data, he was able to obtain two-dimensional slope spectra of the wind waves. He concludes that microwave scattering from low-speed wind waves (in a short fetch tank) can be satisfactorily accounted for by low-order Bragg scattering. Wright conjectured that the Doppler bandwith is a kind of inverse lifetime for the Bragg resonant wind wave. This suggestion, attributed to Crombie, means that the currently accepted views by oceanographers on wind waves are incomplete at best. There was no rebuttal from any physical oceanographer in the audience!

An unscheduled but useful presentation was given by L. Wetzel on the signal characteristics received beneath a rough ocean. He compared several different models proposed on earlier occasions.

A round-table discussion on the Radio papers was held. An edited account of this is being prepared by A. W. Biggs. It served as a useful mechanism to extend the discussions which followed each of the papers above. Unfortunately, the format of the round-table session was not conducive to informal discussion. It may be better in future meetings of this kind to dispense with "round-table" discussions and instead allow more time for discussion after each paper.

This meeting, organized by the Electromagnetic-Wave Propagation Panel of the Advisory Group for Aerospace Research and Development (AGARD), was held at the Centre National de la Recherche Scientifique in Paris. The program chairman was P. Halley from Saclay, and the cochairman was T. Hodara (Tetra Tech, Inc., Pasadena, California). The EM Wave Propagation Panel is under the chairmanship of K. Davies (Environmental Science Services Administration, Boulder, Colorado), and the executive officer is C. R. Smith (U.S. Navy, AGARD staff, Paris).

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Oral-Facial Sensory and Motor Mechanisms

The U.S.–Japan Cooperative Science Program has fostered an exchange of scientific information through joint seminars on subjects under intensive investigation in both countries. Neurobiological research on sensory and motor function in the oral-facial regions was the subject of such a seminar held on 19 to 22 January 1970, in Honolulu, attended by 22 investigators, including nine representatives from Japan.

The major topics under consideration included thermoreceptor and mechanoreceptor activity, and central mechanisms of oral-facial sensation and movement. Basic neurophysiological mechanisms and correlated ultrastructure underlying sensory and motor function were emphasized.

There was considerable interest in thermoreceptor activity in the face area. A common finding was that specific thermoreceptive myelinated afferents were usually "cold" fibers; they increased their activity with cooling and decreased their activity with warming. "Warm" fibers were uncommon. However, a high density of warm spots confined to an area of skin across the bridge of the cat's nose was reported; electrical activity was recorded from myelinated fibers whose activity was approximately the reverse of that seen in "cold" fibers.

Units responding to both thermal and mechanical stimulation were found in the trigeminal ganglion, medulla, and thalamus of monkeys. These units responded to rapid cooling with increased dynamic discharge rates and had response profiles that increased linearly over the entire range of cooling temperatures. It was suggested that both the thermal and mechanical units and specific thermal units function in the central coding of temperature change.

In another study, the subjective responses to temperature changes in man were compared with the peripheral neural activity evoked in the rhesus monkey by a comparable series of thermal stimuli, on the assumption that the sensory capacities in the two systems were similar. It was found that the responses of A delta thermoreceptive fibers alone can transmit sufficient information centrally to account for man's subjective estimation of temperature change in the cooling direction over the range of 10°C. In light of the paucity of "warm" units found by various investigators, it was suggested that warming might be coded by the magnitude of the decrease or cessation of activity of "cold" units. However, in man, such changes in the activity of "cold" units did not transmit sufficient information centrally to account for the subjective estimation of warmth.

Another area which generated intense discussion dealt with jaw-opening and jaw-closing reflexes. A number of participants reported that stimulation of cutaneous nerve fibers from the mouth (inferior alveolar, lingual, maxillary) resulted in inhibition of the jaw-closing reflex. It also was found that stimulation of these sensory nerves excited the digastric, a jaw-opening muscle. However, stimulation of sensory nerves evoking jaw closure had no effect on jaw openers. Thus, the reciprocal interaction of antagonistic sets of muscles controlling limb movements is incompletely present between muscle antagonists involved in jaw movement.

Intracellular recordings from masseter motoneurons revealed that there were two phases of inhibition evoked by sensory nerve stimulation, an early phase lasting about 15 msec, followed by a late phase enduring for approximately 100 msec. The early phase clearly had the characteristics of an inhibitory postsynaptic potential (IPSP). The late phase of inhibition had some of the characteristics of an IPSP, but presynaptic inhibitory mechanisms were not ruled out. It was shown that the early IPSP was evoked via a disynaptic pathway involving an inhibitory interneuron located in the supratrigeminal nucleus.

In another report, single unit activity was recorded from the face motor cortex in awake monkeys during voluntary jaw movement. Half of the units were correlated with jaw opening, and the other half with jaw closing. The level of maintained unit activity was not correlated with the force of muscle contraction, in contrast with previous reports on the activity of motor cortex neurons active during limb movements.

Much controversy centered about studies on presynaptic modification of afferent input in trigeminal brainstem and thalamic nuclei, and the morphological basis of such findings. In one study, stimulation of high-threshold proprioceptive afferents from the masseter muscle produced presynaptic depolarization of lingual afferent fiber terminals from tongue mechanoreceptors, and also suppressed the linguo-digastric reflex. Other investigators studied the excitability changes in single primary afferent and corticofugal fibers projecting to trigeminal brainstem nuclei, and in thalamic afferents projecting to ventrobasal thalamus. Presynaptic depolarization was the predominant effect of conditioning stimulation on the excitability of primary afferent and corticofugal terminals. However, in thalamic afferent endings, conditioning stimuli usually produced an early presynaptic depolarization followed by presynaptic hyperpolarization at longer intervals between conditioning and testing. It was reported that, under barbiturate anesthesia, excitability increases and decreases rhythmically; the periodicity was similar to that of intrinsic thalamic spindle rhythms, suggesting that presynaptic hyperpolarization may be responsible, in part, for the facilitatory phases of thalamic rhythms.

Some earlier data suggests that axo-axonic synapses represent the morphological substrate for the presynaptic depolarization found in many parts of the somatic afferent system. Electron microscopic evidence presented at the conference revealed that such synapses occurred between axons in the spinal cord, trigeminal brainstem nuclei, and ventrobasal thalamus. However, corticofugal axons which projected to trigeminal brainstem nuclei and exhibited presynaptic depolarization of their terminals (see above) were not involved in axo-axonic synapses. In addition, medial lemniscal terminals in ventrobasal thalamus were always presynaptic to other axons, in disagreement with the postulated functional role of axo-axonic synapses in presynaptic depolarization. Thus, the relationship between axo-axonic synapses and presynaptic depolarization remains inconclusive.

The most fruitful discussions between Japanese and U.S. participants were on the central organization of the trigeminal brainstem nuclei and their role in sensory transmission and motor outflow. U.S. scientists were very interested in the techniques used by Japanese scientists to unravel the excitatory and inhibitory mechanisms controlling jaw movements. For their part, the Japanese scientists were particularly interested in the ultrastructural organization of trigeminal sensory and motor nuclei. The exchange of ideas should lead to new and exciting advances in our understanding of the trigeminal system.

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Note

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