

understanding time has been the central obsession of the 20th century. As Allan says, it is remarkable that this abstract entity is more accurately measured than anything else in the world—with an uncertainty of about eight parts in ten to the 14th power, or roughly 1 second in 300,000 years. Winkler describes it another way: it is akin to measuring the distance between the earth and the sun with an uncertainty of 1.5 millimeters. Time standards are now so precise that the universal definition of the meter was established in 1983 as the length of a path traveled by light (in a vacuum) during 1/299,792,458th of a second.

Meanwhile, the cesium atomic clock, upon which the recent progress was built, has found some rivals. They include the hydrogen maser and the mercury trapped-ion clock. The latter, which has been running on a test basis at the Naval Observatory since July 1986, appears ready to push the standard a step higher, into the realm of ten to the fifteenth power. At the Bureau of Standards, work has already begun on a laser-cooled clock that is expected to leap three steps further, into the eighteenth power of ten. Allan says it "may take 20 years to get this clock to a place where you can buy it," but he expects that day will come.

There are many uses for precise time. As it becomes more accessible, more will be found. The most common application—aside from navigation—may be as a tuning standard for commercial TV and radio signals. The oldest and most interesting use is as a tool in astronomy. Allan points with excitement to a recent example, the discovery of a radio-emitting neutron star (or pulsar) whose emissions keep time with at least as much stability as the best atomic clocks (*Science*, 6 November, p. 761). This particular pulsar, one of four known to "tick" out radio waves at millisecond intervals, has only been observed steadily over a 6-month period. Over a longer period, Allan says, it might prove to be the best clock in the universe. Allan and others hope to use it to "look at all kinds of astronomy" in the solar system, to test theories of gravity waves, and to conduct experiments in relativity. None of this could be done without very precise control clocks on the earth.

Despite the tremendous improvements in the timekeeper's skill, the nature of the thing being measured remains confusing. Winkler has written, "Time is the abstract measure of change, an abstractum of an abstract notion." After reviewing some philosophers' definitions in a recent essay, he concedes that time has "no more substance than other notions as virtue or vice," but notes that it is "vastly more applicable." ■

ELIOT MARSHALL

Maxwell May Back Gallo

Several months ago, Robert Maxwell, the British publisher and entrepreneur whose holdings include Pergamon Press and valuable real estate in the center of London, approached Robert C. Gallo of the National Institutes of Health with an offer to support a new institute for AIDS research. Maxwell's philanthropic interest apparently came out of the blue, but it provided new impetus to Gallo's own long-standing desire to expand his laboratory beyond what NIH is readily able to support.

Since the 1970s, Gallo's lab has pioneered research on retroviruses, which includes the AIDS virus. Indeed, it has been said that it was this expertise that enabled Gallo and his colleagues to move quickly on AIDS. When the AIDS crisis hit about 5 years ago, Gallo's lab had about 35 people. Today, the number is the same. Efforts to expand have been frustrated by federal personnel ceilings that apply as much to NIH as to any other government agency. Salary limitations of \$73,000 for a Ph.D. and \$84,000 for an M.D., coupled with government restrictions on outside income, also stand in the way of attracting new people. It is these obstacles, rather than any desire for increased personal wealth, that lie behind Gallo's much publicized thoughts about leaving NIH after 22 years.

NIH officials, who are anxious to keep a number of first-rate scientists who are receiving attractive offers to leave, have been struggling to find ways to creatively manipulate the federal bureaucracy so that Gallo could lead some sort of consortium of scientists without leaving NIH itself. One proposal is to create a laboratory under what is called a "cooperative research and development agreement (CRADA)." In such an arrangement, Gallo would remain an NIH employee, as head of a newly created laboratory. University faculty could work in the new laboratory. However, according to an NIH memo, they could not be paid with government (e.g., NIH) funds. But they could be paid with money donated by Maxwell. In a CRADA deal, industry scientists could also work in the Gallo laboratory with money from their company. A complex set of rules governing who can supervise who, and who can and cannot share in royalties would be in force. Were this idea or some modification of it to be adopted, this university-industry-government triumvirate would have to find lab space somewhere. Maxwell has already anticipated that by buying a good-sized research building not far from the NIH campus, where a collaborative program could be housed.

From time to time during the past four or five years, Gallo has entertained the idea of moving to Duke, where he already has research collaborators. Since Maxwell entered the scene, talks with Duke have picked up.

Shortly thereafter, Gallo also had preliminary talks with Johns Hopkins University when he was approached by David and Isaac Blech, two businessmen and Hopkins supporters who wanted to raise venture capital from the health insurance industry in order to fund an AIDS institute in Baltimore. The Hopkins deal, which apparently was never more than tentative, fell apart when Gallo refused to sign a contract that he interpreted as tying him too closely to the potential products and profits that might come from his research (*Science*, 4 December, p. 1349). Hopkins, which had plans for a new AIDS center even before they had talks with Gallo, will go ahead anyway.

During the course of the summer, Yale also entered the picture as a possible academic home to Gallo and an AIDS center that would be developed with a major philanthropic gift from Maxwell to the university. Maxwell has been to Yale to talk with university officials and faculty. Medical school dean Leon E. Rosenberg is attracted to the idea of a major new AIDS research program which, he says, is being seriously considered. However, he cautions, the discussions are only in preliminary stages.

Gallo, who declines to talk in detail about the Duke or Yale negotiations, says that if either comes to fruition it would have to be for research dedicated to virology and immunology, not just AIDS, in order to be of long-term scientific value. And it would have to be "fully integrated into the university, with appointments made according to university rules, under the dean," in order to function productively. "If I leave NIH I want to be part of a university, not a profit center," he says. ■ BARBARA J. CULLITON