antenna to eliminate effects of earthquakes, building vibration, and so on. "But if you see nothing, then there's nothing there." A second detector in that case would only have the effect of doubling the sensitivity.

Tyson has an aluminum bar weighing 8000 pounds, 12 feet long, 2.5 feet in diameter, and its mass is about three times that of Weber's cylinder. Almost all of the experimenting has been done with the main longitudinal mode, which is at 710 Hz. It is also sensitive at 2080 Hz. Once a new amplifier is added, Tyson expects the sensitivity at 2080 Hz will be about the same as Weber has now at 1660 Hz.

By putting fake gravity waves into the antenna, Tyson gets blips on a calibrator plate. For example, he applies a small glitch at $(\frac{1}{4})$ kT and sees if it shows up on his chart recorder. By this technique he finds that the detector can tell if the energy has increased by as little as $(\frac{1}{4})$ kT in 1 sec. Tyson says that his present sensitivity is 40 to 100 times Weber's sensitivity in 1969–70.

Tyson told us he found no events above $(\frac{1}{2})$ kT in three months of observation, and from random statistics, he would have expected none. He feels that one of two conclusions can be drawn. Either the source Weber saw in 1969–70 has decreased its intensity or else he was seeing something other than gravitational radiation. Tyson noted that Weber is still seeing his effect and has now increased his sensitivity by a factor of ten or more. He remarked that the effect has always remained right at the noise level, so that it corresponds to a flux that is much smaller now than it was in 1969–70.

A coincidence experiment is now operating between the original antenna and another run by David Douglass at the University of Rochester. They hope to have a sensitivity ten times better at 710 Hz than Weber's present sensitivity (at 1660 Hz). Some critics of the experiment have noted that the spectrum of the source may not be wide enough to be picked up by the antenna. In earlier experiments, though, Weber had detected signals with a disc antenna sensitive to 1030 Hz, implying a fairly broadband spectrum. The antenna, Tyson says, now has an effective temperature of 40 K at 0.1 sec resolution and 13 K at 1 sec resolution; the Rochester antenna is less sensitive by a factor of two.

Weber, when asked to comment, said, "The single-detector gravitational radiation experiments suggest that there are not *at the present time* enough pulses of energy exceeding $kT/4$ to account for observations of the period *1969–70.*

"That may be true. However, the 1969–70 experiments, like the present ones, were capable of recording coincidences in response to pulses of lower energy, albeit with a detection efficiency much less than one. Information on detection efficiency of present experiments is included in a paper in press in *Phys. Rev. Letters.* Earlier instrumentation did not permit measurement of that part of the energy not due to internal noise. However, we can examine two things which are known, to obtain some evidence for the energy input. Firstly, for a typical two-detector coincidence, the amplitudes reached by the detectors were often very different, suggesting that the amplitude was generally made up of a fairly small bit of real signal on top of a lot of noise. Secondly, the small ratio of three-detector coincidences to two-detector coincidences indicates that a detector only crossed threshold when the external signal and the intrinsic detector noise were in phase, once again suggesting that the input pulse energy was not large compared with noise. The statistics of both the amplitudes and the three-detector coincidences are therefore consistent with a significant fraction of observed pulse energies smaller than the $kT/4$ limits of the Garwin–Levine–Tyson observations."

A well-known experimenter, commenting on the three experiments, said he was impressed with the instrumentation employed by IBM and Bell. On the other hand, he said, he is also impressed with the big peak at zero lag that Weber finds. That is, recording the data from the two bars and then correlating them, Weber finds that when the two signal peaks are in coincidence with each other (zero-lag peak), the peak is "very convincing," sticking way out above the peaks at longer lags. —GBL

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Anomalous water: an end to the anomaly

Several years ago the possible discovery of a form of water with anomalous properties—high density, high refractive index, low vapor pressure, low melting point—generated intense experimentation and heated debate (PHYSICS TODAY, September 1969, page 61; October 1970, page 17). In a new book[1] (*Recent Advances in Adhesion*, edited by Lieng-Huang Lee of Xerox Corp), Boris V. Deryaguin, whose group of workers at the Institute of Physical Chemistry of the Soviet Academy of Sciences in Moscow first reported this anomalous water[2] (later called "polywater" by others to suggest a polymeric structure), has concurred with his former opponents that the observed properties are caused by the presence of impurities rather than by a new structure of the hydrogen and oxygen atoms. Deryaguin states that he and his coworkers, using an electron-probe technique, detected silicon and/or some other impurities in even the cleanest samples of anomalous material.

Although the central issue of the existence of polywater has finally been resolved, several phenomena remain unexplained. One mystery, Deryaguin feels, is that fresh water vapor condensate appears to dissolve quartz and impurities more readily than aged liquid water. In their experiments Deryaguin, Churaev, Zorin and others were able to produce the material with anomalous behavior only by condensing water vapor periodically under pulsing vapor pressure on the walls of quartz capillaries, and then only by varying the pressure of the vapor; no anomalous behavior was observed when liquid water was introduced directly into the capillaries.

An explanation for this phenomenon has been proposed by Barry Brummer (Environmental Impact Center, Cambridge, Mass.). He feels that the material present will dissolve equally well in either liquid or vapor. However, in the case of water vapor, the amount of water is so small that the initial material that dissolves produces a more alkaline solution than liquid water; hence it more readily dissolves other material.

A second unresolved question is the exact nature of the material that was once taken to be anomalous water. Many impurities such as sodium, boron, silicon and carbon, have been found to varying degrees in the samples prepared by different experimental groups. Yet no one knows which of these elements are essential constituents of the anomalous material. Brummer and his former colleagues from Tyco Laboratory in Waltham, Massachusetts believe the material is primarily organic in nature, with the organic materials being drawn from the atmosphere.[3] They concur with Denis Rousseau of Bell Telephone Laboratories that the material behaves like a carboxylic acid, a substance found in human perspiration. Others have similar experimental evidence for the presence of both organic and inorganic material but do not take a stand as to which constituents are most important. Deryaguin suggests the formation of a gel or sol of silicic acid, with sodium atoms possibly penetrating into the condensate simultaneously. Others have felt that the silicon impurities present are in the form of "chunks" of glass and are not uniformly distributed throughout the material.

Will these questions ever be resolved? The experiments are difficult and the rewards are no longer as promising as the possible confirmation of the existence of a new form of water. It is unlikely that these answers will be forthcoming unless someone finds a way to produce the anomalous material in quantities larger than a few micrograms. —*Barbara G. Levi*

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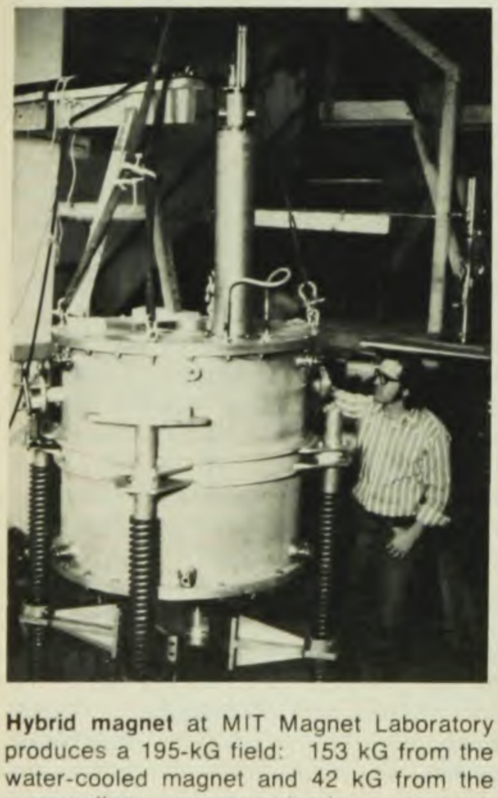
Hybrid magnets promise high field for low power

Researchers at MIT's National Magnet Laboratory are employing a hybrid system to produce high magnetic fields with relatively low power consumption. A field of 195 kilogauss has been produced through the combined effect of a water-cooled magnet within a superconducting magnet.

Such a field is not the highest produced at MIT. An all water-cooled magnet there produces a 230-kG field, but it draws the full power capacity of the laboratory—ten megawatts. It is envisioned that hybrid-magnet technology will allow a 300-kG magnet to be constructed without requiring any more power; without the hybrid concept, 30 megawatts would be needed.



Hybrid magnet at MIT Magnet Laboratory produces a 195-kG field: 153 kG from the water-cooled magnet and 42 kG from the surrounding superconducting magnet.

The 195 kG of the hybrid magnet is reached by a 153-kG contribution from the water-cooled magnet and 42 kG from the superconducting part. This section is composed of 24 double pancakes of a niobium–titanium alloy embedded in copper ribbon. This metal combination remains superconducting until approximately 100 kG, well above the 60 kG that the superconducting part was designed to produce. It draws 1500 amperes, and the field it produces stores two megajoules.

Inside the core of the superconducting magnet is the water-cooled portion with an access region of 3.2 cm. When both portions of the magnet are in operation, large forces exist between the two parts—80 000 newtons per cm axially and 12 000 newtons per cm radially.

Bruce Montgomery (MIT) spoke to us about the problems of using more powerful superconducting magnets in a hybrid system. A 165-kG superconducting magnet has been produced at Intermagnetics General Corporation of Schenectady, N.Y., but it has a bore of only two cm. The much larger bore of the MIT magnet (40 cm) allows the insertion of the water-cooled magnet. A 165-kG superconducting magnet with such a bore would be very costly, he said.

A group at Oxford Instruments in England is also involved with hybrid magnets. They are testing a unit having a field of approximately 160 kG, but its access of 5.0 cm is larger than MIT's thereby increasing certain research capabilities despite the lower field.

MIT workers are moving toward providing the laboratory with several hybrid magnets to provide fields of over 200 kG to a larger number of researchers and at the same time optimize the use of existing power sources. —RAS

Magnetosphere study planned for 1976–78

Plans for a two-year International Magnetosphere Study (IMS) have been drawn up by the International Council of Scientific Unions. The programs, to run from 1976 to 1978, will pool ground-based, balloon, rocket and satellite capabilities and data-analysis facilities throughout the world to study the magnetosphere.

United States participation in the program is outlined in a report of the Joint Ad Hoc Study Panel of IMS, headed by Robert A. Helliwell of Stanford University. The report recommends that the US endorse IMS and participate in it with a coordinated research program. It suggests that an NSF office for IMS be established and that representatives from other participating agencies be designated.

Other recommendations of the panel include US participation in a worldwide network of incoherent-scatter radars, support of satellite programs including the reactivation of satellites launched and used before the IMS period, and funding for balloon and rocket investigations and for data-evaluation centers.

Observations over the last 15 years have revealed a more complex picture of the magnetosphere than had once been thought. Before the 1960's it was conceived of as a simple extended, bipolar field. In recent years the model of geomagnetic-field lines that cross an open magnetosphere and connect with interplanetary magnetic field lines is gaining wide acceptance.

Increasing our knowledge of the magnetosphere is expected to further the understanding of many processes on earth. The amount of the sun's magnetic-field energy and charged-particle populations that reach the upper atmosphere is regulated by the magnetosphere. Changes in the amount of energy reaching the atmosphere can affect the delicate energy balance in the lower atmosphere. Other issues of interest include the possible magnetospheric involvement with climate and power-transmission disruptions.

European nations plan molecular biology lab

A great stride forward has been taken to establish a European molecular biology laboratory in Heidelberg. Eight member nations of the European Molecular Biology Conference have approved the plan (Austria, France, Federal Republic of Germany, Israel, Netherlands, Sweden, Switzerland, and the UK) although Greece, Norway and Spain indicated that they could not join at the beginning.

The program will be under the supervision of Director-General designate John C. Kendrew, Nobel Prize winner in 1962 for his work on the structure of proteins. Member states will exercise control through a council of delegates, but maximum autonomy is envisioned for the laboratory and its director-general.

Initial nonrecurring expenses for the laboratory will be $11 million over the first seven years, with the Federal Republic of Germany contributing $3.3 million of this in addition to the site in Heidelberg. Annual operating costs are expected to grow to $4.2 million. □