physical sciences

Confirming charge symmetry

Particle physicists believe that nature is symmetrical with respect to matter and antimatter (charge symmetry, designated C), left and right (parity, P) and time reversal (T). A grand scheme called CPT says that if all these characteristics are reversed at once for any interaction the result will be indistinguishable from what was before. Thus, a particle going forward in time cannot be distinguished from its antiparticle (with opposite charge and parity) going backward in time.

But in certain interactions governed by the weak subnuclear force C and P appear to be violated. Physicists have been searching rather nervously among interactions governed by other forces to look for further violations.

One of the last experiments done at the Princeton Particle Accelerator looked for violations of C in an interaction governed by the strong nuclear force, the decay of neutral eta mesons into charged pi mesons and gamma rays and into charged and uncharged pi's. The work was done by a group from Columbia University led by J. J. Thaler (now at Princeton University). In both cases, they report in the July 31 PHYSICAL REVIEW LETTERS, equal numbers of positive and negative pi's were produced, confirming the integrity of C.

Optical frequency and the speed of light

The frequency of radio waves can be measured to very high accuracy by tuning the circuits of receiving equipment. Visible light does not excite electrical circuitry as radio waves do, but in the July 17 PHYSICAL REVIEW LETTERS Zoltan Bay, G. G. Luther and J. A. White of the National Bureau of Standards report the first measurement of a visible frequency by a method that combines the light with radio microwaves.

The light was from a red laser with a wavelength of 6,330 angstroms. It passed through an electrooptical crystal which added a microwave frequency to it in a way that generated two sideband frequencies, light plus microwave and light minus microwave. The detecting equipment could then determine the difference and the ratio between the sideband frequencies, and from this the light frequency was determined. It came to 473,612,166 $\pm$ 29 megahertz. Combining this frequency with the known wavelength of the light gives the speed of light as 299,792.462 $\pm$ 0.018 kilometers per second.

Galactic-cluster X-rays—bremsstrahlung

A number of clusters of galaxies have been shown to be strong X-ray sources, and the identity of the mechanism producing the X-rays is a hot question for astrophysicists. In the Aug. 1 ASTROPHYSICAL JOURNAL LETTERS Alan B. Solinger and Wallace H. Tucker of American Science and Engineering cast a vote for thermal bremsstrahlung, radiation produced by decelerations of charged particles in clouds of intergalactic matter.

The argument is based on the finding that the X-ray luminosity of a cluster seems to correlate with its velocity dispersion, the range of velocities belonging to the individual galaxies. If bremsstrahlung is the source, the luminosity will depend on the amount of matter emitting. That should be proportional to the total amount of intergalactic matter in the cluster. If the cluster is or was gravitationally bound, the total intergalactic matter is necessarily related to the velocity dispersion.

medical sciences

Tracking cyclic AMP in brain cells

Recently scientists determined that nerve chemicals of the brain, particularly norepinephrine, can regulate cyclic AMP in certain brain tissues (SN: 8/5/72, p. 94). In the Aug. 4 SCIENCE, F. E. Bloom and his neuropharmacology team at the National Institute of Mental Health and immunologists C. W. Parker and H. J. Wedner of the Washington University Medical School in St. Louis report first evidence for the location of cyclic AMP in specific neurons.

Sections of rat cerebellum and brain stem were frozen in liquid nitrogen, then examined by fluorescence microscopy. Cyclic AMP was found in particularly high amounts in specific neurons of the cerebellar cortex, but hardly at all in the white matter. To determine whether cyclic AMP concentrations vary with brain function, the investigators looked at cyclic AMP deposits after their animal subjects had been anesthetized with several kinds of anesthetics. Deposits varied depending on the kind of anesthetic used, suggesting drugs can regulate cyclic AMP in brain cells. The authors would now like to see whether stimulating specific neurons of neurotransmitters in the brains of live animals might alter the amounts of cyclic AMP in various areas of the brain.

Vaccine against tooth decay?

The explosive field of immunology is serving up a platter of clinical promises—birth control by vaccine (SN: 4/22/72, p. 261), transfer of cancer immunity to patients (SN: 5/27/72, p. 341). Now S. J. Challacombe and T. Lehner of Guy's Hospital Medical and Dental Schools in London report in the July 28 NATURE that immunization may prevent tooth decay.

They found that in the saliva of patients with lots of caries, there are fewer antibodies to caries-causing bacteria than in the saliva of patients with less caries. What's more, they have reason to believe that the antibodies inhibit an enzyme that lets the bacteria stick to teeth. If enzyme inhibition is really crucial to caries prevention, they conclude, then immunizing people with the enzyme might be a means of preventing caries.

T-cells use their hatchet men

Thymus-derived lymphocytes (T-cells) play a crucial role in both humoral (antibody) and cell-mediated immunity—the body's two major lines of immunological defense. But exactly how T-cells are implicated in the two kinds of immunity is one of the hottest questions of immunological research. Past research has suggested that T-cells might indirectly trigger humoral immunity, whereas the T-cells themselves attack foreign invaders in cell-mediated immunity.

Experiments reported by G. Dennert and Edwin S. Lennox of the Salk Institute for Biological Studies in the July 26 NATURE NEW BIOLOGY suggest that T-cells perform essentially the same roles in both kinds of immunity. In both instances T-cells trigger bone marrow-derived lymphocytes (B-cells) to produce target-cell-specific antibody. The antibody probably acts as the killer in humoral immunity, but the antibody makes macrophages (scavenger cells) do the dirty work in cell-mediated immunity. In neither instance do T-cells dirty their hands directly.