days, and then return elsewhere on the skin. They affect mostly the extremities and the lumbosacral region. The lesions disappeared when patients were removed from the industrial region, but reappeared after reexposure. A similar epidermal lesion was induced in rabbits fed forage grown in the industrial regions where livestock is afflicted with fluorosis. Thus, the lesions may serve as an important diagnostic criterion in subjects exposed to industrial fluoric emission.

A Czech group from Bratislava's Research Institute of Hygiene (Balazova, Lezovic, and Macuch) presented a series of papers on the monitoring of fluoric pollution and ingestion in industrial regions. Air concentrations as high as 1.13 milligrams of fluoride per cubic meter were recorded; close to the factory the fluoric distribution was 61 percent solid and 39 percent gaseous. Farther away, the distribution was 15 percent solid and 85 percent gaseous. In afflicted areas, fallout of fluoride-bearing particles was 7337 kilograms of fluoride per square kilometer; that is, a 90-fold increase over the 82 kilograms per square kilometer found in a control area. Surface waters, at a 10-kilometer distance from the factory, contained 10.9 milligrams of fluoride per liter. Within a 5-kilometer distance tree leaves were necrosed, had a decreased chlorophyl content, and the amount of fluoride was 7 to 72 times more than that normally found. Vegetables and fruit were disfigured in shape and color, and contained from 5 to 21 times more fluoride than did control samples. All bee colonies had died, and 95 percent of the cattle were afflicted with fluorosis; this condition was confirmed by fluoride analysis in several tissues. In comparison with a control group, local children had a decreased hemoglobin and increased erythrocyte level, with two to three times more fluoride in their teeth, fingernails, hair, and urine. The children's daily intake of fluoride was estimated to be 2.15 milligrams per day, of which 1.40 milligrams was obtained from food, 0.55 milligram from air, and 0.20 milligram from drinking water (deep well; low fluoride content). In the control area total daily intake of fluoride was 1.0 milligram of which 0.8 milligram was ingested with food. The fluoric intake in the industrial area was therefore more than twice that found in the control region.

The papers were presented in English, French, and German, with subsequent translation to insure a maximum degree of intercommunication and participation in the discussion periods. The delegates were unanimous in recommending (i) continued research into all aspects of the topic, (ii) that a second meeting be held, either in London or Rome, and (iii) that the proceedings of the current conference be published as soon as possible.

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Low-Temperature Physics

Fluctuations in superconductors were discussed at a seminar on low-temperature physics in Tokyo, 20 to 24 November 1967, under the joint sponsorship of the National Science Foundation and the Japan Society for Promotion of Science. Talks on the nature of the phase transition in helium and magnetic phenomena related to the Kondo effect were included.

Fluctuations are very important in determining the behavior of a condensing system in the immediate vicinity of the transition temperature (Y. B. Kim, Bell Telephone Laboratories). In pure bulk superconductors, the critical region over which fluctuations play an important role is unobservably minute. However, if the superconducting region is reduced to a microsize (as it is in microbridges, junctions, constrictions, and others), the fluctuations do give rise to an observable effect.

The fact that most of the interesting superconducting phenomena involve large supercurrents flowing in the system sets the superconductivity apart from other phase-transition phenomena. Since the supercurrent is proportional to the gradient of the phase of the order parameter, phase fluctuations play a dominant role in the critical region of superconductors.

Quantum fluctuations provide a means for the decay of persistent currents in superconductors. W. A. Little (Stanford University) argued that the necessary condition for d-c resistive behavior in a superconductor was the fluctuation of the order parameter to zero amplitude, and, therefore, the fluctuations of the phase alone were irrelevant. R. D. Parks (Rochester University) postulated that fluctuation of the phase was sufficient to introduce resistance in a superconductor. He presented some experimental results on narrow "one-dimensional" and thin-film "two-dimensional" specimens which tended to support his basic postulate.

A lively debate among the U.S. participants developed on the problem of experimentally shielding the specimen and leads from radio pickup and thermal noise—both of which would give similar experimental results to those reported.

T. Ohtsuka (Institute for Solid State Physics, Tokyo University) discussed an experiment being conducted at his institute in collaboration with Y. B. Kim of Bell Labs, in which the probability distribution for a superconducting cylinder to enter one or other of its many possible quantized states would be determined.

At the second day's session, S. Nakajima (Institute for Solid State Physics, Tokyo University) discussed fluctuations in a superconducting ring specimen containing a weak link. The height of the free-energy barrier between quantized states had been calculated as a function of the applied field.

J. Mercereau (Scientific Laboratory, Ford Motor Co.) spoke on recent work on noise measurements in superconducting junction devices. He showed how noise currents originating from thermal or extraneous sources can smooth the I-V characteristics of weakly connected junctions. He stressed the need for scrupulous attention to adequate radio-frequency screening in order to obtain meaningful intrinsic noise measurements on these devices. He also mentioned a novel device consisting of a point contact between a superconducting cat's whisker and a normal metal which exhibited superconducting behavior at temperatures well above the superconducting transition temperature of either metal of the junction.

Recent work in tunneling was discussed by T. Shigi (Osaka City University; experiment) and Y. Wada (University of Tokyo; theory). Wada compared his calculations of the isotope effect in lead and aluminum with Garland's work. The session ended with some brief comments by the various delegates on the future problems of low-temperature physics. The principal areas of interest appear to lie in (i) high-temperature superconductivity based on thin-film manipulation or on new chemical structures, (ii) very low temperatures with He^3–He^4 refrigeration, and

(iii) development analogous to that of the superconducting magnetometers with superfluid helium for inertial sensors.

The next part of the meeting began with a comparison by D. Douglass (Jan Franck Institute, University of Chicago) of the phase transition in liquid helium and superconductors. He discussed the consequences of assuming first a real-order parameter to describe the ordered phase and then a complex-order parameter. By use of a somewhat arbitrary, so-called "self-consistent" cut-off procedure on the partition function suprisingly good agreement was obtained of the logarithmic contribution to the specific heat of helium at the λ-point. He showed then why the relatively large coherence length in a pure superconductor attenuates this logarithmic term to negligible proportions. Next, R. Kubo (University of Tokyo) reviewed the development of the theorem relating fluctuations and dissipation, and outlined a generalized statistical mechanical derivation of the proof. He compared the fluctuations of an order parameter to the Brownian motion of a macroscopic particle. Recent developments have shown how these time-dependent fluctuations can be related to a succession of time-independent averages which promise new understanding of the dynamic effects of critical fluctuations. In this regard, T. Tsuneto (Kyoto University) mentioned his recent work on the time-dependent and space-dependent fluctuations of the order parameter in superconductors where the recovery time for a fluctuation becomes increasingly long as the transition temperature is approached from both above and below. N. Tsuda (Institute for Solid State Physics, Tokyo University) presented some interesting new data on tunneling between various superconductors and phosphorus-doped silicon. Anomalies in the tunneling characteristic of the order of several millivolts were found in each case.

The final day of the meeting was devoted to discussion of the influence of magnetic impurities and spin fluctuations on the superconducting state. M. A. Jensen (University of Pennsylvania) reviewed recent work on the correlation between the magnetic susceptibility, the specific heat, and the conduction electron mass enhancement arising from interactions with the phonons and with paramagnetic impurity spins. He showed how these factors should influence the superconducting transition temperature and compared the prediction of the calculation with experimental values of the depression of T_c with paramagnetic impurities. The semantic question was raised: whether these spin effects could be called spin fluctuations or whether they should more correctly be considered part of the ground state of the system.

T. Sugawara (Institute for Solid State Physics) presented data on the influence of the Kondo effect on the depression of T_c for gadolinium and cerium impurities in lanthanum. An exchange coupling of opposite sign was obtained for Gd and Ce. From the work of Benneman, R. D. Parks indicated that the depression of T_c was extremely sensitive to the degree of spin orbit scattering and mentioned briefly his results on alloys of $InLa_{3-x}Gd_x$. Then T. Soda (Tokyo University of Education) outlined work on the s-d exchange interaction in a superconductor. Using perturbation theory he investigated under what conditions a bound state can exist in the vicinity of an impurity atom in a superconductor. For both the ferromagnetic and antiferromagnetic cases, he predicts a discrete impurity level in the energy gap if the exchange interaction is weak.

The seminar was attended by six participants and two observers from the United States and five participants and nine observers from Japan. Y. B. Kim and T. Sugawara were the respective coordinators of the two countries.

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Nervous Integration

Physiological and biochemical aspects of nervous integration in vertebrates and invertebrates were discussed at a symposium in Woods Hole, Massachusetts, 30 August–2 September 1967.

Eric R. Kandel and Howard Wachtel (New York University Medical School) summarized results obtained with their co-workers on the abdominal ganglion of *Aplysia*, which contains about 1500 neurons in its four quarters. The endogenously active cells of one quarter ganglion are neurosecretory; the other cells innervate the viscera. Impulses from neuron L10 produce: slow hyperpolarization in six cells of a second quarter of the ganglion; fast hyperpolarization in four cells of a third quarter; and, in the last quarter, depolarization of three cells and successive depolarization and hyperpolarization in another cell. All of these effects are mimicked by applied extracellular acetylcholine. Although there are no direct interconnections among these 14 follower cells, each of four cells that inhibits neuron L10 affects some of them, thus silencing neuron L10 and substituting a different pattern of activity among its followers.

The endogenous activity of one of the large secretory neurons of the same ganglion was reported on by F. Strumwasser (California Institute of Technology). This cell generates a burst of spikes about every 40 seconds, followed by a period of hyperpolarization whose termination causes the next burst. The cycle is initiated by a depolarization that accumulates during the burst. Tetrodotoxin blocks the spikes, but there persists a damped hyperpolarization-depolarization cycle of the same period, which depolarization restarts. Ouabain blocks this residual oscillation, indicating that it depends in part on a sodium pump. It is also blocked by reducing sodium or chloride outside the cell or by increasing chloride inside. The burst pattern has a superimposed circadian rhythm which can be entrained by light. The protein synthesis of the whole ganglion is affected by light, and actinomycin D can reset the circadian rhythm.

A. O. D. Willows (University of Oregon) described his recent work on the nudibranch *Tritonia*. Like other gastropods, *Tritonia* has huge pigmented neurons. They are more favorably situated than those of *Aplysia* for behavorial studies; the whole central nervous system is permanently attached and grouped in three ganglia near the dorsal surface. Thus the animal could be suspended by hooks around a dorsal incision and the cells stimulated and monitored by intracellular pipettes while the animal moved. Stimulation of certain cells always caused the whole animal to stiffen; other stimulations produced turning. Some cells responded to a sufficiently strong stimulus of the branchial tufts; the tuft was withdrawn just as the cell fired. Weaker stimuli did not fire the cell, and excited only local peripheral withdrawal. Natural or intracellular stimulation of any member of another group of neurons in the central ganglia sometimes caused