

tures low enough so that bacteria were not active showed that an actively metabolizing microflora is quite necessary for the removal of ABS and adsorption on the soil particles has no significant role in removal. The use of activated charcoal in the adsorption and removal of these sulfonates is sometimes a necessary but expensive expedient. Adsorption with aluminum salts, often used as flocculants in water purification, and with ferric salts has not been found promising except in certain limited industrial usages. This type of removal is greatly influenced by pH, since the adsorbed material must be the ABS anion.

Several of the participants in the symposium cited the inadequacy of available analytical procedures. The methylene blue test provides a very poor quantitative estimate of the intermediate compounds in the case of this biological degradation. This is due more to the ineffectiveness of the chloroform extraction of the intermediates than to lack of sensitivity, although certain ions and other contaminants in sewage may adversely affect interpretation of the test. In one experiment an organic compound, molecularly identical with ABS except for one oxidized carbon atom (a carboxyl group), was added to a test synthetic sewage. The standard methylene blue assay procedure was then used, and only 47 percent of the test material was recovered; the results demonstrated clearly the weakness of this assay.

The need for effective analytical techniques with respect to the polyethylene glycols is even more urgent. These materials are being more widely used in an expanding variety of products, but there is no test specifically sensitive for determining their presence in water.

There are existent "biologically soft," or easily degraded, synthetic detergent compounds. Examples of these are the sulfate esters of long-chain alcohols and certain sulfonate compounds with unbranched carbon chains. The "biologically hard" detergents are the ABS compounds with branched chains in which the branching stops the progressive bacterial oxidation of the hydrocarbon chains, and the polyethylene glycols of large molecular weight, which may be too large to penetrate bacterial cells and thus become subject to oxidation. There was some suggestion that future legislation may restrict the marketing of detergents to the

easily biodegradable products. However, intensive studies of the degradability of the branched-chain (tetrapropylene derived) ABS complex may indicate better means of disposal of this more economically produced material.

A promising new technique for analyzing degradation of these detergents in sewage and waters is gas chromatography. It was reported that microorganisms in river water degraded several selected isomers of straight chain ABS to intermediates with progressively shortened, oxidized side chains. These were further degraded to unknown, unextractable compounds, perhaps even to carbon dioxide and water.

Although most of the papers in the symposium reported experiments with the mixed bacterial populations of sewage or river water, there were two papers describing work with pure cultures of bacteria obtained by soil enrichment. One of these described a bacterium capable of growing on ethylene glycols ranging in complexity from one to several hundred repeating units. These glycols, containing ether linkages, can serve as the sole source of carbon for the bacterial growth. In studies of the smaller, structurally simpler glycols it was noted that the efficiency of oxidation varied directly with the number of ethylene glycol units in the molecule, whereas the efficiency of conversion of the carbon of the substrates to bacterial cytoplasm varied inversely. Substitution of methyl, butyl, and phenyl groups for glycol groups impeded growth of the bacteria, whereas compounds with carboxyl groups attached were effective growth substrates.

The utilization of the "biologically soft" detergent, sodium lauryl sulfate, and a mixed sulfonate preparation by pure cultures of bacteria were reported. These materials served as sole sources of carbon after "enrichment culturing," and either one of two isolants was able to degrade sodium lauryl sulfate so completely that it could no longer form suds after the period of bacterial growth. These bacteria grew on and oxidized a variety of long-chain acids and alcohols, and one of them could grow on just the ring compound of the sulfonate molecule, that is, benzene sulfonate. When cultured in a medium containing both a very small amount of rich natural organic matter (yeast extract) and the deter-

gent compounds, the rate of growth of the bacteria on the detergents was greatly increased. However, only 20 to 25 percent of the ABS provided was consumed by the growing cells of this single pure culture of bacteria. Three of five purified isomers of dodecyl benzene sulfonate supported growth of the bacteria, whereas the other two isomers were toxic and killed the cultures. The desirability of learning more about the degradation of branched-chain ABS (derived from tetrapropylene) by both the mixed population of sewage seed and by pure strains isolated by "enrichment cultures" emerged as the dominant idea from this symposium.

There were two contributed papers. The first reported that the polyethylene films, because of their sturdiness and the various thickness available, serve well as surfaces for testing disinfectants. The second paper described experiments on the keeping quality of hides, particularly during the prolonged holding time between skinning and processing. The surfactant benzalkonium chloride preserves the untreated hides for longer periods without adversely affecting quality.

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Neuromuscular Function

For the last decade the laboratory of Ernest Gutmann and his associates at the Institute of Physiology of the Czechoslovak Academy of Sciences has been a leading center for research on the biochemical and physiological aspects of neurotrophic relations between nerve and muscle. Thus it was appropriate that an international symposium on the Effects of Use and Disuse on Neuromuscular Function was held 18-22 September at Liblice, near Prague, Czechoslovakia.

The purpose of the symposium was to evaluate current knowledge of the effects of neuromuscular use and disuse with respect to the nature of the still unidentified trophic influence. The participants always returned to this key point even though many of the papers were only peripherally related to it.

In introductory talks, Sir John Eccles (Canberra) reviewed the general physiological relationships between nerve and skeletal muscle which indicate neuro-

trophic effects, and E. Gutmann (Prague) discussed the findings of the Czech workers on metabolic alterations in muscle which result from denervation and regeneration. Eccles and Gutmann agreed that maintenance of the normal trophic state of muscle depends, not on the rapid excitatory effects associated with conduction and transmission of impulses, but on a continuous, peripherally directed flow of axonal material to the muscle. In this flow the subthreshold release of acetylcholine at the neuromuscular junctions, which is signalized by miniature end-plate potentials, may play some role.

In the first group of sessions, papers were presented which greatly extended and in general supported these basic ideas. Microscopically visible axoplasmic movement, evidently in the proximo-distal direction, was dramatically shown by P. Weiss (New York) in his time-lapse motion pictures of mature nerve fibers explanted with their ganglion cells. R. Miledi (London) and S. Thesleff (Lund, Sweden) discussed their recent independent work on the direct neural influence that restricts, to the end-plate zone, sensitivity to acetylcholine of the normally innervated muscle. M. Singer (Cleveland), L. Guth (Bethesda), and J. Szentagothai (Pecs, Hungary) discussed the specific trophic affinities and influences between nerve and muscle cells that are involved in the generation and regeneration of reflex patterns in these structures. H. Hydén (Göteborg) discussed results obtained with his extremely sensitive ultramicrochemical techniques; these techniques revealed certain features of the hitherto almost completely unknown metabolic and functional interactions—that is, trophic influences—between neuronal and glial cells. J. Eccles, in discussing work of the Canberra laboratory, reported striking indication that the physiological, and hence the nutritive, nature of a muscle fiber is neurally determined. This work showed that slow and fast muscles can be made to interchange their characteristics by surgical cross union of the respective nerves to the muscles, and that maintenance of the basic functional pattern of at least the slow muscles requires connection to proper segments of the spinal cord. A. J. Buller (London), Z. Drahota and E. Gutmann (Prague), and N. M. Shamarina (Moscow) discussed the search for basic distinctions between slow and fast muscles. Buller discussed differences in active state: Drahota and Gutmann, differ-

ences in chemical composition; Shamarina, differences in electrophysiology. A very curious and interesting difference in a particular pair of fast and slow muscles was reported by T. P. Feng and W. Y. Wu (Shanghai). They found that, after sectioning of its motor innervation, the anterior latissimus dorsi muscle of the chicken (a slow muscle) develops a true hypertrophy—a remarkable anomaly in itself—in contrast to the typical atrophy that appears after denervation of the posterior latissimus dorsi muscle (a fast muscle). Although these reports dealt, in general, with effects which have in common neurotrophic influences acting along the “forward” direction of the reflex arc, evidence of antidromic action was also presented. Thus, J. Zelená and P. Hník (Prague) showed that proper development of muscle receptors—that is, muscle spindles and tendon organs—depends on neural influences from their sensory nerve fibers, and L. Lubínska (Warsaw) presented evidence of ascending movements of cholinesterase activity.

A second set of sessions dealt with the extremely varied adaptive effects in nerve and muscle cells subjected to various kinds of use and disuse. Regarding the nervous system, the predominant interest was in the modifiability of spinal-cord reflex mechanisms according to the nature of the afferent inputs. E. A. Asratyan (Moscow) showed that after unilateral deafferentation of a hind limb, systematic training resulted in enhancement of reflex activity, whereas inactivity produced opposite results. R. Beránek, P. Hník, L. Vyklický, and J. Zelená (Prague) described experiments which indicate that tenotomy causes changes in the sensory outflow from the immobilized muscle, and that these changes in turn increase synaptic excitability in monosynaptic spinal responses. Describing studies of intracellular potentials of a spinal motoneuron affected by degenerating sensory neurons, P. G. Kostyuk (Kiev) reported deleterious effects in transmission at the degenerating synapses and enhanced transmission at neighboring normal synapses. Thus, “partial denervation” of the motoneuron causes increased sensitivity in the postsynaptic membrane, homologous to that found in the denervated muscle membrane. With regard to chemical effects, B. Jakoubek, E. Gutmann, and J. Hojék (Prague) discussed changes in protein metabolism in activated peripheral nerve, and H. Hydén and E. Egyhazi (Göteborg) re-

ported the important result that RNA content was increased, and RNA base composition was altered, in neurons of rats subjected to intense learning activity.

The last three sessions of the symposium were concerned with changes in the muscle cell in response to altered conditions broadly conceived as involving modifications of use and disuse. S. V. Perry and D. J. Hartsborne (Birmingham) discussed their pioneering work on the changes in the proteins during development of muscle. E. Fischer (Richmond) gave a comprehensive review of the behavior of normal and of rehabilitating muscle throughout the organism under conditions of use and disuse. Many of the contributors (G. Schapira and J. C. Dreyfus, Paris; D. L. Ferdman, Kiev; O. Hudlická and A. Bass, Prague; K. Lissak, Pecs) dealt with alterations in enzymes, structural proteins, energy metabolism and blood flow, and nucleic acid metabolism in muscle treated in various ways. A. Sandow and A. Eberstein (New York) reported that fatigue of the muscle fiber is due not to impairment of the excitatory or the contractile systems but to decreased effectiveness of the excitation-contraction link.

The many symposium papers that were related only indirectly to the theme of trophic influence had a useful function. By stressing the extreme plasticity of muscle as it develops and as it reacts and adapts to various regimens of use and disuse, they indicated the many facets of muscle function that can conceivably be affected neurotrophically. Such relationships suggest that disturbances in neurotrophic relationships may play a decisive role in generating myopathic states of which the causes are now considered to be inherent in the muscles themselves. This was one of the points stressed in the long and lively discussions that followed the formal presentation of papers.

The proceedings in general demonstrated that trophic influences of nerve are exceedingly important in determining the long-range metabolic state and hence the basic functions of the various cellular elements upon which reflex action depends. A monograph of the proceedings is now in press.

The symposium was organized by Gutmann and his associates at the Institute of Physiology and sponsored by the International Union of Physiological Sciences; about 60 investigators from 13 different countries were among the

invited guests. The Czechoslovak Academy of Sciences played host for the occasion by making available the 250-year-old baroque castle, at Liblice, which it has developed as a countryside center for its general scientific functions.

Diversion from the scientific sessions was provided by a recital of violin sonatas played at the castle by P. Hník (Prague), and by trips to Prague to see some of its extraordinary architectural grandeurs and attend various ballet and symphony performances. The farewell banquet was highlighted by many spirited toasts warmly expressing appreciation for the cordial hospitality of the Czechoslovak hosts and the generally gratifying experience enjoyed by all throughout the symposium.

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Kinesics and Paralanguage

The developing study of nonverbal communication was discussed in an Interdisciplinary Work Conference on Paralanguage and Kinesics, held recently in Bloomington, Indiana. The forms of communication principally discussed were body motion and those aspects of speech which are designated paralanguage, rather than language itself. Workers from the fields of psychiatry, psychology, education, cultural anthropology, and linguistics participated.

At each of the five sessions a paper was presented to cover, from the points of view of bibliography and theory, the contributions which the discipline in question may be expected to make to a study of the different modalities of communication. Peter F. Ostwald showed how the clinician must be able to collect all available information about a patient's mental and physical state, including signals which are sometimes culturally patterned and sometimes purely physiological. George F. Mahl, in a paper prepared by himself and Gene Schulze, gave an extensive survey of relevant psychological literature, much of it methodological, and an outline of the potential formulations of extralinguistic research in terms of

theories of development, motivation, adaptation, and characterology. Alfred S. Hayes combined a discussion of the specific development of these two fields, especially the work of George L. Trager and Ray L. Birdwhistell, with an analysis of possible applications in the field of foreign language teaching. Weston LaBarre discussed some of the many contexts in which anthropologists have handled material related to kinesics and paralanguage, and some of the questions that further research may be expected to answer. In a paper on linguistics, Edward Stankiewicz discussed the problems of emotive language and the ways in which the noncognitive aspects of communication impinge upon and overlap verbal communication.

Because of the present state of development of linguistics, a great part of the discussion centered on the usefulness of the linguistic model in the handling of paralinguistic and kinesic data, and on the difficulty of isolating units for analysis, apart from language proper, and of identifying the level on which they function. However, a developed theory of communication, or semiotics, would have to include communication through touch, smell, and taste as well as through sight and hearing; in the visual mode, at least, two codes would be needed to account for the data, standing in the same relation to one another as language and paralanguage.

The need for a unified, interdisciplinary approach was indicated by the fact that different cultures vary in the extent to which they exploit or rely on any one mode of communication, and the fact that the same observed material may be shown by analysis to belong to different levels of the total system in different societies. Since interaction is a continuous process and communication through such means as posture may be effected over long periods, the tendency, characteristic of linguistics, to study only one party to the communication system, in isolation from his social environment, is partly responsible for the fact that paralinguistic and kinesic theory have been so late in developing.

Similar limitations on observation have characterized psychiatry and psychology. Thus, much of the increased

interest which led to the organization of the conference stems from the work of anthropologists. However, the need for an expanded framework in which to study communication is apparent in all disciplines. On the one hand, a great part even of verbal behavior can be analyzed only in the context of the total interactive communication system, and thus, in a purely linguistic analysis, was often ignored or consigned to footnotes; on the other hand, many data, especially for diagnostic purposes, may be more readily available in nonverbal behavior, if it can be systematically recorded. As for pedagogy, it was felt that encouraging language students to a general imitation of foreign speech and gestures, through moving pictures or informants, is more practical than an analytical approach, provided the language teacher is aware of the importance of paralinguistic and kinesic material. It was strongly recommended that further interdisciplinary seminars be held and that training programs be set up.

A lecture by Margaret Mead in the "Horizons of Knowledge" series was correlated with the conference. She will provide a general overview of the conference in a volume, to be published by Mouton, which will include revised versions of the five papers and transcripts of the discussion. The volume will be edited by Thomas A. Sebeok and Alfred S. Hayes, assisted by Mary Catherine Bateson.

Among the 60 scholars who were present at the conference, held from 17 to 19 May 1962, were Emma M. Birkenmaier, representing the National Education Association; Charles A. Ferguson, for the Center for Applied Linguistics; A. Bruce Gaarder, for the Office of Education; John Lotz, for the American Council of Learned Societies; Klaus A. Mueller, for the Associated Colleges of the Midwest; Donald Walsh, for the Modern Language Association; and Harold Wooster, for the Air Force Office of Scientific Research. The conference was sponsored by the Indiana University Research Center in Anthropology, Folklore, and Linguistics, under a contract with the U.S. Office of Education.

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