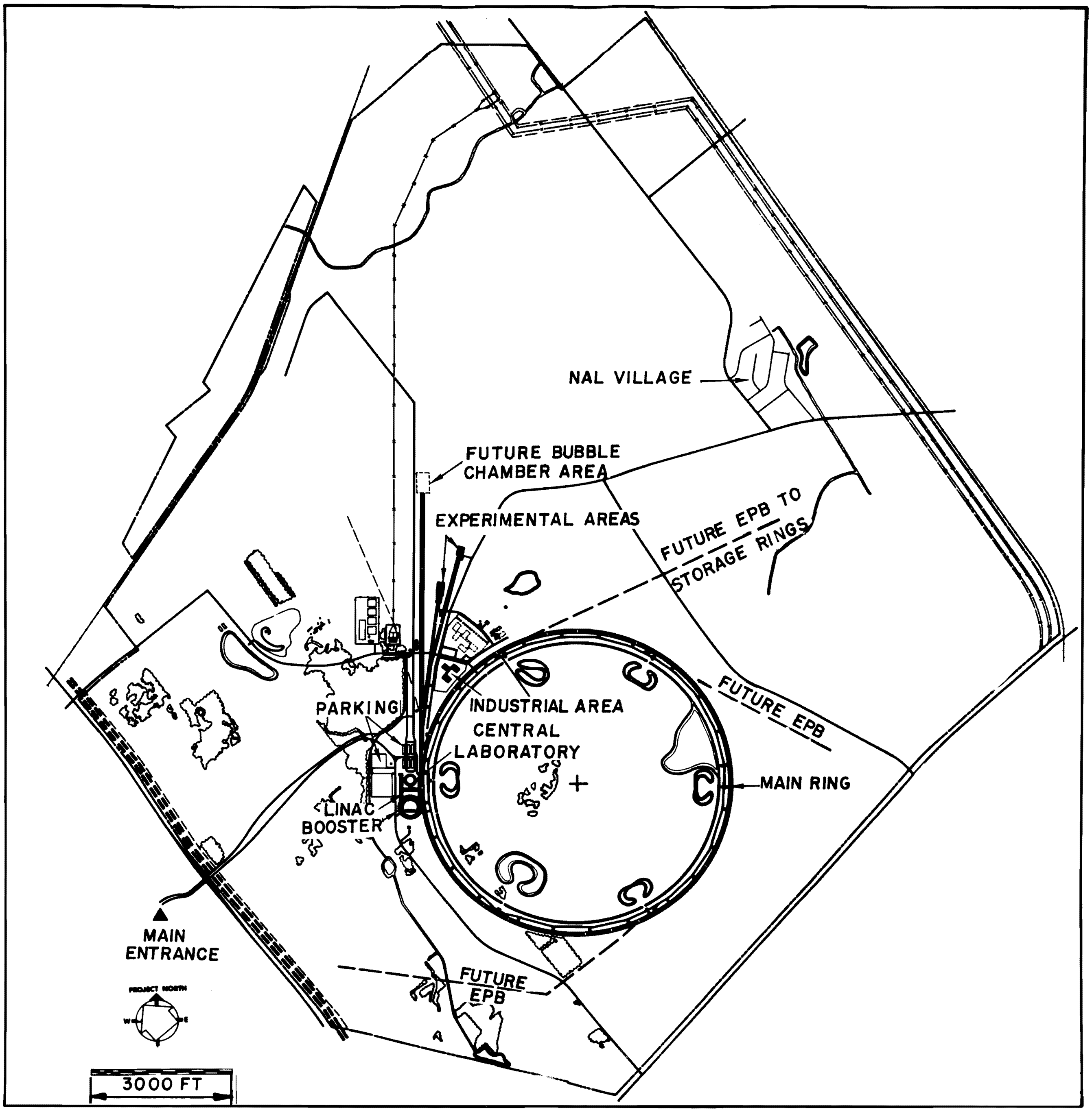
national accelerator laboratory

MONTHLY REPORT OF ACTIVITIES

May 31, 1969



MASTER PLAN OF THE LABORATORY

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MONTHLY REPORT OF ACTIVITIES

F. T. Cole

May 31, 1969

Abstract: This report covers the activities of the National Accelerator Laboratory for the month of May, 1969.

General

1. Experimental-Area Layout. A new conceptual layout of the external beams and experimental areas has been developed, following the work of the 1968 Summer Study. A general master plan of the site, incorporating the new ideas, is shown on the cover. The layout is described in more detail in the "Experimental Facilities" part of this report.

On the basis of this conceptual design, we have been authorized by the Atomic Energy Commission to proceed with Design Specification (Preliminary Design) of experimental areas.

2. Summer Study. The 1969 Summer Study will begin in Aspen on June 9. It will continue through August 2. The Summer Study will again be focused on experimental use of the 200-BeV accelerator.

3. Construction Progress. All active construction subcontracts are on or close to schedule. Figure 1 is a recent aerial photograph of the main construction site.

Structural work is continuing on the linac building. At the middle of May, the building was approximately one-third completed.

The booster enclosure had a slow start because of bad weather. It is now moving ahead. For a part of the below-ground ring, the floor slab has

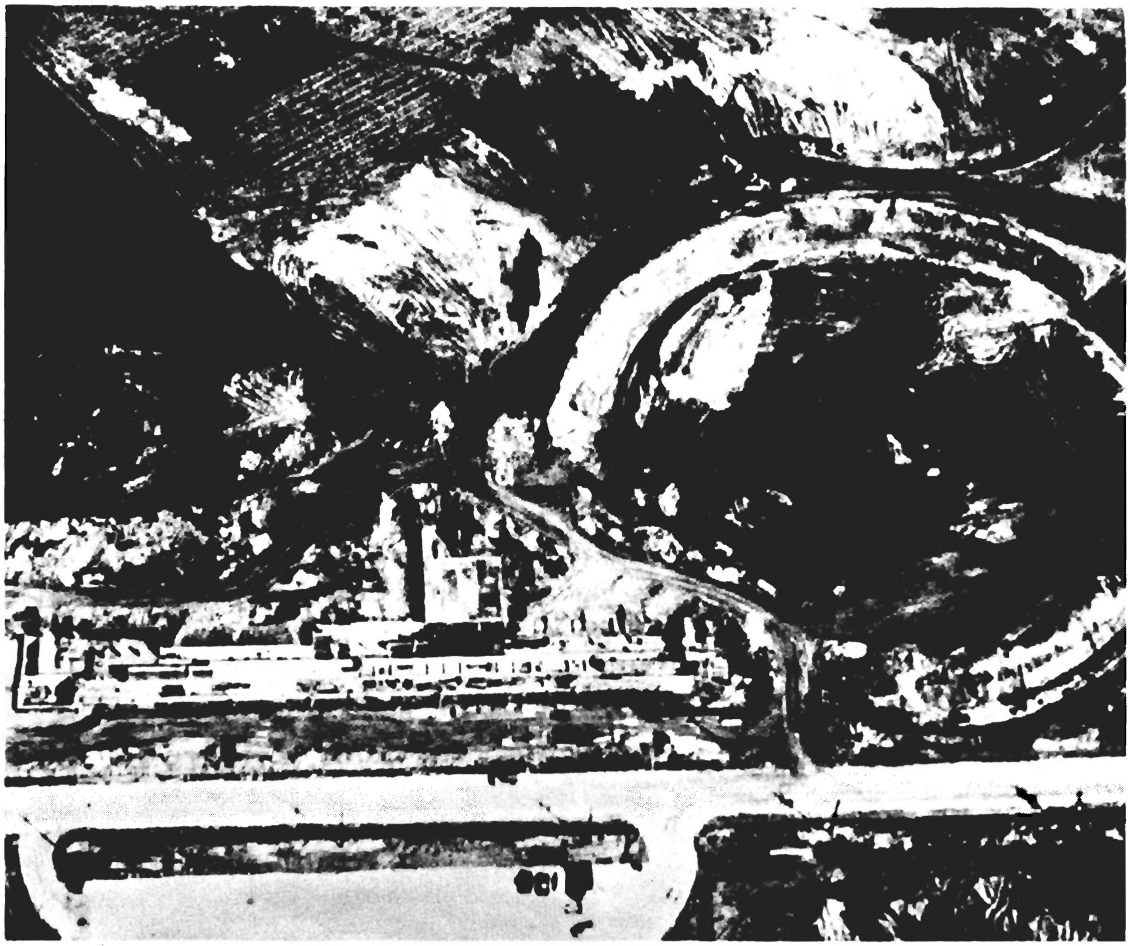

Fig. 1. An aerial photograph taken May 25, looking southeast. The booster enclosure is at the right, the linac building to the left. The stub south of the linac building will connect to the cross galley. (This photograph courtesy of Donald Mendenhall of the Linac Section).

been poured and forms erected for the concrete of the tunnels. Figure 2 shows this work. The booster enclosure is approximately 5% complete.

The rough-roads and drainage work is now 65% complete. It is scheduled to be finished in July. The main-ring and booster prototypes are both virtually complete. Figure 3 shows the interior of the interior of the main-ring prototype. The survey house is 15% complete.

Work has proceeded rapidly on the temporary ditch around a part of the main ring. This work is now 50% complete.

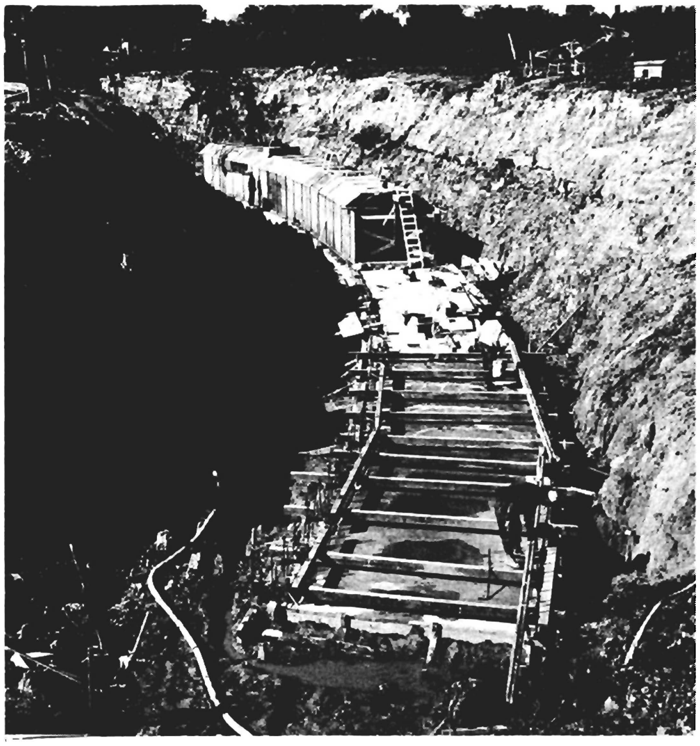

Fig. 2. The booster enclosure on May 23. The view is of the western part of the ring.

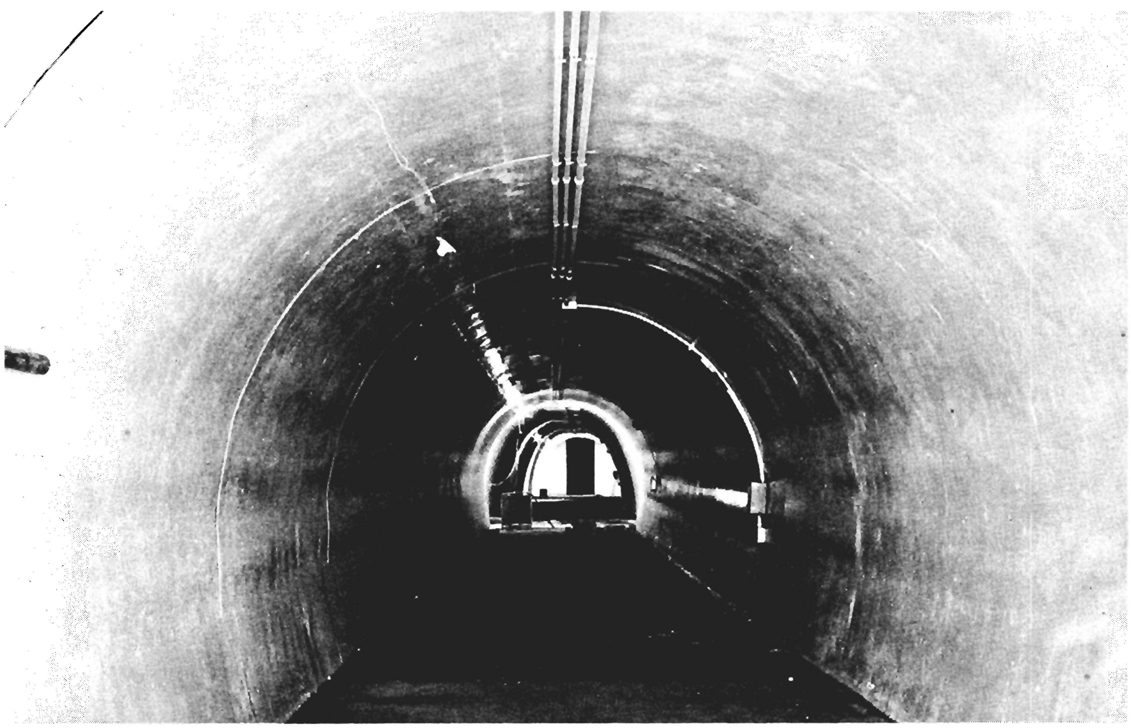

Fig. 3. Interior of the main-ring enclosure prototype. The curvature can just be seen.

Booster

1. Booster Energy. It has been decided to decrease the booster output energy from 10 GeV to 8 GeV, in a manner that will allow the energy to be raised back to 10 GeV, if desirable, at a later time. The booster radius and magnet lattice will not be changed. The consequent reduction in the peak guide field will result in a significant reduction in the cost of the energy-storage system of the booster magnet power supply. The number of booster rf cavities can also be reduced, from 16 to 14. These reductions in cost are larger than the estimated extra cost of the main-ring rf system, which must be frequency-modulated over 0.55% for 8-GeV injection instead of 0.37% for 10-GeV injection.

2. Booster-Magnet Studies. DC magnetic measurements of the D-magnet profile using laminated pole-tip inserts have been completed. The results are shown in graphical form in Fig. 4. There is excellent agreement between theoretical and measured fields throughout the desired field range.

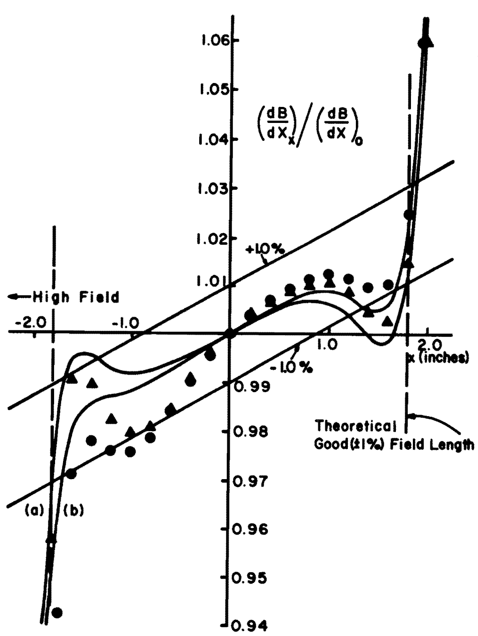

Fig. 4. Field gradient vs. radius for booster D magnet. Curve (a) is the theoretical low-field gradient; the triangles are measured points at 0.525 kG. Curve (b) is the theoretical high-field gradient. The circles are measured points at 7.8 kG. The ± 1% tolerance limits are skewed because of the sextupole component built into the field.

3. Diagnostic Equipment. Members of the Booster Section are working with the Linac Section to produce beam-diagnostic facilities for the 10-MeV beam line. This work includes computer control of the beam-line components and the diagnostic equipment and will be used as a prototype of the 200-MeV transport system.

Main Ring

1. Magnet Design. Considerable progress has been made in recent months in the design of main-ring bending and quadrupole magnets. Sketches of the present designs are shown in Figs. 5 and 6. Both kinds of magnets make use of angle-iron pieces for stiffening. These pieces are part of the magnetic circuit, unlike the stiffeners of the Design Report magnets. The magnetic use of these pieces has enabled us to decrease the cross-sectional dimensions of the magnets to those shown. In addition, the quadrupole has the smaller 12-turn coil mentioned in last month's report. Mechanical tests of the new designs are now being made.

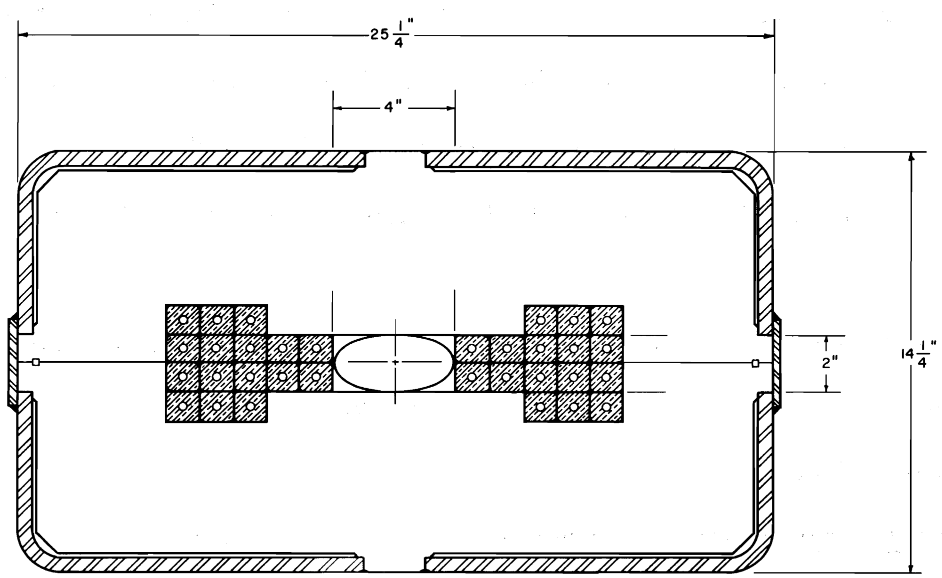

Fig. 5. Cross section of main-ring B2 bending magnet.

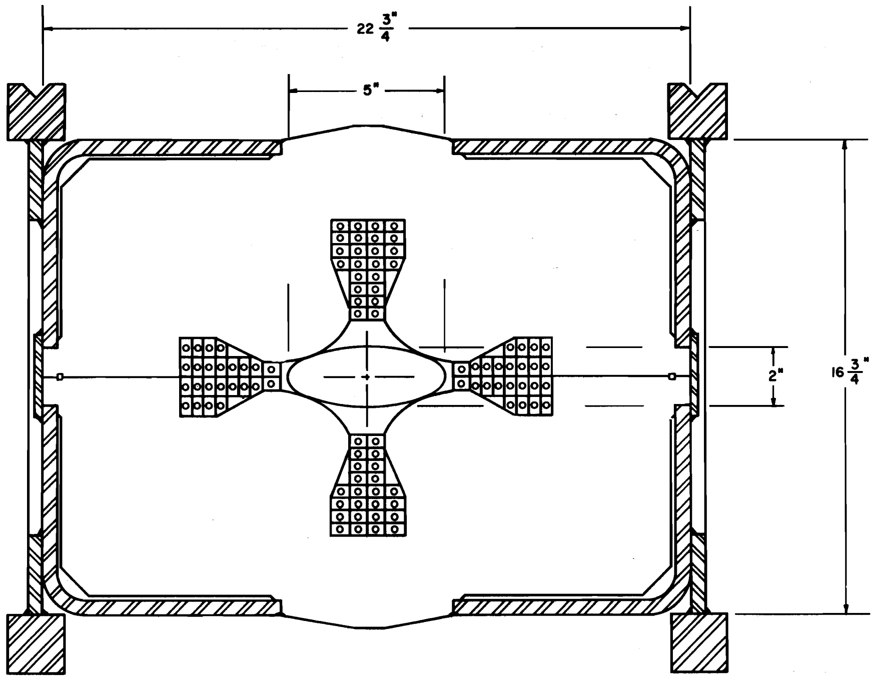

Fig. 6. Cross section of main-ring quadrupole.

2. Magnet-Steel Evaluation. Sample 5-ton lots of steel from five different steel companies have been tested magnetically and mechanically. Two samples have satisfactorily low (less than 1 oersted) coercive force. This coercive force gives rise to a remanent-field contribution with undesirable nonlinear components at injection. Discussions have been initiated with these two companies for production of prototype quantities, with options for future production of the full quantity of steel required for the main-ring magnets.

3. Prototype Coils. A contract has been let for coil tooling and one prototype 20-foot coil for B2 magnets. We will build another coil in our own shops as a parallel effort.

4. Model Power Supply. A power supply has been delivered for use in magnet tests and power-supply controls studies. It is capable of powering a 20-foot magnet to over 400 BeV.

Radio Frequency

1. Booster RF Control-System Design. The general system design for the booster rf controls has been completed. This system will provide the communication between the booster control system and the rf modules (cavity, tuning system, and amplifier chain).

2. Beam-Position Sensors. Several designs have been worked out and ferrite-core testing begun for beam-position monitors for the linac, booster, and main ring. These are being compared with induction-electrode designs in collaboration with the Booster Section. A monitor is also being built in the Linac Section.

3. Ferrite Testing. Delivery has begun on 8-inch ferrite cores for the prototype booster rf system. A testing program on these cores as they are delivered will continue for several months. The ferrite test equipment is shown in Fig. 7.

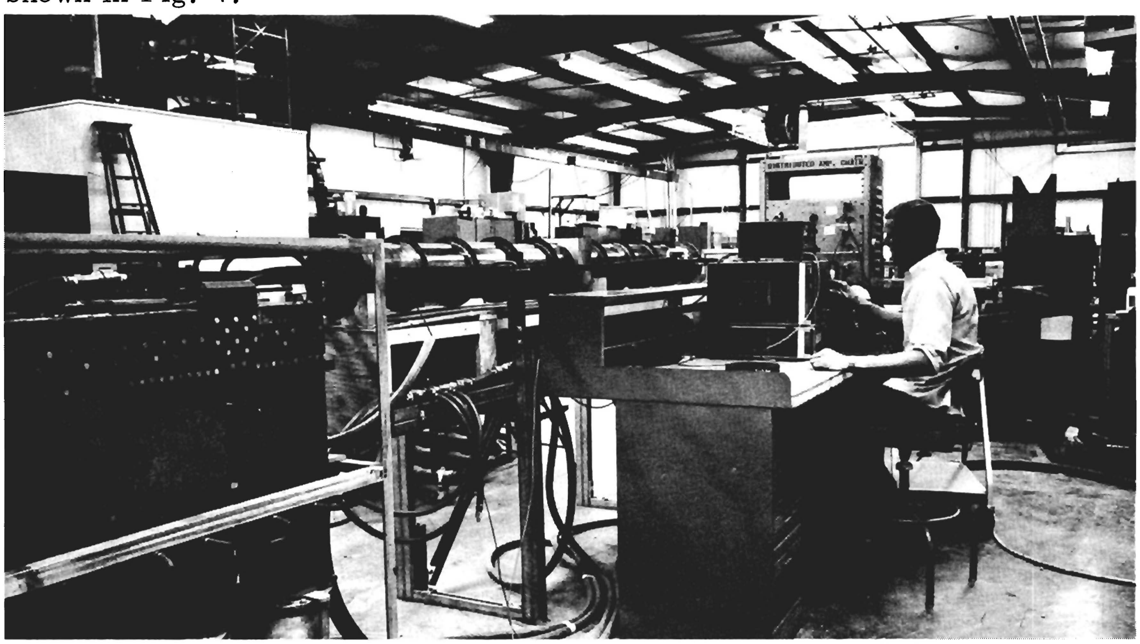

Fig. 7. The ferrite-testing cavity in the RF building. The operator is Mark Augustine.

Radiation Physics

1. Main-Ring Enclosure. The AEC Advisory Panel on Radiation Safety has reported on their review of our design of the main-ring enclosure. They agree with our shielding design.

2. Particle-Production Estimate. A set of yield curves has been developed for the production of $\pi^{\pm}$, $K^{\pm}$, and $p^{\pm}$ by 200-BeV protons on hydrogen, beryllium, or lead targets. They make use of a new version of the Hagedorn-Ranft particle-production model. Figure 8 is an example of the antiproton-production curves. These curves were developed for possible use at the Aspen Summer Study.

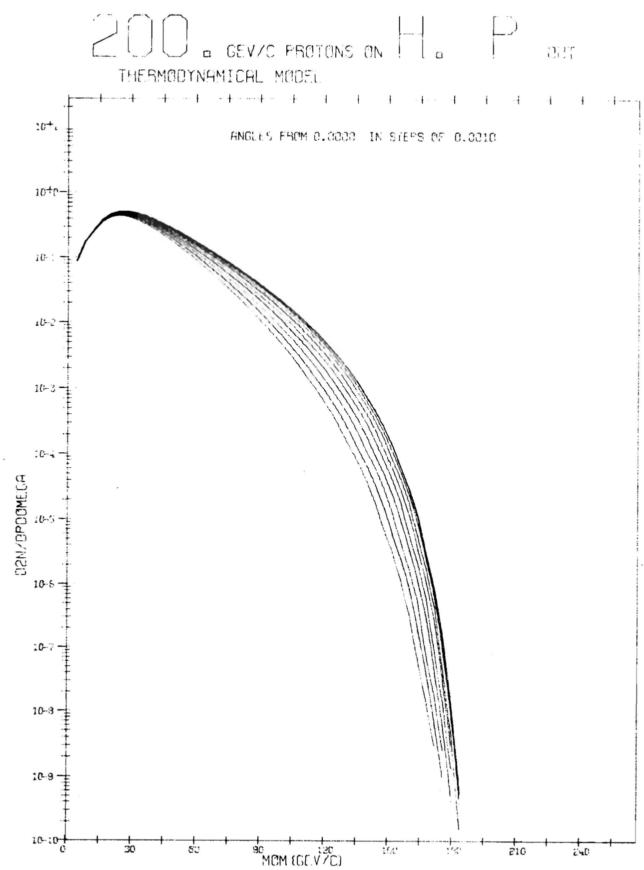

Fig. 8. Production of antiprotons per GeV/c per steradian per interacting 200-BeV proton. Angles are in radians.

Physics Research

Particle-physics experiments are to be carried out by Laboratory physicists through the Physics Research Section. This section now has no members; it is expected that engineers and technicians will be added to it during the next fiscal year, to aid physicists from all other sections in the performance of their experiments.

Proposals for a first round of experiments are being submitted up to June 1. These proposals will be evaluated during June and those accepted will be supported by the Laboratory.

The section has acquired a scanning table for use in film analysis. It is shown in Fig. 9.

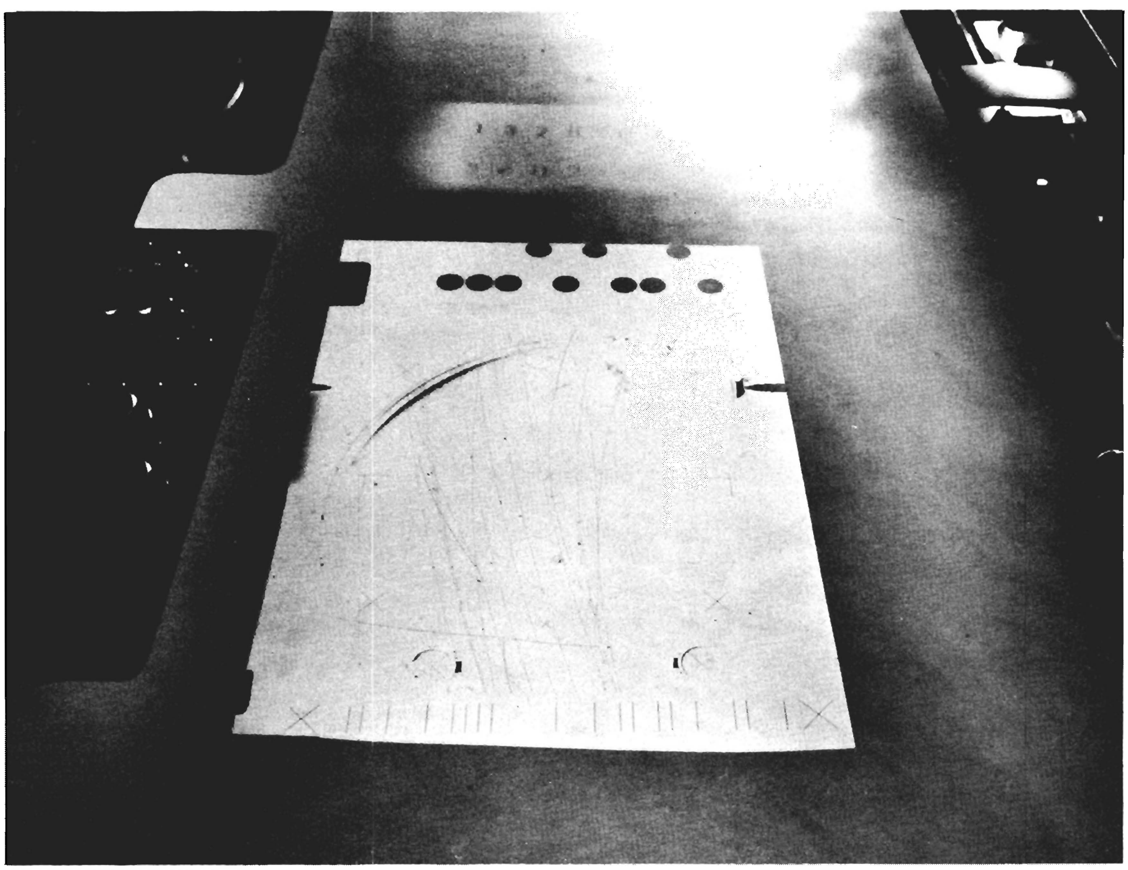

Fig. 9. The film-analysis scanning table.

Experimental Facilities

The new conceptual design of the experimental-area layout is shown on the cover of this report and in more detail in Fig. 10, which shows specifically the areas and stations described below.

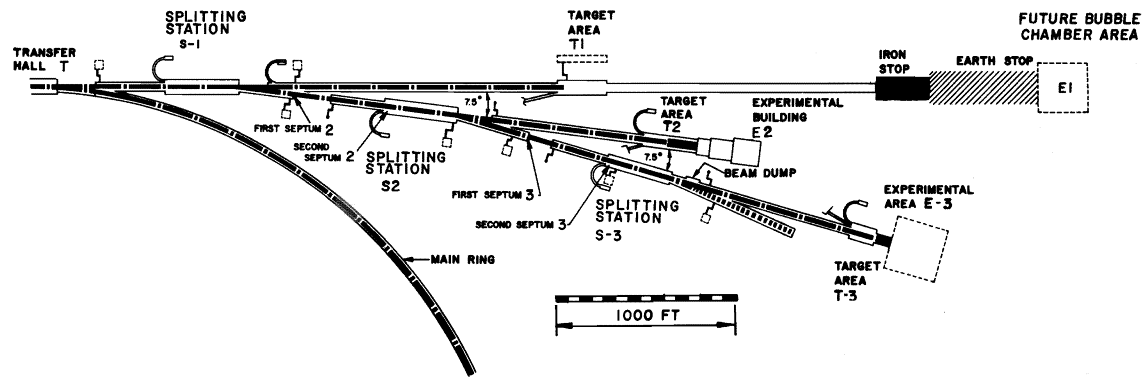

Fig. 10. Layout of the Experimental Areas.

In this layout, the beam is extracted from the main accelerator and is carried from the Transfer Hall in a tunnel very similar to that of the main accelerator itself. At Splitting Station S1, all or part of the beam can be sent straight ahead to Target Area T1; the remainder is bent 7.5 degrees toward the Splitting Station S2. Here it can again be split, with all or part going to Target Area T2 and the remainder bent 7.5 degrees to Splitting Station S3. Target Area T3 is straight beyond S3. Here the split beam could be diverted toward future target areas, if such expansion is shown to be desirable.

The purpose of Target Area T1 is to provide beams to a large bubble chamber at E1, planned to be built as a collaborative effort with Brookhaven National Laboratory. It is planned to provide a high-intensity, broad energy-spectrum neutrino beam and an rf-separated π and K beam with a maximum energy of approximately 80 BeV. Counter and spark-chamber experiments can also use the neutrino and charged-particle beams in Area 1.

Target Area T2 and Experimental Area E2 are designed for counter and spark-chamber experiments. An assortment of approximately six charged and neutral secondary beams will be provided. It is expected that these beams will stay in place and not be rebuilt often for special purposes.

The third area will also be designed for counter and spark-chamber experiments, but will be more flexible and able to accommodate a wider variety of secondary beams. Its design is less complete than those of the other areas.

Area 2 will be designed in detail and constructed first. It is planned to begin its construction late in calendar 1970 and complete it in April, 1972. Area 1 will begin construction in the middle of calendar 1971, and is planned to be finished in July, 1972. (It is simpler than Area 2). Area 3 will not begin construction until July, 1972, so that experience can be gained from the other areas, and is planned for completion in July, 1973.