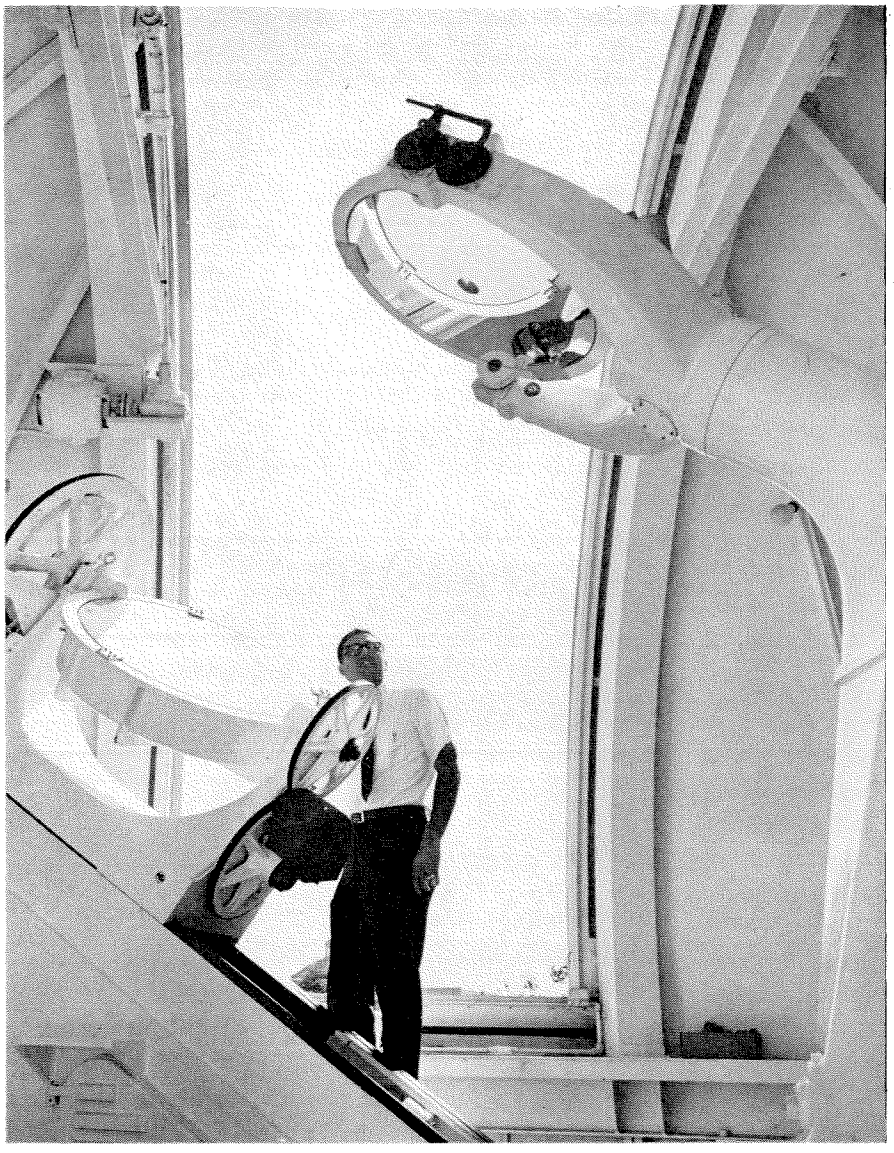


George Ellery Hale's solar telescope comes to life at Caltech after 40 years.

RESEARCH NOTES

REBIRTH OF A SOLAR TELESCOPE

A solar telescope built at Caltech almost 40 years ago under the supervision of George Ellery Hale is being revived by astronomers here. The coelostat, a stationary telescope with an adjustable mirror to follow the sun, is the world's largest. It was designed and partly constructed in the Robinson Laboratory of Astrophysics in the early 1930's, but work stopped on the telescope when Hale became ill. He died in 1938.

The old telescope is being rehabilitated for use in the analysis of the fine structure of the sun's surface and for studying sun spots. The restoration is being done under the supervision of J. David Bohlin, research fellow in astronomy, with the support of a National Aeronautics and Space Administration grant. Harold Zirin, Caltech professor of astrophysics and astronomy, suggested the rehabilitation and obtained the grant. Cost of the restoration is about $10,000, a small fraction of what a new instrument of similar size and quality would cost.

The coelostat is mounted vertically on a 125-foot octagonal shaft. Sunlight is reflected in a fixed direction by a movable 36-inch-diameter flat mirror. A 30-inch flat mirror then directs the light downward to a fixed vertical telescope in the shaft. That telescope, a Cassegrain system with a 26-inch primary mirror 50 feet down the shaft, reflects the light upwards to a choice of secondary mirrors. These reflect the light back down, forming excellent solar images from 8 to 22 inches in diameter.

The dome and mirror guidance apparatus are mounted on top of the octagonal tower located on the roof of the three-story Robinson Labora-

tory. The shaft, which extends 80 feet underground, was originally intended for installation of a vertical spectroscope. The coelostat was so close to completion in the 1930's that all of the wiring was in and ready for the spectroscope, which was never built.

In restoring the instrument, the astronomers had to clean up the gearboxes and repaint some equipment, but the only things they had to replace were mirror mounting cells, which had been lost.

The rotating primary mirror, made in Holland before 1935, is a thin layer of glass fused onto metal. The glass and metal expand at the same rate when heated by the sunlight. The secondary mirror is a pyrex disc cast at the Corning Glass Works. It was the first of a series of discs made in preparation for casting the 200-inch pyrex mirror for the Hale telescope at Palomar.

Pasadena is a surprisingly good location for solar observations, according to the astronomers. Although the area has heavy smog, the conditions that lead to smog also lead to good seeing. The stable temperature inversion which keeps the smog from blowing away also reduces air turbulence—a major problem for solar astronomers.

The coelostat will be a facility of the Mt. Wilson and Palomar Observatories, which are operated by Caltech and the Carnegie Institution of Washington.

AN EMERGENCY CELL SOURCE

Nature has provided rabbits, rats, and probably human beings with a stand-by source that, in emergencies, produces red corpuscles at a rate which is several times faster than normal. Although this subsidiary source is in operation continuously, it normally produces only about 10 percent of the red blood cells in animals. However, Henry Borsook, Caltech professor of biochemistry, emeritus, has found that when there is an acute loss of blood production from the secondary source is stepped up markedly, and red cells can be assembled in about a third of the main source's time.

Red cell production in adult human beings normally takes place in the bone marrow. These cells—tiny packets of hemoglobin—transport oxygen from the lungs to the cells and help carry carbon dioxide waste from the cells to the lungs. During an emergency situation, such as a loss of blood, the primary production source of red cells increases its output considerably. Meanwhile, the secondary source produces a higher percentage (25 percent or more) of the total number of red cells and turns them out several times more rapidly. This secondary source requires only a day or two to assemble the finished product, compared with five or six days for the main source. However, Dr. Borsook has found that the red cells that emerge are about twice the normal size and do not live as long.

After the emergency subsides, both production sources resume their former, more conservative output. Erythropoietin, a hormone which Dr. Borsook and two colleagues were the first to synthesize, regulates this output.

Henry Borsook, Caltech professor of biochemistry, emeritus.

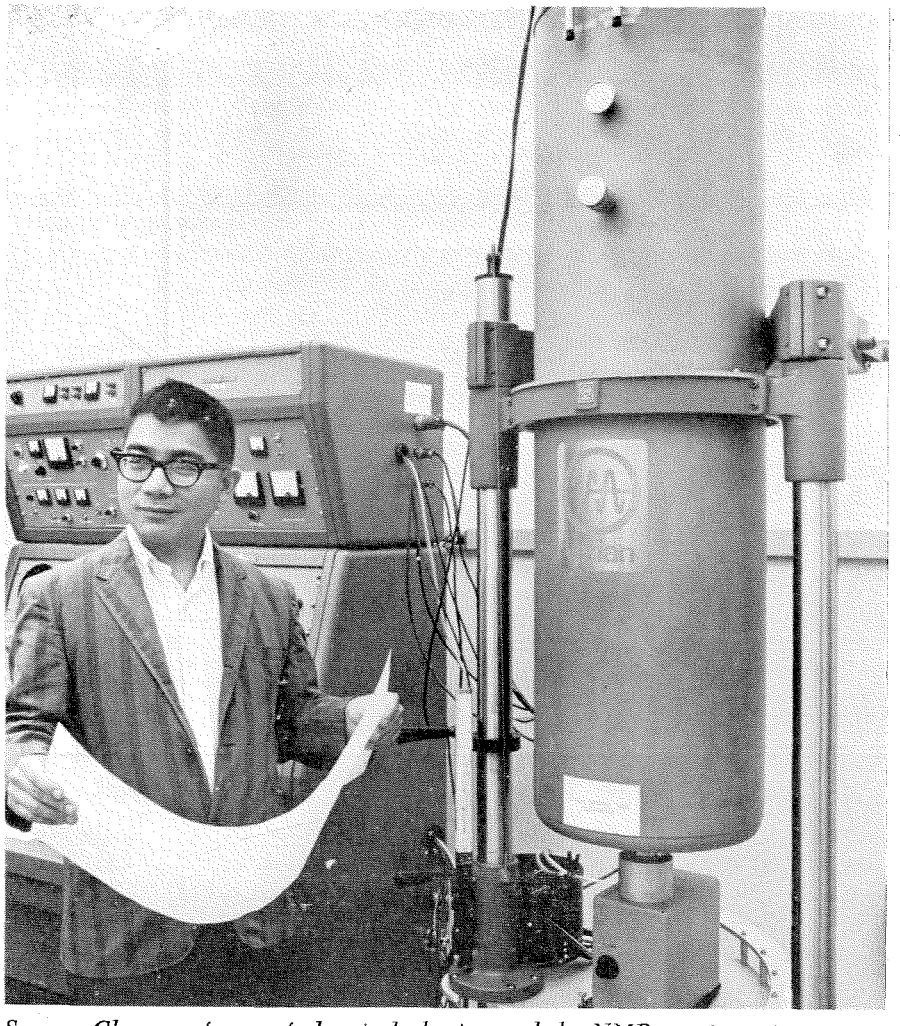
Dr. Borsook's associates in this research at Caltech were Mrs. Amelia Gunderson and Miss Dian Teigler. He is continuing the work at the University of California at Berkeley under sponsorship and support of the U.S. Public Health Service and the Atomic Energy Commission to determine the cellular pathway along which red cells are formed.

WHAT MAKES A MOLECULE

A powerful new research tool that helps scientists learn how complex molecules are constructed and how they are held together is now in use at Caltech. The device—an ultra-high-resolution nuclear magnetic spectrometer—is the first instrument of its kind to be used at an academic institution in the United States. Caltech is sharing the time on the new instrument with at least 13 other investigators from nine other institutions in southern California.

Sunney I. Chan, Caltech professor of chemical physics, is using the NMR to find some of the answers to problems of chemical bonding and molecular structure. With the aid of this new instrument, Dr. Chan and his colleagues are also trying to learn more about the precise manner in which small molecules bind to such biologically important macromolecules as nucleic acids and proteins. Through these experiments they hope to elucidate the physiochemical basis of the action of enzymes, mutations, carcinogenesis, and, perhaps, even the molecular basis of certain diseases.

Other studies planned include routine chemical analyses of complex chemical systems, including hydrocarbon fuels, boron-containing rocket propellants, natural products such as carbohydrates, sugars, ster-



Sunney Chan, professor of chemical physics, and the NMR spectrometer.

oids and terpenes, and even complicated mixtures such as those that have been exposed to intense radiation for long periods.

Operation of the NMR spectrometer is based on the principle that many atomic nuclei have associated magnetic qualities that tend to align them with an external magnetic field. These atomic nuclei, when aligned in the spectrometer's strong field, absorb certain radio frequencies beamed at them. An NMR spectrum of the substance under study is obtained by varying the frequency of the radio frequency transmitter or sweeping the magnetic field at which the radiation is absorbed. Locations of the peaks in the spectrum identify the atoms, while the heights of the peaks represent the number of atoms present in each environment. Interpretation of these data enables the investigators to determine molecular structure and also to find impurities if they are present.

The spectrometer was obtained on a grant of $216,000 from the National Science Foundation. Caltech will contribute a total of about $46,000 for related equipment and operation of the spectrometer.

A THREAT TO UNDERSEA FORESTS

Nuclear reactors that will provide power for cities in the future may also change the character of coastal waters, modifying many marine communities. The huge generating plants are expected to raise the water temperatures along parts of the coast from three to eight degrees as they discharge water used for cooling back into the ocean. Even the generating plants already in use along the coast have raised water temperatures somewhat, although not over significantly large areas.

An increase in water temperature of only a few degrees, for example, in the past has caused deterioration of giant kelp beds and may also have a profound effect on other forms of ocean life. Wheeler J. North, Caltech professor of environmental health engineering, is currently trying to find plants that will survive when the coastal waters are warmer. If kelp that would grow despite temperature changes could be planted now, a future scarcity of the huge sea trees—an important economic resource—could be avoided. Kelp plants are harvested to obtain algin, a jelling agent used in paints, pharmaceuticals, and cosmetics.

Working much of the time at Caltech's Kerckhoff Marine Laboratory at Corona del Mar, Dr. North grows cultures of kelp plants in the laboratory and then places them in the sea to watch their progress. He has made several trips to semitropical Turtle Bay in Baja California to gather samples of marine life that grow well there. He is trying to determine if the vegetation will also grow in the coastal waters of southern California when the waters are warmed by power plant discharge.

Dr. North believes that the expected warmer water could seriously affect local kelp, particularly where the plants are already under stress in areas exposed to pollution. Sewage dumped at sea indirectly may have contributed to the disappearance of much of southern California's kelp. The spiny sea urchin which feeds on the root-like anchor of the kelp plant may also feed on the sewage. Its natural predator, the sea otter, has been virtually eliminated by fur hunters and the urchin population has run rampant.