

SCIENCE

28 June 1963

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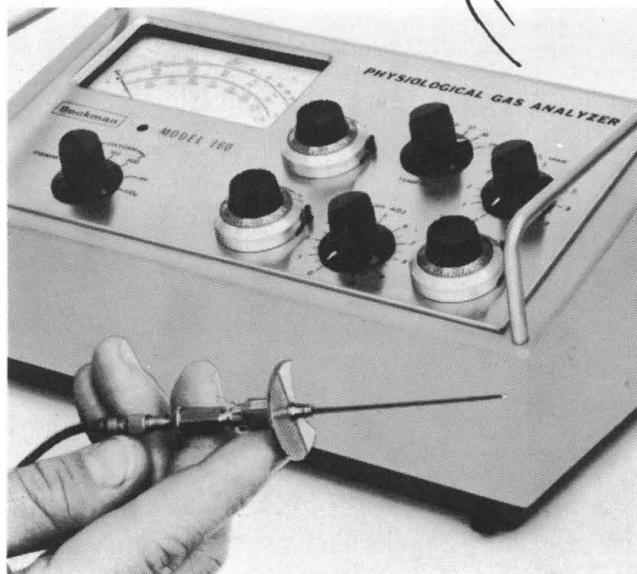
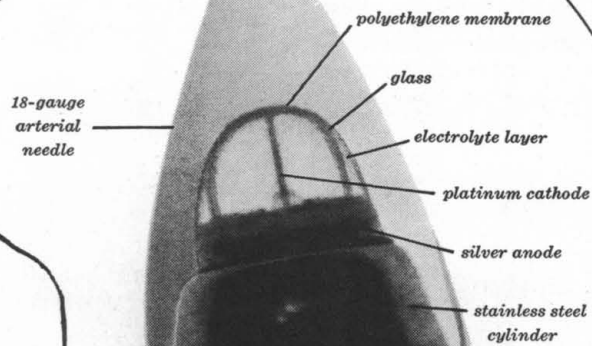
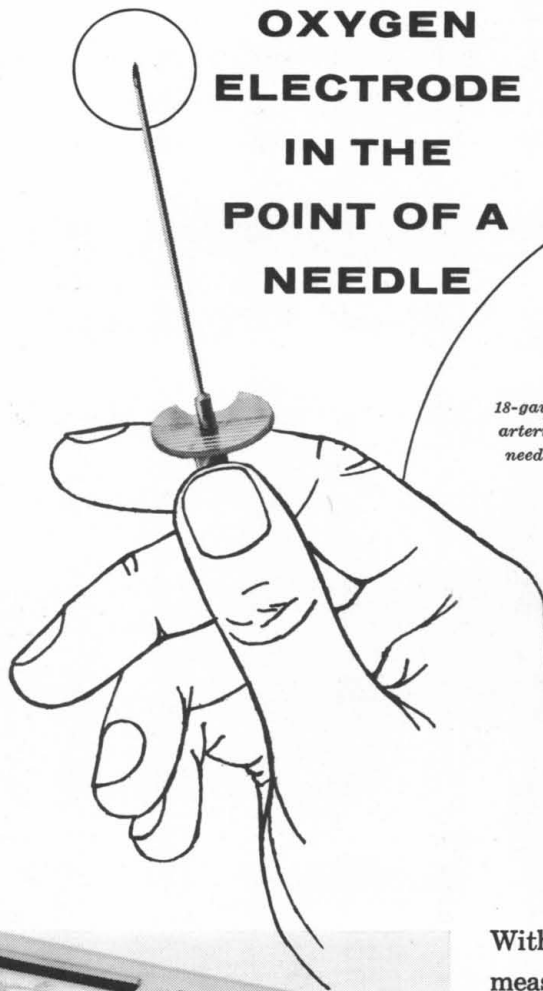
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



SILKWORM MOTH

Index Issue

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1357

28 June 1963

Vol. 140, No. 3574

SCIENCE

LETTERS	Society for Holistic Biology; Function of Research Centers; Terrestrial Magnetosphere	1362
EDITORIAL	Devil's Advocates	1365
ARTICLES	Chemical Insect Attractants: <i>M. Jacobson</i> and <i>M. Beroza</i> Insects promote their own destruction in responding to traps baited with specific lures.	1367
	Carbamyl Phosphate: <i>M. E. Jones</i> Many forms of life use this molecule to synthesize arginine, uracil, and adenosine triphosphate.	1373
NEWS AND COMMENT	Civilian Technology—Blasted in the House: AMA—Stress on Science: ACE—How To Do It; Krebiozen—Anatomy of a Scientific Controversy II	1380
BOOK REVIEWS	V. Grant's <i>The Origin of Adaptations</i> reviewed by <i>C. Zirkle</i> ; other reviews	1386
REPORTS	Cancer Therapy: A Possible New Approach: <i>A. Szent-Györgyi</i> , <i>A. Hegyeli</i> , <i>J. A. McLaughlin</i>	1391
	Recombination Events in the Bacterial Genus <i>Nocardia</i> : <i>J. N. Adams</i> and <i>S. G. Bradley</i>	1392
	Calorific Values of Microcrustacea: <i>G. W. Comita</i> and <i>D. W. Schindler</i>	1394
	Electrocardiographic Studies of Free-Swimming Sharks: <i>P. W. Gilbert</i> and <i>S. D. Douglas</i>	1396
	Photoperiodism: An Effect of Darkness during the Light Period on Critical Night Length: <i>W. S. Hillman</i>	1397
	Rhodium-102 Fallout: Variations in Deposition and Concentrations in Precipitation: <i>M. W. M. Leo</i> and <i>A. Walton</i>	1398

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Nitrogen Mustard: Diminution of Toxicity in Axenic Mice: <i>L. P. White and E. F. Claflin</i>	1400
Aquitanian Planktonic Foraminifera from Erben Guyot: <i>O. L. Bandy</i>	1402
Sodium Chloride Deprivation: Development of Sodium Chloride as a Reinforcement: <i>W. Wagman</i>	1403
Cardiovascular Responses of the Chicken to Seasonal and Induced Temperature Changes: <i>J. A. Vogel and P. D. Sturkie</i>	1404
Antibody to Rat Kidney: In vivo Effects of Univalent and Divalent Fragments: <i>J. H. Baxter and P. A. Small, Jr.</i>	1406
Haploids: High Frequency Production from Single-Embryo Seeds in a Line of Pima Cotton: <i>E. L. Turcotte and C. V. Feaster</i>	1407
Complementary RNA in Nucleus and Cytoplasm of Mouse Liver Cells: <i>B. H. Hoyer, B. J. McCarthy, E. T. Bolton</i>	1408
Zeolite ZK-5: A New Molecular Sieve: <i>G. T. Kerr</i>	1412
Blood Group Studies with Turtles: <i>W. Frair</i>	1412
Poliomyelitis in Monkeys: Decreased Susceptibility after Avoidance Stress: <i>J. T. Marsh et al.</i>	1414
Tumors Induced in Primates by Chicken Sarcoma Virus: <i>J. S. Munroe and W. F. Windle</i>	1415
Thyroxine: Effects on Amino Acid Incorporation into Protein in vivo: <i>R. Michels, J. Cason, L. Sokoloff</i>	1417
MEETINGS Bionics; Protein Structure and Function during Differentiation; Resonant Particles in High-Energy Physics; Forthcoming Events	1419
DEPARTMENTS New Products	1432

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COVER

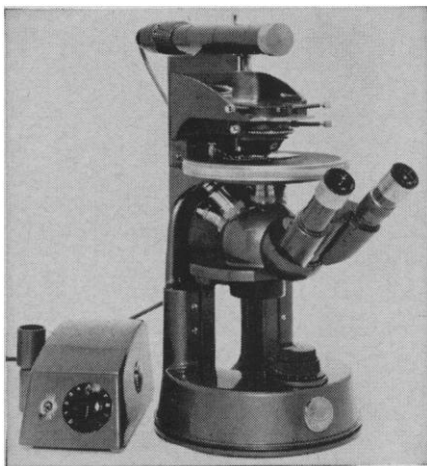
Magnified front view of a male silkworm moth (*Antheraea pernyi*). The branches of the feathery antennae contain numerous sensory receptors. These receptors are the nerve cells by means of which the male perceives the female sex attractant odor from a distance of approximately 1 to 2 miles. See page 1367. [D. Schneider, Munich, Germany]



VICKERS BRIEFS

Instruments and Applications

The Vickers Inverted Biological Microscopes



Inverted Microscope with Baker Trilux Condenser allowing instant interchange between regular, dark ground and phase contrast examination.

This new series of microscope stands has been produced to suit the needs both of those who are concerned with the examination of material in large flasks and those who wish to employ all techniques of high-powered microscopy and photomicrography on preparations which may or must be viewed with slide or chamber in inverted position.

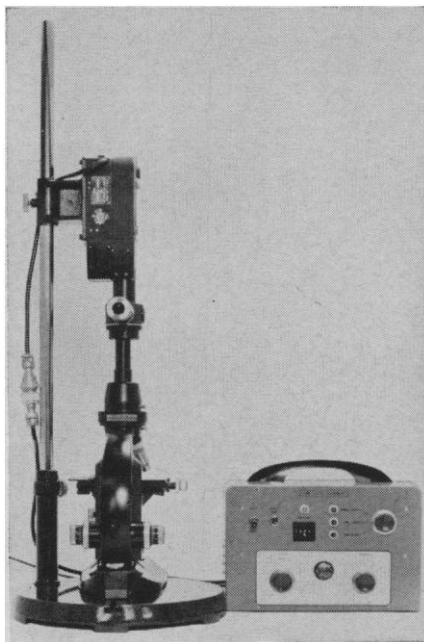
A feature of the design is that the stage is fixed and does not move upon manipulation of the focusing controls. Stability is further increased by the employment of ball bearing focusing slideways, set unusually far apart and of extra length, which move objectives and body tube. An omni-directional gliding stage provides for fast scanning and precise positioning of the object.

The focusing substage can be swung off the optical axis so as to accommodate even very large bottles and flasks. With the substage in use accessories are provided for normal transmitted light, dark ground or phase contrast examinations at all magnifications. A special long working distance objective is offered, initial magnification 20X, N.A. 0.25, working

distance 14mm, which can be used either dry or immersed, with or without a cover-slip.

Accessory equipment for simultaneous viewing and 35mm photography can be employed. The new Vickers Automatic Exposure equipment (which provides for automatic integrating calculation of exposure time and actuation of electromagnetic camera shutter) ensures the obtaining of rapid, correct and uniform exposures.

Vickers-Vinten Equipment for Time-Lapse Cine-photomicrography



Vickers-Vinten Time Lapse Equipment.

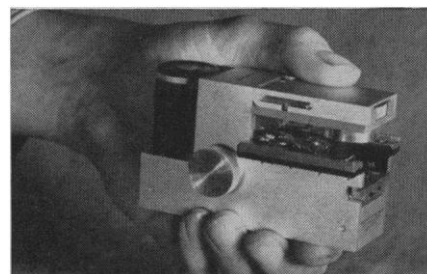
Featured in this new equipment is an Electronic Time Lapse unit of extraordinary versatility which has been developed in collaboration with Dr. R.

Barer and Mr. J. Underwood, Oxford University. With this unit the 16mm Vinten Camera can be operated on Single Shot, Time Lapse or Continuous (8, 16 or 24 frames per second) settings, with changeover between these instantaneous. On the Time Lapse setting any of 15 time intervals from $\frac{1}{4}$ second to one hour can be dialled in. Nine different exposure times from $\frac{1}{4}$ sec. to 1 minute can be selected. A zeroing frame counter is fitted as well as provision for switching off an external light source between exposures (when interval times longer than one minute are selected).

The Vinten 16mm Scientific Camera Mk 1. has been especially designed for time-lapse applications. It is remarkably free of vibration. Construction is at once rugged and precise — its operation is absolutely dependable at any speed and over long periods of time. A 200 ft. film magazine is supplied.

The viewing system shown in the photograph allows the operator the choice of (1) viewing object or (2) monitoring light level, either simultaneously with exposure.

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The McArthur Microscope shown was originally designed for malaria diagnosis and control work in the field in Southeast Asia. It can be quite easily carried in a coat pocket, but retains all the performance advantages of a full size instrument. A full range of achromatic and fluorite objectives is available as well as dark ground accessories. Illumination can be by mirror or by a battery or transformer operated built-in light source.

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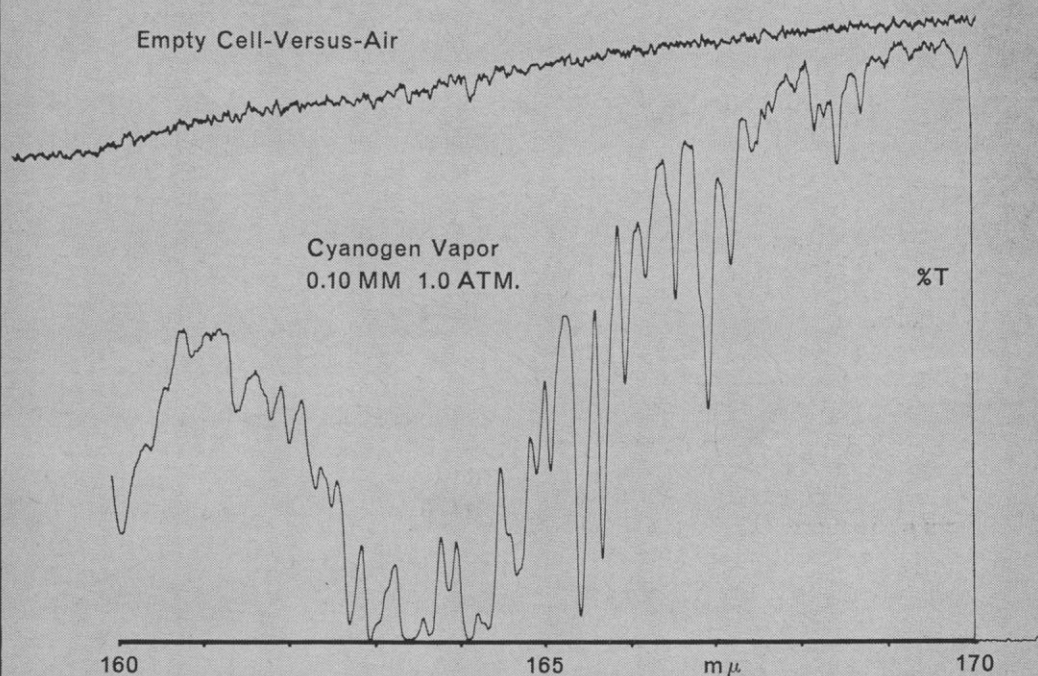
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The Far UV DK-2A goes to the other extreme, too—3500 $m\mu$. This is *the widest continuous wavelength range commercially available!* The Far UV DK-2A covers it with resolution of 0.2A for emission studies and 0.5A for absorption studies at 210 $m\mu$. Consider also: 7 separate scanning speeds, multiple wavelength scale expansions, single-switch selection of 11 different chart ordinate presentations. Plus a wide variety of accessories.

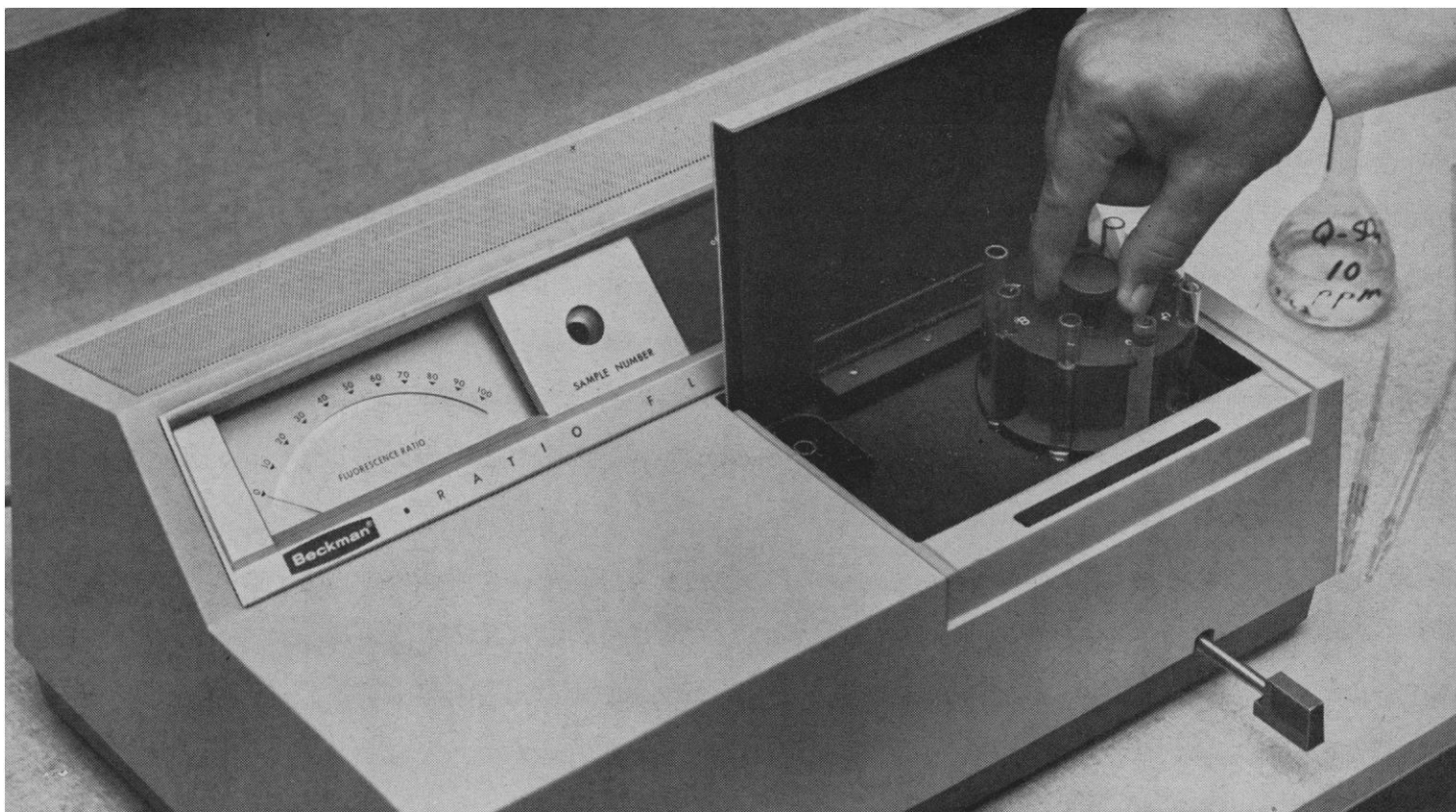
Your Beckman Laboratory Dealer has the full Far UV DK-2A story. Also facts on the Far UV DK-1A if you want the same range in a strip-chart recording instrument. And for work in the 185-3500 $m\mu$ region, ask about the DK-1A with strip-chart recorder or DK-2A with flat-bed recorder. Contact him or write direct for Data File LUV-38-163.

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The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

Devil's Advocates

Increasingly the future shape of science is being determined by legislative actions taken by men who can be expected to have only a superficial knowledge of the technical facts embodied in their decisions. The government provides about two-thirds of the support for the nation's efforts in science and technology, and the fraction has been growing.

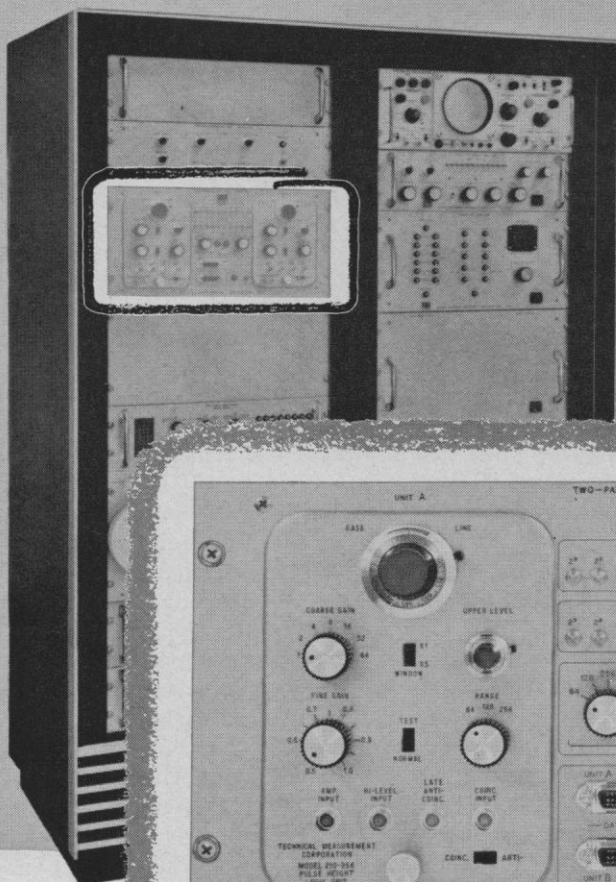
On the surface it would seem that more money for science is a good thing. Indeed, I have heard some scientists say that it would be almost impossible to provide too much support. However, the realities today are that in many areas of science and technology the crucial bottleneck is brains, not money. For instance, top-quality physicists are in short supply, and this deficiency is likely to continue. When Congress votes to expand activity in a field requiring first-rate physicists, it simultaneously makes the negative decision to remove them from other important endeavors.

It has been pointed out that the educational background of members of Congress is heavily weighted toward the legal profession, with little representation from science. The remedy usually proposed is that more scientists should get into politics. On the surface this suggestion is attractive. One obvious difficulty is the time it would take for any considerable group to be elected. A second problem is that, in becoming politicians, the erstwhile scientists would in general lose their professional acuity. Moreover, there is no certainty that a man trained in science would bring as much wisdom to Congress as one trained in the law. Some of the most narrow-minded, uncompromising, chauvinistic individuals in this world are scientists. Many research workers are deeply convinced that their narrow area of inquiry is the only one worth pursuing. I recently sat on a panel which cheerfully toyed with the desirability of channeling the total gross national product into a single area of scientific endeavor. A man representative of such a body of opinion would be a dangerous nuisance on the congressional scene.

The government does not suffer from a quantitative lack of scientific information. Rather, the difficulty is that most of the advice comes from special pleaders. The executive branch has good counsel from the Bureau of the Budget and Jerome Wiesner's office, but the Congress has no independent impartial source of advice. Since the legislative branch cannot evaluate technical proposals, the temptation arises to employ phony arguments in advocating major projects. In scientific circles there is a tendency to be more concerned with the glamorous, salable aspects of a proposal than with intrinsic merit.

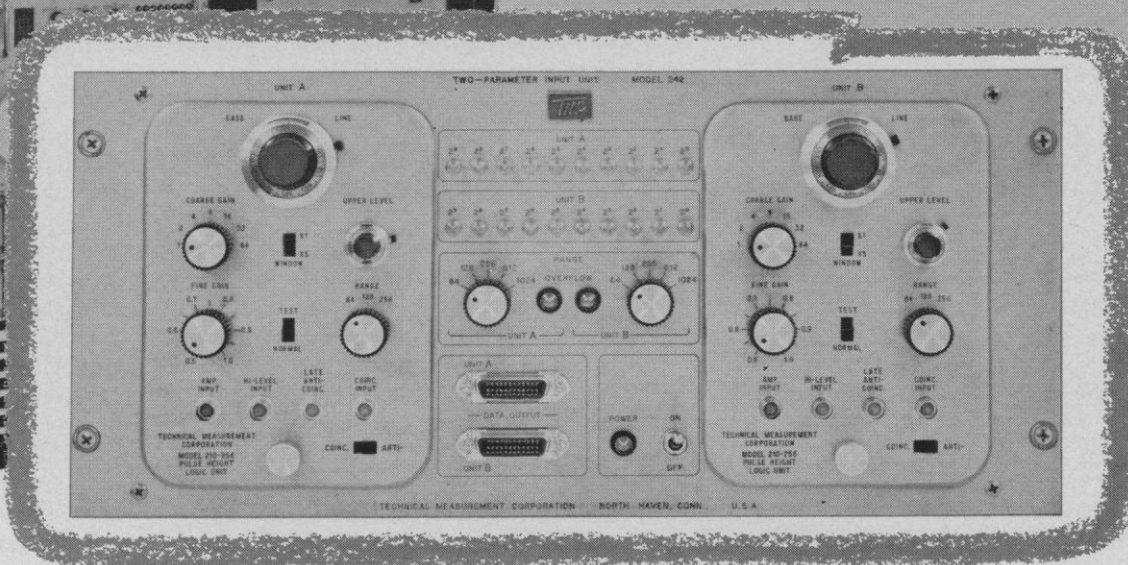
It seems well to consider other ways of improving the scientific judgments of Congress. To make good decisions it is not necessary to digest all the facts. It is necessary to be well advised. One of the more promising methods would be to make available to Congress a special group of scientific counselors. These would supplement existing staff and would not be permanent government employees. They could be nominated by such a body as the National Academy of Sciences on request of Congress. They might serve for short, intensive periods while retaining their professional connections. They would be expected to act as devil's advocates (the *Washington Star* recently made a similar suggestion), with a duty to insure that the public interests was well protected. If such a system could be properly implemented, a substantial improvement in the quality of science legislation might ensue.—P.H.A.

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The most popular configuration for TMC's 4096 Channel Pulse Analyzer Systems is for 2-Parameter studies of coincident nuclear events. To provide the flexibility needed for this general class of experiments, TMC has designed the Model 242, 2-Parameter Input Unit. The Model 242 will accommodate two Plug-in Logic Units to carry out PHA vs. PHA, PHA vs. TOF, TOF vs. TOF. It may also be stacked to provide 4 or 6 logic units for multiple-parameter studies. The above photo shows two Model 210 PHA Logic Units inserted.

The 242 contains two 10-bit address registers, thereby providing dual 1024-channel address resolving capability. The registers can operate in coincidence or in an independent fashion. Access to the registers is possible by parallel entry into all bits or by a serial pulse train into either 10-bit register. Neon indicators are provided for address identification. The output format may be binary or BCD, as selected by a rear panel switch. In addition, register outputs are buffered so the unit can feed parallel address information simul-

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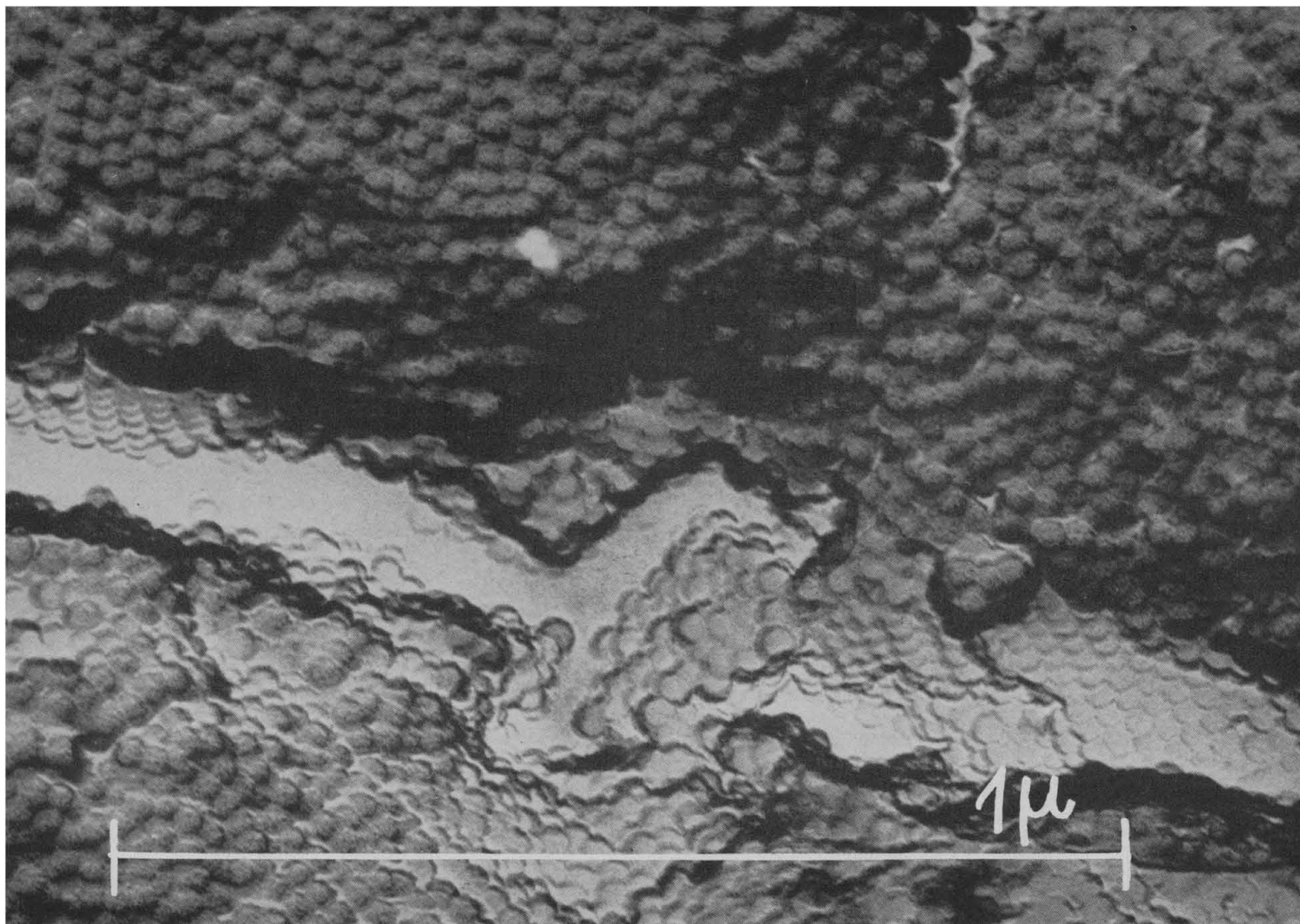
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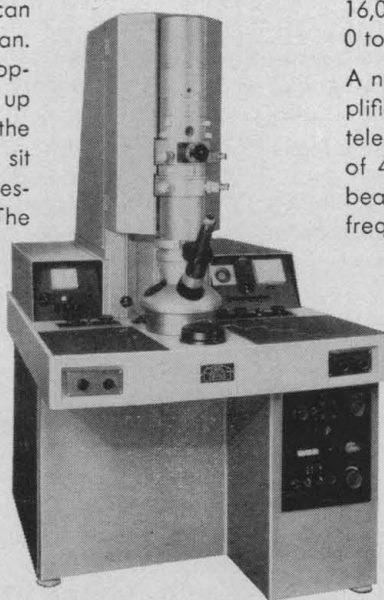
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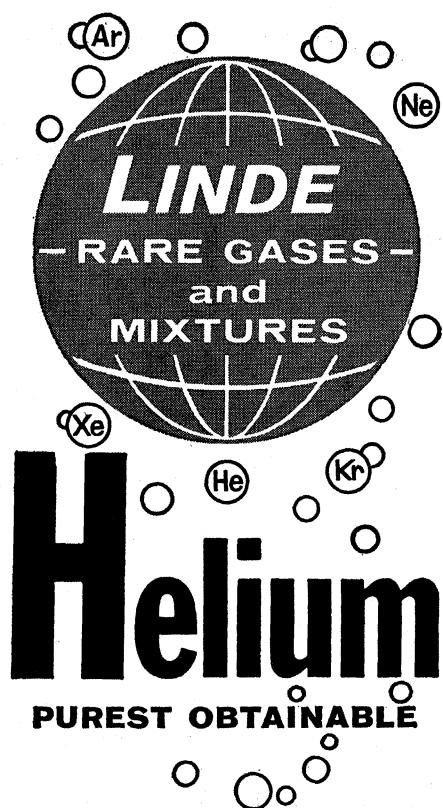
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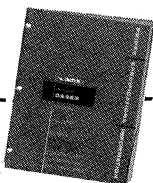
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in the relative amounts of activity transmitted by the pathway from the inner hair cells versus the pathway from the outer hair cells.

Another biological system which exhibits multistable behavior is the system controlling "following" movements of the human eye. Its mode of operation when tracking a predictably sinusoidally moving target is different than when tracking an unpredictably moving target. Laurence R. Young and Lawrence Stark presented a model of this system which provided the two tracking modes and had an input adaptive configuration which switched the tracking modes as needed.

A somewhat different and simplified approach to the problem of multistable systems was presented by Mihajlo D. Mesarovic. He considered multi-level systems in which the first level received information from the environment and produced actions (responses) on the environment. A second-level system examined the behavior of the first level and modified that level's actions so as to achieve some particular goal. Such multi-level systems were simulated by having one person act as the second level "coordinator" of the activities of a number of persons acting as the first level systems. Some findings were that the second level has to have incomplete knowledge of the first level; that the second level can only affect the rate at which the first level converges on achievement of the goal; that second-level control could either speed up or slow down that rate. He found that, in general, such a two-level, goal-seeking system had the advantages that the goal-decider was better isolated from the environment, and that the behavior of such a system was easier to describe than that of a single-level, goal-seeking system.

Analyses of Biological Systems

The increasing willingness of communications scientists and biologists to share problems and techniques was shown by the number of papers presented which involved analysis or theory of actual biological systems—triple the number presented at the first symposium. The types of biological systems were also much more varied. For example, Adrian M. Wenner and Robert C. King presented evidence that honey bees communicate by sound and suggested that in the waggle dance, a method by which a bee informs its

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hivemates of the location of a food source, the information is primarily transmitted by the accompanying sound. This offers the intriguing picture of future bee hives outfitted with a sound source and a mechanical "dancing" bee so that the bee keeper could dial instructions to the bees as to which field to visit.

Experiments were described by William D. Neff which used anatomically specified lesions of the central nervous system in conjunction with behavioral testing to trace those neural paths which carry auditory information. It was found that information concerning frequency discrimination was carried along paths different from those which carry information concerning localization of a sound. He suggested that the latter information was transmitted in the form of time differences in the signals from the two ears to the superior olivary nuclei, where they were re-coded in the form of place differences. He pointed out that in the medial olivary nucleus there was a type of neuron which had two large dendrites, each connecting to the path from a different ear, which seemed like an ideal unit for comparing the responses of the two ears.

A paper on peripheral neural mechanism of hearing in the monkey had been contributed by Yasuji Katsuki, Nobuo Suga, and Masahiro Nomoto, but none of the authors were at the meeting to present it. Fortunately, Keidel, in his invited talk, gave the symposium an excellent introduction to this group's fine studies of the different neural pathways from the inner and outer hair cells.

A most interesting theory of color vision was briefly outlined by J. Y. Lettvin. Starting with the known anatomy of the primate fovea, he proposed certain reasonable-appearing functional interactions of the various cellular elements so that the outputs of the ganglion cells for differing retinal illuminations would be related by the psychophysically determined laws of color matching. A basic assumption of the theory is that the response of each cone is determined only by the number of photons absorbed within its photopigment; the cone therefore is not able to distinguish changes in intensity from changes in wavelength. (In a later paper, E. L. Paulter and R. A. Wilson proposed a theory of color vision in which the rate of change of a photoreceptor's output potential was a function of the illuminating wavelength and



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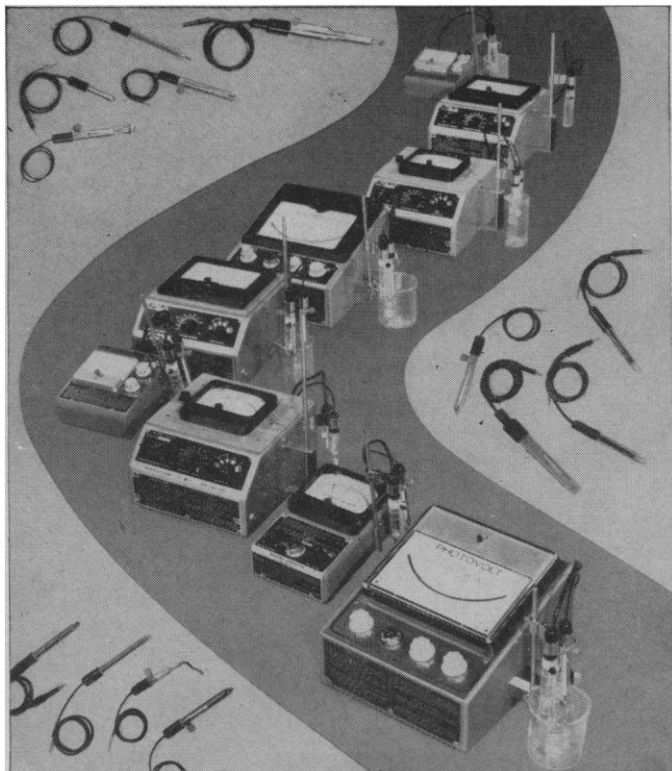
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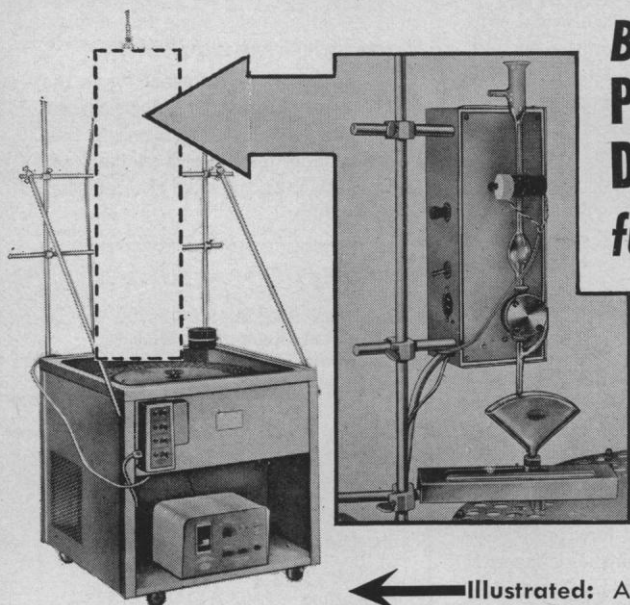
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the magnitude of the potential a function of the intensity.) In one of the neural circuits proposed by Lettvin, excitation from a foveal cone passes by means of a midget bipolar cell to a midget ganglion cell, while excitation from a surrounding annulus of cones is summed by brush bipolar cells and applied as inhibition to the dendrite of that midget ganglion cell. This inhibition acts to shunt and, therefore, to divide the amplitude of the excitatory signal reaching the output of the ganglion cell. In this way the output of that particular foveal cone is normalized with respect to the summed outputs of the neighboring cones, which include all three assumed types of foveal cones. This gives the same kind of mathematical function as Grassman's laws of color mixture. As a consequence of the basic assumption mentioned previously, such a circuit cannot distinguish a change in wavelength from certain changes in intensity distribution over the field of cones or from combinations of such changes. The uncertainty as to the meaning of the output of the midget ganglion cell can be reduced by comparing it with the outputs of the neighboring ganglion cells, thus making it possible to distinguish color and shape. Lettvin's theory is supported by the fact that it leads to the property of color constancy without additional assumptions, and by Kohler's old finding that the human visual system can learn to compensate for the colored edges of objects seen through a prism, so that the edges appear colorless.

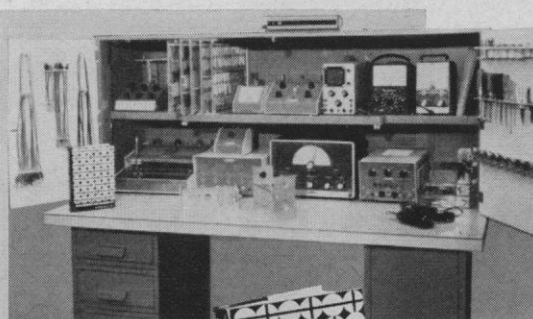
Evidence in support of the concept that the activity of neurons is modified by the surrounding glial and other non-neuronal cells was critically reviewed by Leo E. Lipetz. He pointed out that this concept is still highly controversial and has not yet been proved. However, he concluded that, at least for the vertebrate retina, the evidence makes such non-neuronal control seem highly likely. The basis of such control is the very small space between those cells and the neuron, particularly in the brain and retina, so that those surrounding cells must act as the sources and sinks of ions during any sustained flow of ions across the neuronal membrane. This permits the amplitudes of the neuron's resting and action potentials and the propagation of potentials along the neuron to be affected by changes in the resting potential of the surrounding cells and changes in the ionic conductivity of the membranes of those cells.

Some of the resting potential changes of the surrounding cells seem to be passive reflections of changes in the potentials of the neighboring neurons. But, the evidence makes it seem likely that some changes in the ionic conductivity of those non-neuronal cells are triggered and propagated through the cells by chemical processes. Lipetz proposed that retinal light adaptation could be explained in terms of such a process (for which there is some experimental evidence) propagated along the (non-neuronal) horizontal cells of the retina. He further proposed mechanisms by which certain other retinal functions, such as incomplete spatial summation

and movement detection, could be explained on the same basis.

The aforementioned physiological processes of the non-neuronal surrounding cells provide modifications of neural activity which are slow compared to the responses of the neurons. It is interesting to compare this with H. D. Landahl's explorations of mathematical models of neural activity. He reported that by assuming neural elements which had two sets of time constants, one short and the other long, he was able to form neural nets whose behavior very adequately matched many known psychophysical functions. Such behavior includes flicker phenomena, ap-

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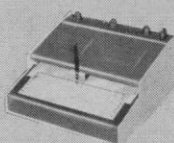
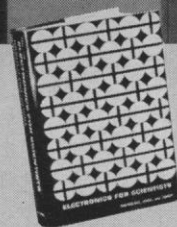


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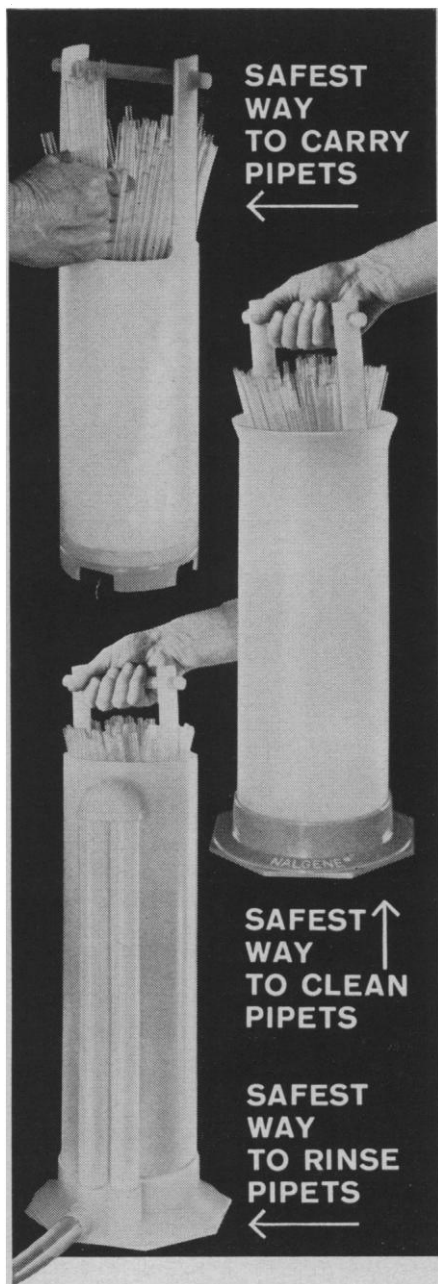
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parent movement, color induction, and color constancy, and other known psychological phenomena such as conditioning and avoidance learning. However, one should note that a neural network may exhibit a long time-constant even though made up only of neurons with short time-constants. This was shown by B. G. Farley, who studied the behavior of computer-simulated networks of formal "neurons." He found that under the proper conditions, such as the presence of a few distant connections among the neurons, the overall network exhibited rhythmic waves of activity with a time constant about 15 times that of the neuron. His films of the activity of the networks in which the firing of each neuron was depicted by a light immediately called to mind Sherrington's beautiful description of the nervous system in action.

The noise limitations of information processing systems were discussed by John L. Stewart who pointed out that, especially in neural systems, there is more noise at frequencies close to zero than at higher frequencies. The system can be made more sensitive to the signal by removing this noise with a high-pass filter and time modulating the signal so that it contains higher frequency components. This technique seems to be used by a number of biological systems, for example physiological nystagmus of the eye, sniffing, and ear wiggling. Stewart described an electronic system for analyzing and specifying (recognizing) patterns of speech. He played a tape recording of some sentences of words synthesized according to those specifications and many of the words proved intelligible to the audience.

A beautiful example of the use of a new technique to illuminate an old problem was provided by the work of Patrick Wall and C. Kronacker. They investigated how the sensory nerves of an animal make the proper connections with its central nervous system. They started with the classical technique of grafting extra organs onto an amphibian and testing behaviorally which reflexes could be elicited by stimulation of the organ. For example, when the cornea of an added eye was touched, one of the normal eyes winked. Their innovation was to insert a microelectrode into the medulla at the level at which the corneal nerves terminated and to record, for 20 or more positions in that level, the electrical potentials which occurred following stimulation of the

cornea. A computer was then used to convert this information into maps of the sources and sinks of current at that level for a number of time intervals after the stimulation. Large sources and sinks were found to be indicative of the terminations of large diameter nerve fibers, such as those from head skin; these were observed to be concentrated medially. Terminations of the smaller nerve fibers, primarily the fibers from the cornea, were concentrated laterally. The authors pointed out that a cut peripheral nerve which instead of regenerating, forms a neuroma, becomes smaller in diameter all the way back to its central termination.

They suggested that, similarly, the skin nerves that penetrate the bloodless cornea become smaller and change their central terminations from medial to lateral medulla. It appears that at the lateral medulla the fibers make monosynaptic connections with motor cells of the sixth nerve nucleus to stimulate the retractor bulbi muscle of the normal eye and elicit the corneal reflex. The basic hypothesis is that the tissue at the peripheral termination of a sensory nerve affects in some way both the diameter and the central termination of that nerve fiber. Additional evidence was provided by studies of normal and transplanted patches of back and belly skin of the frog. The sensory nerve fibers from all patches of back skin were small in diameter, and from all the patches of belly skin were large in diameter, and these different diameter fibers terminated at different positions in the cross-sectional plane of the spinal cord. It appears that a good start has been made toward understanding the code by which the external world is anatomically represented in the central nervous system.

In fact, it could be said that the symposium as a whole made a good start toward providing a logical basis on which to analyze and design information processing systems. For the first time it now seems possible that when the techniques of DNA alteration, molecular electronics, tissue culture, and so forth make possible the laboratory construction of new biological systems, there will exist a theory on which to base the design of the new forms of life.

LEO E. LIPETZ

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Institute for Research in Vision,
Ohio State University, Columbus*

Protein Structure and Function during Differentiation

Problems of developmental biology are proving increasingly attractive to biochemists and geneticists. The central importance of these problems has long been recognized but the intermittent efforts in the past to apply the tools of biochemistry or genetics to the solution of problems of development have not been very rewarding. Now, a breakthrough, particularly in the area of cell differentiation, seems imminent. One of the most profitable avenues of attack lies through an examination of the synthesis, structure, and function of macromolecules and in particular of the proteins.

At the recent Federation meetings the American Society of Biological Chemists brought together representatives of embryology, biochemistry, and genetics in a symposium (15-17 April) devoted to protein structure and function during differentiation. Three well chosen proteins were discussed: hemoglobin, glutamate dehydrogenase, and lactate dehydrogenase. Each illustrates same fundamental aspect of the process of cell differentiation. Park I. Gerald reviewed the extensive work on human hemoglobin. From this work has emerged the most complete description of the time and cell specificity of gene function in bringing about the synthesis of a specific variety of protein. Hemoglobin is a tetramer composed of two kinds of monomers, each under separate genetic control. At least four distinct genes, and perhaps more, encode the structure of corresponding monomers. The relative rates of activity of these various genes at different stages in development determine the availability of the monomeric subunits out of which the hemoglobin molecule is constructed. The subunit composition in turn specifies the functional properties of the hemoglobin, and these are normally in accord with the requirements of the organism, whether fetal or adult. Many mutant genes have been discovered through the aberrant types of hemoglobin they form, and because of the complete analysis of the primary structure of hemoglobin it has been possible to relate these mutations to the substitution of one amino acid for another in the primary sequence. Presumably the several distinct genes for the synthesis of the different hemoglobin monomers arose during the long course of evolu-

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tion by duplication and gradual divergence through accumulated mutations. On this hypothesis the various polypeptide chains of hemoglobin and myoglobin may be placed in a plausible evolutionary sequence based upon the degree of chemical homology among them. From the viewpoint of developmental biology it is not the structure of hemoglobin may be placed in a plausible evolution the fact that one kind of hemoglobin replaces another during development. The mechanism by which genes for protein synthesis are turned on and off are presently unknown, but Gerald described an interesting mutation in a gene which may be responsible for switching on the synthesis of the adult chains of hemoglobin. The location of this gene adjacent to the genes for adult chains of hemoglobin suggests that the well-known bacterial models for regulating gene activity may also operate in man.

The enzyme lactate dehydrogenase (LDH) has a quaternary structure analogous to that of hemoglobin. In fact, much of the work on the structure of this enzyme was stimulated by the prior analysis of hemoglobin. Some years ago Clement L. Markert and his associates at Johns Hopkins discovered that lactic dehydrogenase is a tetramer which may be dissociated into two different varieties of monomers. They originated the hypothesis that the five different forms, or isozymes, of this enzyme found in mammalian tissues were due to the association of the two kinds of monomers in all possible combinations of four. Thus, the formulas for the five isozymes could be written $\text{LDH-5} = \text{A}^0\text{B}^4$, $\text{LDH-4} = \text{A}^1\text{B}^3$, $\text{LDH-3} = \text{A}^2\text{B}^2$, $\text{LDH-2} = \text{A}^3\text{B}^1$, $\text{LDH-1} = \text{A}^4\text{B}^0$. This attractive hypothesis has received general support by investigators working with lactic dehydrogenase, but critical proof was lacking. In this symposium Markert presented for the first time what appears to be a decisive verification of his hypothesis. LDH-1 and LDH-5, each of which according to the hypothesis should contain only one kind of subunit, were isolated as pure preparations from the usual mixture of isozymes. These two isozymes were then mixed, dissociated without denaturation, and allowed to reassociate. Random recombination of the two subunits should generate a mixture of all five isozymes in the proportions of 1:4:6:4:1. This definitive result was obtained.

Amino acid analyses of the different isozymes as presented by Markert also

supported the hypothesis since LDH-3 showed a composition that was the average of LDH-1 and LDH-5. These latter two isozymes have very different amino acid compositions and thus their subunits must be under the control of different genes. The characteristic pattern of LDH isozymes found in each tissue at each stage of development can then be explained by different relative activities of the two genes for the A and B subunits of the enzyme.

Having obtained undenatured subunits of lactic dehydrogenase, Markert combined these subunits from different species to produce a wide spectrum of hybrid isozymes. These hybrid molecules, between mouse and cow or horse and rabbit, are not likely to be found in nature, but may have interesting potentialities for examining the monomeric characteristics essential to the formation of functional tetramers.

Nathan O. Kaplan (Brandeis University) emphasized the functional significance of the different isozymes, particularly LDH-1 which is predominant in heart and certain other muscle tissues, and LDH-5 which is predominant in most skeletal muscles. Kaplan commonly refers to these isozymes as the H and M types, respectively. These two isozymes are known to be differentially inhibited by high substrate concentrations; LDH-5 functions better at the higher concentrations. Moreover, LDH-5 is prevalent in tissues that function under conditions of relative anaerobiosis and that accumulate lactic acid. Kaplan presented an extensive analysis of the LDH composition of many different muscles from birds and other animals and demonstrated excellent agreement between the metabolism of the tissue, whether oxidative or glycolytic, and the isozyme composition. These analyses have been greatly facilitated by Kaplan's ingenious use of analogs of nicotinamide adenine dinucleotide as cofactors in enzyme tests. These analogs discriminate among the isozymes and allow a calculation of isozyme composition in a mixture from the overall relative rates of reaction with the different analogs.

Significantly, the isozyme composition of several tissues changes during embryonic development and may also be shifted by disease or by various treatments such as with hormones. These induced changes in LDH composition are in accord with the apparent functional significance of the different isozymes and also demonstrate

that differential synthesis of related polypeptides can be induced in specific tissues by specific agents. Whether these agents act directly at the gene level or at some later point in the sequence from gene to protein is not yet known.

The coordinate control of groups of enzymes has been extensively studied in microorganisms but little work of this nature has been done with vertebrates. Kaplan presented a novel and intriguing analysis of the distribution of α -glycerophosphate dehydrogenase (GPDH) with reference to lactic dehydrogenase. A close correlation exists between the level of GPDH and the relative abundance of LDH-5, generally prevalent in most skeletal muscles. In exceptional conditions as in the breast muscle of birds accustomed to sustained flying, however, both the LDH-5 and GPDH decrease greatly and LDH-1 becomes predominant. Thus some sort of coordinate control is suggested.

Gordon Tomkins (National Institutes of Health) discussed a different type of biological regulation brought about by molecular conformational changes. He has analyzed the properties of the enzyme glutamate dehydrogenase (GDH) at various states of polymerization and has found, remarkably, that the higher polymers have GDH activity, but as the state of aggregation decreases the GDH activity declines and a corresponding increase in alanine dehydrogenase activity occurs. Moreover, the state of aggregation is subject to regulation by steroid hormones, and this fact opens the prospect that some hormones may act through controlling polymerization of polypeptides and by this means regulate metabolic activity. Such mechanisms permit a very rapid, reversible shift in function without involving de novo protein synthesis. Tomkins finds that in addition to steroids, guanosine triphosphate and the reduced form of nicotinamide adenine dinucleotide, promote disaggregation, whereas adenosine diphosphate promotes aggregation. The availability of these small molecules is closely tied to cell metabolism and their action on protein polymerization bridges the gap between the metabolism of small molecules and the regulation of the activity of specific macromolecules. The specificity of the different polymers was further emphasized by his report that each level of polymerization of glutamate dehydrogenase is characterized by different antigenic properties.

It is interesting to note that each of

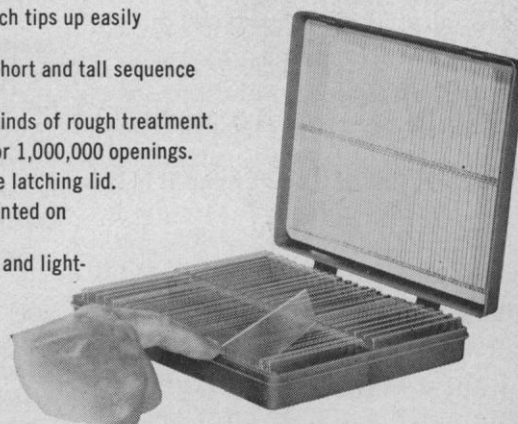
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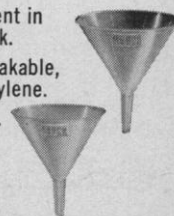
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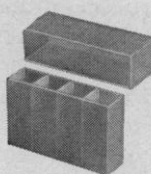
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the proteins discussed in this symposium is a polymer and that variation in its subunit structure leads to altered function. Mechanisms controlling the synthesis of specific polypeptides or governing their association seem immediately related to the functional differentiation of cells and in fact may be fundamentally responsible for differentiation. It is a moot question as to whether all the characteristics of any organism are ultimately attributable to intrinsic molecular structure or whether pre-existing organization (as in the egg or embryonic cell) confers specific order on molecular populations independently of the molecular properties themselves. Some support for both points of view could be found in this symposium.

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Resonant Particles in High-Energy Physics

Recently discovered resonant particles were the main theme of a high-energy physics meeting held at Ohio University, Athens, 26-28 April 1963. The objective of the meeting, attended by about 90 physicists from the United States and Europe, was to achieve a better understanding of the status of the many resonance states and new particles that have been discovered or have shown some evidence of existence in recent experiments. More than 30 elementary particles or resonance states are now known to exist. Until recently there had not been a coherent picture that could serve as a framework to tie all these particles and states together.

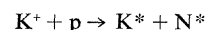
Among the papers of general interest was a comprehensive survey of the isobaric states of mesons and baryons presented by R. Dalitz (University of Chicago). He reviewed the classification of these states into multiplet schemes based on the unitary symmetry model originally suggested by S. Sakata (Osaka University, Japan). This is essentially a symmetry scheme which is a generalization of the isotopic spin. Practically all the existing states fit into this representation very well, and form families of resonances whose structure can be conveniently studied.

Evidence for the existence of a particle which decays into two charged pions (π^+ and π^-) was presented by D. K. Robinson and E. O. Salant

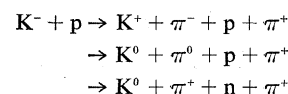
(Brookhaven National Laboratory) and W. D. Walker (University of Wisconsin). The mass of the particle was determined to be 782 Mev, which coincides with that of the known ω particle. Since the ω particle usually decays into three pions ($\pi^+\pi^0\pi^-$), this particle is interpreted as the two-pion decay mode of the ω . The branching ratio of the two-pion decay mode versus the three-pion decay mode:

$$\frac{\omega \rightarrow \pi^+ + \pi^-}{\omega \rightarrow \pi^+ + \pi^- + \pi^0} \sim 5 \text{ percent.}$$

G. Goldhaber and S. Goldhaber (University of California) presented evidence for the production of double resonances of the following reaction:



where K^* and N^* are the K meson resonance state (895 Mev) and the nucleon resonance state (1238 Mev), respectively. This subsequently decays into a four-particle final state:



A one-pion exchange model with a form factor gives a good fit in the experimental angular distribution.

A. Thorndike (Brookhaven) reported the observation, for the first time, of antihyperons in a 20-inch hydrogen bubble chamber in the 3.69-Bev/cm anti-proton beam of the 33-Bev Brookhaven alternating gradient synchrotron.

More detailed information on the properties of $\phi(K_1K_2)$, the most recent member of the family of newly discovered resonant particles, was presented by J. Leitner (Syracuse University) and N. P. Samios (Brookhaven). They reported the following information: mass = 1019 ± 1 Mev; parity, $P = -1$ ($= C$); spin $J = 1$; width $\Gamma_\pi > 0$; isospin $I = 0$ or $G = -1$.

A report on high-energy elastic scattering and Regge pole predictions was presented by L. C. L. Yuan (Brookhaven). Slightly over a year ago a theory based on Regge pole hypothesis predicted that the diffraction pattern in high-energy elastic scattering shrinks with increasing energy. This means that the radius of interaction of a nucleon becomes larger at higher energies. It has also been proposed that all the strong interacting particles are associated with Regge poles and that these poles control the asymptotic behavior of scattering amplitudes. These predictions have aroused great excitement