side effects. In gouty arthritis urate crystals may adsorb Factor XII and thus trigger the release of bradykinin and aggravate symptoms (V. Eisen and C. A. Keele, Middlesex Hospital). I. Trautschold (University of Munich) attributed the beneficial effects of proteolytic inhibitor Trasylol in pancreatitis to the inhibition of serum kallikrein or to the inhibition of the activation of serum kallikrein. He also proposed a new unit for kallikrein activity.

Investigators tried to solve the problem of amino acid sequence of the substance P and to analyze its effect on the central nervous system. H. Meinardi and L. Craig (Rockefeller University) found in goat hypothalamus a good source of the peptide. Contrary to earlier reports, substance P is a pure peptidic material, possibly containing two or three different peptides. G. Zetler (University of Lübeck) discovered a peptide component in the substance which contracts smooth muscles by releasing acetylcholine.

Scientists of 14 countries participated in the meeting, which was sponsored by the University of Florence and by the State University of New York at Buffalo and supported by various pharmaceutical houses. F. Sicuteri and E. G. Erdös were cochairmen.

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Information and Control Processes in Living Systems

"Aids to biological communication: prosthesis and synthesis" was the theme at the second of a projected series of conferences on information and control processes in living systems held in Pacific Palisades, California, 27 February–2 March 1966.

Otto H. Schmitt (University of Minnesota) introduced the discussion of input-output relations in man-machine systems by suggesting that we are limited in the prosthesis and synthesis of human cognition of our own available figures of thought and stereotyped modes of perception. He emphasized the intellectual tyranny imposed by our notions of analog versus digital as a logical dichotomy in representing sensory information. He pointed out that it is quite possible for a bivalent system to make use of both forms of data representation interchangeably.

Marvin Minsky (Massachusetts Institute of Technology) offered the view that there was an even worse tyranny in biological computation, where the notion of analog processes had blurred differences between the concepts of "numeral" and "number." Either can deal with continuous variables. It is important to ask whether the biological problem resembles numeral processes in their information content or numbers in their formulation of magnitude.

For purposes of data compression Schmitt described a scheme for recording only the times at which a function changed significantly in an increasing or decreasing fashion, thus acheiving as much as a 100-to-1 data reduction. He also offered the view that we need to reevaluate man-machine coding relation currently in use. Our traditional use of the base 10 probably is the best way of encoding information for machine use. Possibly an octal representation would have more advantages for arithmetic operations in both the man and the machine. In exploring the concept of a spatially distributed transmission function, Schmitt suggested more extensive consideration of the nature of information transforms in a multidimensional space with special reference to significance to temporal factors. The time domain, for example, may be used to indicate only transitions from one state to another, and thus to draw attention to significant trends or altered states. Antoine Remond's (Hôpital de la Salpetrière, Paris) chronograms involve analyses and displays in accordance with this concept.

In discussing the role of heuristics in biological communication, Arthur L. Samuel (International Business Machines Corp.) suggested that, in attempting to model the brain, it may be more fruitful to abandon any descriptions of human behavior as a basis for stimulation of cognitive functions. It is possible to develop logical game-playing computer programs without taking into account the way in which humans may play these same games. He offered the view that computers can act as ancillary memories for humans and can serve as mnemonic aids. The search strategies employed by humans in playing games such as checkers can only be simulated economically on a computer through the use of techniques for pruning nonprofitable branches of the search tree structure such as that afforded by the Alpha-Beta heuristic.

Ruth M. Davis (Department of Defense) reviewed the history of sensorimotor automata that exhibited goal-seeking behavior. These early devices had both photo and tactile sensors. Most of the development of automata since 1961 has been theoretical, however. Warren S. McCulloch (Massachusetts Institute of Technology) described a visual sensor that his group is developing which weighs 0.7 kilogram and occupies the space of a 15-centimeter cube. He noted that this reduction in size of hardware is a very important aspect of developing artificial automata. He pointed out that the neural membrane in the ganglion cells of *Aplysia*, the California sea slug, have a capacitance on the order of 40 microfarads per square centimeter, and its physical stimulation is proving extremely difficult. Minsky remarked that increased miniaturization of circuit components is inherently associated with increased computational speeds. This was supported by Walter L. Wasserman (Philco Corp.) who noted that miniaturization is vitally important in any practical prosthesis for man. There was general agreement that any successful stimulation of an automation must take into account feedback from the environment. Remond introduced material on what he described as a typical visual automation. In the human electroencephalogram, lambda potentials appear after the gaze is shifted and might thus act as a substrate for altered cortical excitability associated with deflection of the gaze. Seymour Papert (Massachusetts Institute of Technology) thought these were merely transients and that the true transaction of visual information occurs later. Robert Galambos (Yale University) emphasized the need for studies in ontogeny to improve our understanding of "programming" in the human subject as the basis for known aspects of innate behavior.

V. A. Koshevnikov (Pavlov Institute of Physiology, Leningrad, U.S.S.R.) described in detail a model of speech perception and production formulated in his laboratory which involved the cochlea as an analyzer. The next level of sensory pathways was represented by a matrix of 28 bandpass filters. These filters interacted with linguistic and semantic analyzers and with genera-

tors of grammatic sentences, which in turn generated both a phoneme sequence and prosody resembling that of speech, and thus controlled the motor coordinating centers for speech. On the motor side, respiration, laryngeal movements, and articulation were all involved. It was his conclusion that it is impossible to use phonemes for automatic speech recognition and that speech production must take into account the total behavior of the articulatory system. In the Russian language the open-ended syllable sequences appear to offer better prospects for speech recognition than the use of the phoneme sequence. E. E. David (Bell Telephone Laboratories) indicated that research in this country had also demonstrated that phoneme analysis was not adequate for automatic speech recognition. Lawrence J. Fogel (Decision Science, Inc.) pointed out that pattern recognition of musical instruments depends on their percussive nature rather than on their sound, and this distinction may also be important in speech recognition.

Fogel also described his model for simulating Darwinian evolution in fast time, thus permitting the experimenter to simulate 15,000 generations of intelligent machines in a matter of several minutes of computer time. In his view the human operator can be helped most by the design of adaptive transducers for optimally displaying the sensory data of the real world.

Minsky reviewed the development of mechanical hands and arms for amputees which could be computer coupled. Wasserman and Ralph Alter (Massachusetts Institute of Technology) described engineering models of mechanical arms (constructed in their laboratories) which use electromyographic signals from the remaining portion of amputated limbs for control purposes. In order to achieve portability, the computational adjunct to a mechanical arm cannot be too complex and the power pack cannot be too large. Other problem areas mentioned were velocity control during flexion and control of torque. The arm developed by Alter incorporated a Sprague clutch which permitted fixation of the artificial limb without the use of motive power. David commented on the applicability of audio control of prosthetic devices and Remond described an auditory presentation of EEG patterns whose topological organization could be used as the basis for motor control.

The conference was supported by the National Aeronautics and Space Administration and the Office of Naval Research. An edited transcript of the proceedings is scheduled for publication before next year's meeting. The topics of discussion over the next 3 years include communication in social groups, the pathology and therapy of control processes in living systems, and new vistas in biological information processing.

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Ultrasonics

Ultrasonics has many engineering applications (delay lines, mechanical filters, inspectoscopes, thickness gages) and analytical uses. The wide range of physical investigations that can be carried out by ultrasonic wave transmission was brought out at the fifth annual symposium of the Institute of Electrical and Electronics Engineers, Boston, Massachusetts, 1–4 December 1965.

During a general informational session H. E. Edgerton described subbottom exploration with sound pulses and Philip W. Anderson reported on the role of phonons in superconductivity. In discussing the physical significance of third-order elastic constants and their relation to nonlinear processes, R. N. Thurston provided an introduction to a number of papers dealing with nonlinear elastic effects in acoustic wave propagation. Since nonlinear elastic moduli provide the means for interchanging the acoustic energy with the energy of thermal phonons, a knowledge of their values is essential for determining the thermal acoustic losses. In the region for which the product of the angular frequency ω and the thermal relaxation time τ is greater than unity, the direct exchange can be followed. P. G. Klemens showed that for shear waves the loss was proportional to the frequency and to the fourth power of the absolute temperature. For longitudinal waves in the lowest temperature region the increase should be proportional to the ninth power of the temperature, changing to the fourth power at higher temperatures. Experimental results by J. de Klerk indicated agreement with this result in SiO_2, LiF, and CaF_2.

In the region where $\omega\tau < 1$, individual modes cannot be followed, and the interaction is in the nature of a phonon viscosity. Using recently measured third-order moduli for NaCl, KCl, and yttrium iron garnet (from D. E. Eastman) good agreement was found with measured ultrasonic losses according to a formula derived by W. P. Mason.

Electrons can damp acoustic waves by interchange of acoustic energy with electron energy. Dislocations dragged through the crystal are also damped by the "effective" viscosity of these electrons. This effect is the origin of a nonlinear attenuation which is different in the normal state and in the superconducting state (R. W. Shaw and W. P. Mason).

Another major effort was the generation of higher-frequency acoustic waves. The highest frequencies were in the range of 70 gigacycles (70×10^9 cycles), using surface wave excitation in quartz (P. E. Tannenwald and J. B. Thaxter). Cadmium sulfide and zinc oxide thin-film transducers can be put on in the form of layers having half-wavelength frequencies in the high gigacycle range. An alternative method for reaching these high frequencies is by the use of Brillouin scattering of laser beams. This technique was reviewed by G. B. Benedek, and lasers were employed by B. Tell, T. C. Damen, and S. P. S. Porto to investigate Raman active modes in ZnO and CdS. Brillouin scattering was also used by M. G. Cohen and E. I. Gordon to investigate the properties of externally generated sound. Study of thermal phonons in the transmission of heat pulses was described by A. H. Nethercot and R. J. von Gutfeld and by J. M. Andrews and M. W. P. Strandberg.

More conventional transducers, such as ferroelectric antiferroelectric transition transducers, were described by D. Belincourt. J. Bohm, A. W. Warner, and D. B. Frazer reported on GaAs and $LiNbO_3$ piezoelectric transducers. The latter material has very high Q values (above 10^5 at 10^9 cycles) and has a strong electro-optic effect. An ingenious technique for measuring piezoelectric constants of materials with high electrical conductivity is the piezoelectric Hall effect devised by G. Arlt.

Many types of acoustic wave ampli-