

# physical sciences notes

## COSMOLOGY

### Stages of the Universe

The universe began with a primordial explosion some nine billion years ago, with all of the light elements being formed as the result of thermonuclear reactions of primeval matter, which was a mixture of protons, neutrons, electrons and light quanta. These reactions occurred during minutes, days or possibly even years, Dr. George Gamow of the University of Colorado believes.

In a report to *SCIENCE* (Nov. 10) he explains the second interesting period in the history of the universe, about one million years after the big bang. At this time, his recent calculations show, the temperature was about 3,000 degrees Kelvin, a drop of several billion degrees from the first stage.

During this second stage, the universe expanded and cooled, and became very dark as the temperature dropped. Toward the end of this period, stars and galaxies began to form, initiating the third stage that brought light again to the universe.

The fourth stage, where the universe is today, consists of another expansion in which the galaxies have become so far separated they are beyond the point of return. The final stage will be the "thermal death of the universe," probably some 50 billion years in the future, when all will be dark and still.

## SOLID STATE PHYSICS

### Measuring Laser Pulses

Laser pulses lasting about a trillionth of a second, or one picosecond, can now be measured accurately for the first time, making it possible to measure picosecond events in atoms and molecules.

The laser pulses are measured by taking advantage of a phenomenon known as two-photon absorption, Drs. J. A. Giordmaine and his co-workers report in *APPLIED PHYSICS LETTERS* (Oct. 1).

In the technique, the pulse is reflected by a mirror immersed in a clear organic solution. The solution's molecules are such that they emit light by radiating a photon after absorbing two photons from the laser pulse. The resulting intense fluorescence from the release of a large number of photons in the area where the pulse overlaps itself clearly illuminates the pulse as a short bright region near the mirror.

The pulse, usually a hundredth of an inch in length, is recorded photographically—one of the briefest events yet photographed.

## SPACE ENGINEERING

### Russian Proposed 'Skyhook' First

"Skyhook," a ladder to the sky that would link a satellite with earth's surface, really was a Russian first. It was proposed by a Soviet scientist about six years before such a plan was suggested by four U.S. scientists, who discovered the Russian priority only after the Soviets reacted to the U.S. publication of the idea.

In both the Russian and U.S. versions, skyhook would

be a satellite roughly 22,000 miles above the earth tethered to the surface by cable. How strong this cable would have to be is not known, but the U.S. scientists have calculated it would need materials about 100 times stronger than available today (SN: 7/24/65).

The Russian engineer, Y. N. Artsutanov of Leningrad, presented his idea for a skyhook in the official Russian newspaper, *Komsomolskaya Pravda*, July 31, 1960.

## METROLOGY

### New International Second

A new definition of the international unit of time, the second, was adopted in Paris by the 13th General Conference on Weights and Measures. The second is now defined as "the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the fundamental state of the atom of cesium 133."

The frequency the definition assigns to the cesium radiation was chosen to make it impossible by any known techniques to distinguish the new second from the ephemeris second based on the earth's motion.

## ASTRONOMY FROM SPACE

### Astronomy Missions Board Established

A board of 12 astronomers and physicists has been established by the National Aeronautics and Space Administration to assist it in the planning and conduct of all missions involving astronomical telescopes in space.

Dr. Leo Goldberg, director of Harvard College Observatory, is chairman of the board, which will develop and review scientific objectives and general strategy for space astronomy missions involving sounding rockets and balloons as well as satellites.

Telescopes are used in space astronomy to study the whole range of the electromagnetic spectrum—gamma rays, X-rays, ultraviolet, visible light, infrared and radio radiation.

## PHYSICAL CHEMISTRY

### Two Forms of Solid Hydrogen

An answer to the puzzling question of why the crystal structure of solid hydrogen is sometimes hexagonal and sometimes cubic has been found by Los Alamos Scientific Laboratory researchers. Drs. Adam Schuch and Robert Mills have shown by X-ray photos that hydrogen and deuterium of the hexagonal type changes to the cubic form when the temperature is lowered close to 457 degrees below zero F.

By studying diffracted X-rays with a geiger counter, the Los Alamos scientists were able to get a motion picture view of the nature and progress of the change. The crystals switch from hexagonal to cubic because certain layers of molecules shift relative to other layers.

Solid hydrogen and deuterium can be returned to their original hexagonal structure by raising the temperature close to the melting point, the scientists reported at the American Physical Society meeting in New York.

2 december 1967/vol. 92/science news/537