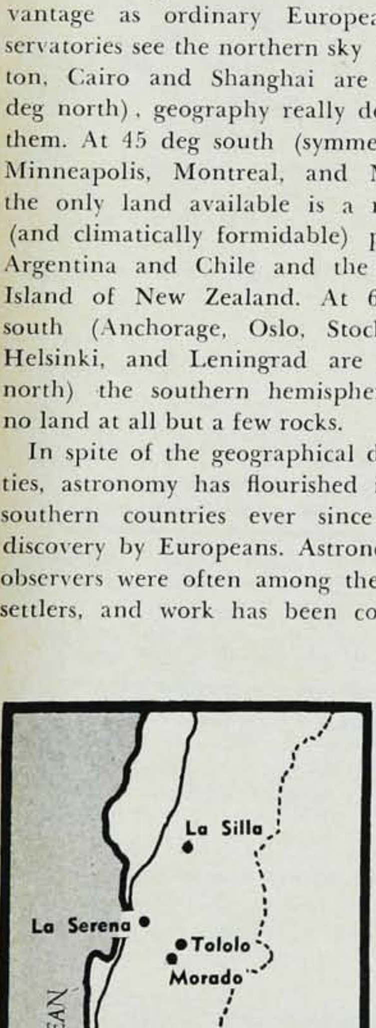
tronomers evolved, the overwhelming majority of their equipment would be built in the north.

To give a specific example: The parallel of 30 deg south, after its passage across Chile, Argentina and a small tip of Brazil, crosses only Australia and the Republic of South Africa. Most of its circuit is open ocean. Thirty degrees is a good location for southern observing, but if astronomers want to see the extreme southern sky with the same advantage as ordinary European observatories see the northern sky (Houston, Cairo and Shanghai are at 30 deg north), geography really deprives them. At 45 deg south (symmetric to Minneapolis, Montreal, and Milan) the only land available is a narrow (and climatically formidable) part of Argentina and Chile and the South Island of New Zealand. At 60 deg south (Anchorage, Oslo, Stockholm, Helsinki, and Leningrad are at 60 north) the southern hemisphere has no land at all but a few rocks.

In spite of the geographical difficulties, astronomy has flourished in the southern countries ever since their discovery by Europeans. Astronomical observers were often among the early settlers, and work has been continuous ever since. But the quantity of work has never come near to matching the quantity of work put out by northern observatories although the countries have generally provided as much equipment as their resources made reasonable. In the past therefore, northern institutions have often constructed southern stations either alone or in concert with local institutions. Until recently such activity has been small compared with the northern institutions' expenditures nearer home. Now, however, the push is on to build observatories for the southern sky to equal the biggest ones operating in the north.



NORTH CHILEAN REGION where large new astronomical observatories are being constructed.

For both bigness and international coöperation the European Southern Observatory is a good example of the new trend. It had its beginning in a 1953 conversation between Walter Baade and J. H. Oort. These gentlemen agreed that if a consortium of European nations were to build a large new observatory, it should be constructed in the southern hemisphere. Their view prevailed, and the organization known as the European Southern Observatory was set up with headquarters in Hamburg. Originally the organization included Belgium, France the Netherlands, Sweden and West Germany. More recently Denmark has joined.

ESO considered sites in Australia, South Africa and South America. It wanted a site with as many clear nights per year as possible and an elevation between 2000 and 3500 meters to lessen atmospheric extinction of radiation.

Australia was ruled out because its mountainous regions do not have good enough weather. The choice was left between South Africa and South America, and at one time South Africa seemed to be favored. Meanwhile American astronomers had been making a three and a half year survey of the Chilean Andes to pick a location for AURA's Cerro Tololo Inter-American Observatory. These findings were pooled with ESO's work, and after visits to Chile by European astronomers, the site at La Silla (elevation 2440 meters) was chosen. (Ironically, the American astronomers' choice of Chile had been one of the reasons the Europeans originally leaned toward South Africa as a kind of eastern hemisphere—western hemisphere balance.)

Access roads have already been constructed, and work on the buildings is now under way. Meanwhile the first telescope, a one-meter reflector for photoelectric observations has already been landed in Chile. It was made by Rademakers of Holland and Jenoptik of Jena, East Germany. Other equipment for ESO now under construction in Europe includes a photometer for the one-meter telescope (by astronomers in Groningen), a 1.5-meter reflector for spectrographic work (being built in Paris), and a one-meter Schmidt reflector (Zeiss/Oberkochen, West Germany). The biggest piece will be a 3.5-meter reflector. Work on its mirror blank has been started by Corning Glass International and will be taken over by a European firm later on.

On its mountain (Cerro Tololo) 100 km to the south of ESO, AURA is working on equipment of the same order of magnitude, including a 1.5-meter reflector and smaller telescopes.

Baseball magnetic field

A magnet coil shaped like the seams on a baseball is being used to study plasma containment and stability at Lawrence Radiation Laboratory in Livermore. The baseball-seam coils produce a minimum-B magnetic field, in which field intensity is a minimum in the center, increasing in all directions outward. Such a system is hydromagnetically stable (no fluting). The first baseball assembly began running in April and a superconducting version will soon be up to bat.

Baseball fields are part of the Livermore Alice program, which uses neutral beam injection to study containment and stability of high temperature plasma.

The idea of using baseball coils for an Alice experiment occurred to Richard Post and Charles Damm about two years ago (who benefited from earlier ideas of Harold Furth of Livermore and J. B. Taylor of Culham Laboratory). Besides the advantage of being a minimum-B system, Damm says that the baseball coil offers excellent beam access, room for probes and good efficiency in generating the field that other magnetic-well coils lack.

In April the first baseball assembly, with a 1-meter diameter, began running. The coil, wound of hollow copper conductor is cooled with liquid nitrogen to reduce resistivity (with conventional water-cooled coils about 30 MW would be required; only one-sixth as much power is needed with liquid-nitrogen cooling).

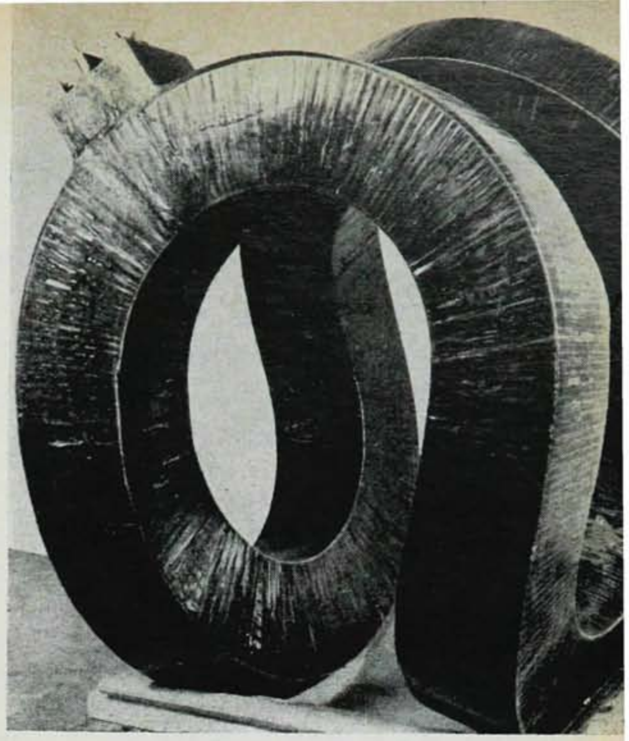
The diagram shows both the curved magnetic-flux lines and the contours of absolute magnetic-field intensity in a central plane of the coil. A central field of 7.2 kG is produced by 2 million ampere-turns. The contours are closed out to about a 30-cm radius, where the field is 20 kG. In this region of closed contours, where plasma containment occurs, the ratio of maximum field to minimum field is about 2.8 : 1. Since the field proportion is short and fat, Post and Damm hope to simplify control of velocity-space instabilities that are expected in open-ended or mirror geometries.

A beam of 15-keV hydrogen atoms is injected to create plasma. Trapping occurs largely from Lorentz-force ($\mathbf{v} \times \mathbf{B}$) ionization of excited atoms; the beam angle is varied to optimize the trapping rate.

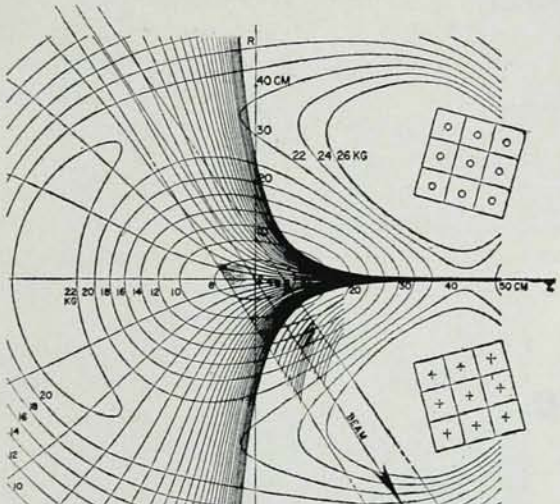
The device is turned on for 5 sec, and in that time the plasma is formed and studied. Coil temperature rises about 100° K, so it is cooled 10 min between pulses. Results are so far very preliminary, Damm says, but plasma has been contained.

In operation the coil is prevented from deforming under the large magnetic forces by an assembly of steel castings and bolts. The entire system is mounted within a 1.5-meter diameter vessel that is evacuated to provide thermal insulation for the coil and the ultrahigh vacuum plasma chamber (also cooled to liquid-nitrogen temperature).

Since plasma buildup time would soon exceed the pulse length achievable with copper, the Livermore physicists had to find a new way of increasing magnetic pulse length. Superconductors seemed to be the best answer, particularly since they want to use stronger fields over larger volumes.



BASEBALL-SEAM COILS used at Livermore to produce minimum-*B* field for experiments on plasma containment and stability. Diameter is 1 meter.



FLUX LINES AND CONTOURS of constant field modulus in one plane of coil shaped like seams on baseball. At 2×10^{6} ampere-turns central field is 7.2 kG.

The first superconducting model has been built with a 25-cm diameter and a 6-kG central field. As a coil it works well, but a plasma has not been generated yet. Since the scale and field intensity are somewhat low, Damm and Post feel they will need a larger version, probably 11.5 meters in diameter, with a central field of 10 kG or more. Sometime next summer it may be ready for plasma experiments.

Other participants in the baseball coil program are: Archer Futch, James Foote, Angus Hunt, R. W. Moir, K. G. Moses, L. C. Pittenger and Clyde Taylor.

Novosibirsk colliding beams

A new kind of colliding-beam device that stores 25-GeV protons and antiprotons is being built at Academic City, Novosibirsk, USSR. The device is the third storage ring to be built there; a pair of 160-MeV electron-electron-storage rings and a 700-MeV electron-positron storage ring are both operating. Academician G. I. Budker, director of the Nuclear Physics Institute in Academic City, described the devices in talks given at seven US laboratories last September.

The 25-GeV storage ring, making full use of both proton and antiproton energy, will open a new energy range—10^{12}–10^{15} eV—to high-energy physics, according to Budker. A counterpart, being built at CERN, will inject 27-GeV protons from the proton synchrotron into a pair of proton storage rings.

At Novosibirsk, however, Budker will combine both the accelerator and ring into one device. Two semicircles, each of 45-meter radius, will be separated by two straight sections, each