physical sciences

Electron-phonon interactions

A phonon is a pulsed vibration of the ionic lattice of a solid. As such a pulse moves through the solid, it acts in many ways like a particle, and in the mathematics of solid-state physics it is usually treated as if it were a particle.

Various kinds of interaction between a phonon and an electron in the solid are theoretically possible, and theories make use of such interactions in the course of explaining a number of solid-state phenomena. From the Ecole Normale Supérieure in Paris comes a report of a direct observation of an electron-phonon interaction.

J. P. Maneval, A. Zylbersztejn and D. Huet report in the Nov. 15 PHYSICAL REVIEW LETTERS that phonons corresponding to heat pulses are absorbed in indium antimonide if they are vibrating longitudinally along the direction they go, but not if they are vibrating transversely. The three Parisian physicists say this is direct evidence for an electron-phonon interaction since theory predicts that in metals and semiconductors with a distribution of electron energy levels similar to that of indium antimonide, the electrons should absorb longitudinal phonons but let transverse one go by.

Cosmology and radio source counts

Data from counts of radio sources have been a main argument used by proponents of cosmologies in which the universe evolves with time. Early counts tended to find an excess of weak, and therefore presumably more distant, sources. This was taken to mean that radio sources were either more numerous or more luminous in past epochs than they are now.

As receivers have become capable of finding weaker and weaker sources, the evidence from counts is becoming ambiguous. K. I. Kellermann and M. M. Davis of the National Radio Astronomy Observatory and I. I. K. Pauliny-Toth of the Max Planck Institut für Radioastronomie in Bonn have completed a survey at a wavelength of 6 centimeters. They report in the Nov. 15 ASTROPHYSICAL JOURNAL LETTERS that they find no compelling evidence that the density of sources depends on their age. While the results do not necessarily support evolutionary cosmology, they do not compel its discard.

Infrared and the cosmic blackbody

Radio observations suggest that the universe is pervaded by radiation representing a blackbody at 2.7 degrees K., and this is taken as evidence of a big-bang origin. But the points recorded in the radio range could possibly fall on another kind of spectrum. Absolutely convincing evidence was awaited from infrared measurements. The first ones were disappointing. They showed much too bright an infrared background. A few weeks ago came a report of an infrared measurement that did fit the blackbody (SN: 11/6/71, p. 312). Now comes another that is much too high. The latest is reported in the Nov. 8 NATURE PHYSICAL SCIENCE by D. P. McNutt, K. Shivanandan of the Naval Research Laboratory and P. D. Feldman of NRL and Johns Hopkins University.

The high measurements were made soon after twilight while the low results were taken near midnight at local time. This circumstance suggests, say the researchers, that the source of the infrared is local rather than galactic or extragalactic.

medical sciences

Ultrasound and fetal chromosomes

Although the womb used to be off-limits to medical probing, it no longer is. Amniocentesis, the withdrawal of amniotic fluid for diagnosing fetal birth defects, is becoming more common. So is the application of high-frequency sound waves to the uterus to detect fetal weight, development and health or the presence of twins or triplets. Evidence to date suggests that amniocentesis does not harm the fetus (SN: 7/17/71, p. 44). However laboratory studies have suggested that ultrasound can damage chromosomes. Thus Mary Lucas and Mary Mullarkey of Galton Laboratory, University College, London, performed a study to see if this might be the case in the human uterus.

As they report in the Oct. 16 LANCET, 35 women about to undergo therapeutic abortion agreed to expose their fetuses to varying degrees of ultrasound. After this exposure blood samples were drawn from the fetuses, and chromosomes in the samples were allowed to divide once, then were studied. The investigators could detect no chromosome breaks or other aberrations. They conclude that the ultrasound fetuses are now exposed to does not pose danger to their chromosomes.

Hormones and RNA enzymes

How hormones exert their action on the cells of target tissues and organs is not well understood, but some of these intriguing interplays are coming to light. Edward Smuckler and Jamshed Tata of the National Institute for Medical Research in London report in the Nov. 5 NATURE that growth hormone (GH) and the thyroid hormone triiodothyronine (T3) alter the activity of RNA polymerase enzymes in target cells.

They isolated enzymatically active RNA fractions, for example, and found that the fractions had three peaks of activity. The two hormones exerted slightly different effects on these peaks; both stimulated the first peak, and this stimulation increased protein content. Such changes, the authors believe, represent subtle hormone-specific modifications of liver nuclear RNA polymerases.

Voluntary control of drug metabolism

Research has previously shown that animals and man can under certain conditions voluntarily control heart rate and blood pressure. Now two University of Rhode Island pharmacologists, Harbans Lal and Mark Roffman, have found that animals can control body temperature and the release of liver enzymes that break down drugs.

The two investigators trained mice by exposing them to either a rapid air flow or to the licorice odor of anise oil, and then immediately subjected them to a low-oxygen atmosphere. Low oxygen, or hypoxia, normally causes a decrease in an animal's body temperature and in its ability to break down drugs. Mice exposed to this sequence of events, Lal and Roffman found, gradually learned to react by raising their body temperatures and drug metabolic rate. Untrained mice did not react to the stimuli, and showed decreased temperature and barbiturate metabolism when exposed to hypoxia.

"Our experiments suggest a new type of drug tolerance based on learning principles—a behavioral tolerance," Roffman points out. He also feels this demonstration may hold some hope for persons with diseases caused by reduced synthesis of a hormone.