presented a theory for the synapse as a biochemical self-organizing cybernetic unit. Roberts concluded that according to the best data presently available it is not necessary to postulate actual production and storage of chemical memory records or stimulus-directed syntheses of special "memory" molecules. During the discussion period there was a vigorous exchange of views between Nachmansohn and the audience.

The chairman of the session on the physiology and pharmacology of the nerve cell, G. B. Koelle (University of Pennsylvania), briefly summarized the two earlier sessions and reviewed evidence supporting the theory of neurohumoral transmission, thus setting the stage for discussion of nerve functions. R. D. Keynes (Institute of Animal Physiology, Cambridge, England) reported on his studies of the thermodynamics of nerve and of the electric organ in fish; he discussed theories of the causes of temperature changes in the nerve which are associated with single impulses and of temperature changes in electric organs. W. L. Nastuk (Columbia University) discussed the action of certain quaternary ammonium compounds in neuromuscular transmission. D. R. Curtis (John Curtin School of Medical Research, Canberra) comprehensively reviewed synaptic transmission in the central nervous system and its pharmacology, including central inhibition, the role of acetylcholine as a central transmitter, and the possibility that amino acids present in central nervous tissue are also transmitters. K. S. Cole (National Institute of Neurological Diseases and Blindness) reviewed the nerve impulse, pointing out that an impulse is conducted along a nerve fiber by a rise of the membrane potential and an inflow of sodium ions. Recovery follows, with a loss of potassium ions and a return of the potential to the original resting level. Cole also pointed out that it now seems probable that the membrane is a bimolecular layer, but that the processes by which ions move across it and produce an impulse are entirely unknown and most proposed theoretical and experimental models for a nerve membrane are not able to explain important observed facts.

At the session on the pathophysiology of nerve tissue, Frederic Bremer (University of Brussels) spoke on "The tissue and the organ." A. A. Ward (University of Washington, Seattle) presented conclusive evidence that neurons in the epileptogenic focus are characterized by autonomous hyperactivity, confirming Jackson's hypothesis that they are in a hyperphysiologic state. His data suggest that such neurons are at least partially denervated. Ward pointed out that there is a body of evidence supporting the idea that denervation of excitable membrane is associated with autonomous hyperactivity and suggested that one of the proximate causes of the autonomous hyperactivity may well be a reduction of resting membrane potential of dendrites or soma, or of both.

D. Elmqvist (University of Lund, Sweden) reported on his studies of neuromuscular transmission in patients suffering from myasthenia gravis; the work was done in vitro with intracellular electrodes. The amplitudes of the miniature endplate potentials and of the quanta in the endplate potentials were found to be small, but the frequencies, as well as the number of quantal components, of the miniature endplate potentials were normal. The sensitivity of the postsynaptic membrane to carbachol and decamethonium was the same in the muscle of myasthenic patients as in that of controls. Elmqvist concluded that in myasthenia there is a deficiency in the amount of acetylcholine in the quanta released from the motor nerve terminals.

R. B. Richter (University of Chicago) presented a general commentary on research accomplishments which have most profoundly influenced the practice of clinical neurology. He anticipated that knowledge of brain as a tissue will provide definitive explanations of the pathogenesis of many degenerative neurological diseases which are currently merely surmised to be inborn errors of metabolism. "It is even possible," he said, "that much more occult disorders such as schizophrenia will be shown to have their specific histo- or cytometabolic substrates."

At the conference dinner Sir John Eccles spoke on the strategy of neurophysiologic research in a most informative and stimulating manner. He pointed out that it is not scientifically disgraceful to have one's hypothesis falsified, saying, "We will advance in scientific understanding by the experimental rejection of erroneous hypotheses, so that the way is cleared for new conceptual developments." He emphasized the importance of choosing very carefully the best sites for experimental investigation and warned against "running in a groove." Eccles recommended breaking off now and then from detailed scientific work "to lift one's eyes to scan distant horizons" and underlined the value of personal communications and free exchange of ideas with constructive criticism. "I would suggest that if your theories are attacked, that is really a compliment," he said; "It shows that they are worthwhile and a challenge to criticism. How much worse it is to have them ignored!"

The proceedings, including discussions, will be published by Harper & Row, New York.

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Nuclear Activation Analysis

What appears to be a major breakthrough in the field of small neutron generators was announced at the conference on recent advances in activation analysis held in Glasgow, Scotland, 27–28 August 1964. Whereas simple sealed-tube sources of 14-Mev neutrons available heretofore have had an output range of only about 10^7 to 10^8 neutrons per second, a new British system has a neutron output of 10^{10} per second.

C. H. Gill (Elliott Electronic Tubes, Ltd.) described the new tube. Operating with a mixed deuteron-triton beam of 1 to 2 ma and an accelerating potential of 110 kv, the tube maintains 14-Mev neutron output rates of 10^{10} per second or more for at least 100 hours and possibly for as long as 500 hours; the target can then be replaced at a reasonable cost. According to P. D. Lomer (Services Electronics Research Laboratory), the tube can be switched on and off at will and rapidly reaches a steady output rate. A thin film of erbium metal (tritiated) on a simple metal backing is used as the target. The lifetime of the tube appears to be limited primarily by target sputtering. A similar 10-ma current tube, which may give about 10^{11} neutrons per second, is under development; this tube would rank in output with the larger, more expensive, pumped, gas-input 14-Mev neutron generators now in wide use, especially in the United States.

An advanced, high-precision activation-analysis system for quantitative determination of oxygen in metals and

other materials, which uses a 14-Mev generator with an output of 2×10^{11} neutrons per second, was described by V. P. Guinn (General Atomic). This system is completely automated and employs a dual pneumatic-tube transfer system (for sample and monitor), sample and monitor rotation during activation, and simultaneous counting of sample and monitor; reproducibilities within the limits of the counting statistics are now achieved. Sensitivity of the system is about 10 μg of oxygen, that is, 1 part per million in a 10-g sample; at higher oxygen levels the precision and absolute accuracy are within 1 to 3 percent. Samples can be analyzed nondestructively at the rate of one per minute or faster. Very low levels of oxygen have been successfully determined in such metals as Li, Na, K, Cs, Be, Al, Fe, Si, Nb, W, Ti, and Mo. Reactive metals are handled and encapsulated (in low-oxygen copper) in a special inert-atmosphere box.

Certain results of activation-analysis studies in the biological-medical field are most intriguing. M. H. Feldman (Walter Reed Army Institute of Research) pointed out that the average concentrations of manganese in different species of ants may differ by as much as 100-fold, and that concentrations in all ants are much higher than those in man; in some species the concentration is as high as 670 ppm. The resistance to radiation of certain species of ants may be related to these high concentrations of Mn. Manganese concentrations in various species of mosquitoes also vary rather widely. F. Girardi (Euratom laboratories, Ispra) reported studies on Mn in fresh-water mollusks in which an automated, purely instrumental procedure was used. Analysis of various organs and tissues of the mollusks revealed a greater accumulation of Mn in some sites than in others.

G. D. Bird (University of Florida) reported studies on manganese in the urine of patients with kidney stones. Surprisingly, such patients excrete rather large amounts of Zn but small amounts of Mn, even though both elements are thought to inhibit mineralization. It is believed that certain trace elements tend to prevent the formation of kidney stones and that persons living in areas where the drinking water is very low in trace elements are more likely to develop kidney stones. Osteoporosis patients also excrete large amounts of Zn, and one diabetes patient studied was found to

excrete large amounts of Mn. N. Spronk (Free University of Amsterdam) presented an apparent solution to one of the major problems in the activation analysis of biological samples for trace elements, that of the large interference produced by the great amounts of Na^{24} formed. In a procedure requiring less than a minute, the activated sample is wet-ashed on top of a Dowex-1 anion exchange column with aqua regia at 60°C, and the sodium is eluted with 6*N* HCl. Polyvalent cations such as Cu^{++} remain in the column. In a typical case 99.99 percent of the Na was removed, with negligible loss of Cu. Spronk is currently measuring the Cu levels in the foot muscles and brains of freshwater snails. G. S. Nixon (University of Glasgow) reported studies of possible roles played by such trace elements as V, Mo, and Se in the prevention of dental caries. H. J. M. Bowen (Wantage Laboratory) announced the preparation of 90 kg of powdered kale leaves as an international laboratory standard for biologists interested in trace-element determinations. Some 30 elements in kale have been identified; samples are available from Bowen.

Two papers on the use of neutron activation-analysis for forensic purposes were presented. R. F. Coleman (Aldermaston Laboratory) reported on characterization of hair trace-element levels; he and co-workers have found as many as ten trace elements in single strands of human hair by purely instrumental analysis; this result is similar to that of R. E. Jervis *et al.* A least-squares computer program is used to resolve the gamma-ray spectrum data. The amounts of some elements in an individual's hair seem to vary considerably owning to external contamination. Coleman's group is initiating a large-scale study of trace-element levels in human hair in Great Britain. Guinn described forensic activation-analysis studies of several types of material, the detection of traces of Ba and Sb in gunshot residues on the skin, and the first three court cases in the United States in which results of activation analysis were admitted as evidence.

The conference, which was preceded by a 2-week advanced training course, was sponsored by NATO. For study and experiment, participants had the use of the new research reactor at East Kilbride, facilities of the University of Glasgow and the Western Regional Hospital Board, and various

activation-analysis equipment, especially neutron generators and multichannel pulse-height analyzers, provided by American and European manufacturers.

Publication of the proceedings is not planned, but abstracts of the 23 papers presented are available from the program supervisor, J. M. A. Lenihan, Regional Physics Department, 9 West Graham Street, Glasgow, C.4.

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Dental Caries: A New Look

Dental caries is a multifactorial disease whose gross manifestations are preceded by events on the molecular, atomic, and subatomic levels. It was specifically to explore and delineate these events that the New York Academy of Sciences sponsored a conference on the mechanisms of dental caries 30 November–1 December 1964 in New York City. The conference represented a multidisciplinary attack on the problem, rather than the usual clinical approaches which have been exhaustively explored in previous dental symposiums.

The mineral structures of the tooth and the physico-chemical laws governing the dissolution of the mineral components were dealt with at the first session. W. E. Brown (American Dental Association) and B. M. Wallace (National Bureau of Standards) pointed out that calcium and phosphorus ions may diffuse through enamel at different rates and that, as a result, an increased concentration of calcium, phosphorus, and hydrogen ions might occur within the enamel; this could account for the subsurface dissolution of the structure. The mechanisms of diffusion of these ions through the enamel can be explained by treating the enamel layer as a semipermeable membrane according to L. S. Fosdick (Northwestern University). Similar results were obtained by M. D. Francis (Miami Valley Laboratories, Proctor & Gamble), who demonstrated a surface complex which controls the rate of dissolution of the underlying enamel structures.

The effects of fluoride were examined in a series of papers from A. S. Posner's (Cornell Medical) group