregation followed random assortment of 8 chromatids, there should be not over 0.13 per cent. singles. In certain races, red flecks occur on white flowers, due to dominant somatic mutations. In diploids the number of flecks per petal is from 2 to 6 times as frequent as in what appears to be comparable tetraploid material. Since there are twice as many chromosomes per cell in tetraploids one would expect twice as many mutations leading to an increased number of flecks per flower. This appears not to be the case, even if account is taken of the fact that there are slightly fewer cells per tetraploid flower. Our present interpretation is that tetraploidy in some way reduces the mutation rate in individual chromosomes.

The genera of the Boletaceae: WALTER H. SNELL (introduced by Charles Thom). The classification of the Boletaceae most widely accepted in Europe and America has contained four genera: *Strobilomyces, Boletinus, Boletus* and *Gyrodon,* with *Boletus* containing all but 14 of the species arranged in 13 subgroups. The genera and the subgroups of *Boletus* are separated on the basis of gross morphological features of the carpophore. Some of the subgroups of *Boletus* as now constituted differ more from one another than *Boletus* does from the other genera, especially *Boletinus.* In the belief that spore characters are more fundamental as a basis for classification and that the use of them will provide a more natural and usable arrangement of the species in this family, it is proposed to adopt the scheme of Gilbert with certain modifications and made up as follows: subfamily Boleteae, with smooth spores containing the following genera—*Phylloporus, Boletinellus* (a segregate from *Boletinus*), *Boletinus, Ixocomus* (the present Viscipelles), *Pulveroboletus* (the Pulverulenti), *Xerocomus* (the present Subpruinosi and Subtomentosi), *Boletus* (including the Calopodes, Edules and Luridi), *Tylopilus* (the Hyporhodii), *Trachypus* (the Versipelles), *Porphyrellus* (containing two pilose, reddish-spored species), *Gyroporus* (the Cariosi), *Gyrodon,* and a new genus for three species with very small spores; subfamily Strobilomyceteae, with ornamented spores, containing the genera *Strobilomyces* (with globose, reticulate spores), *Boletellus* (with large, elliptical spores longitudinally striated or verrucose spores), and *Polyporoletus* (with spherical, warted spores).

Cytogenetic strains in certain species of grasses: GEORGE L. CHURCH (introduced by Charles Thom). In studies correlating polyploidy with species differentiation and geographic distribution in three genera of grasses, some cases of cytological differences are found within the limits of the species. Most of the forms of *Spartina patens* (Ait.) Muhl. are hexaploids, as well as two allied varieties that are usually recognized as distinct species; *i.e., Spartina caespitosa* A. A. Eaton and *Spartina bakeri* Merr. However, a tetraploid form is occasionally found in Massachusetts and a tall, robust, octoploid type is reported from Florida. Coastal specimens of *Spartina pectinata* Link. are hexaploid, but a Nebraska strain is dodecaploid. It is thought that in New England the hexaploid *S. caespitosa* could arise as a cross between *S. pectinata* and *S. patens.* The early-flowering, strand forms of *Spartina alterniflora* Lois. are octoploid, while the taller, robust, late-flowering forms of tidal lagoons are decaploid. The widely distributed *Panicum virgatum* L. is tetraploid, but a smaller strain with pilose leaves from Oklahoma is octoploid. The latter occurred in a planting of a large tetraploid strain. In the genus *Andropogon,* western strains of *A. haillii* Hack. and *A. provincialis* Lam. are hexaploid, but specimens with an extra monoploid complement are found. The lack of polyploidy in the southern strains of *A. virginicus* L. thus far studied is attributed to the fact that the probable parents, typical *A. virginicus* L. and *A. glomeratus* (Walt.) B.S.P. are both diploids.

Biographical memoir of Julius Stieglitz: W. A. NOYES.

Biographical memoir of Graham Lusk: E. F. DUBOIS.

Biographical memoir of Elihu Thomson: K. T. COMPTON.

Biographical memoir of Ernest William Brown: FRANK SCHLESINGER and DIRK BROUWER.

Biographical memoir of George Ellery Hale: WALTER S. ADAMS.

SCIENTIFIC EVENTS

THE EXPOSITION OF CHEMICAL INDUSTRIES

THE seventeenth Exposition of Chemical Industries will be held at Grand Central Palace, New York, from December 4 to 9. Three floors have been reserved for the exhibit, and nearly 300 exhibitors, representing over forty industries, have engaged space.

Chemicals, chemical raw materials and fabricated materials will be shown in terms of their manufacture and use. One exhibit will be devoted to carbon monoxide and its use as a reagent in educational, industrial and commercial laboratories. In the field of drying agents a soluble anhydride, the result of research on the fundamental nature and behavior of hydrates of calcium sulfate, will be demonstrated. Applications range from refrigeration to the drying of cable splices in the telephone and telegraph industries, also a new large-scale process for the dehydration of serums from the frozen state.

Materials of construction will include acid and corrosion proof linings for tanks, towers, process equipment, also for electrolytic refining tanks and for acid water and oil-proof linings which will be demonstrated in their uses for pickling tanks and acid disposal equipment, also for electrolytic refining tanks, and for acid sludge in petroleum refineries.