



Japan's electron accelerator, training ground for the 40 Bev proton machine.

FROM JAPAN

## Japan moves forward

Theorists, isolated from Europe, are betting heavily on their own machine to test their ideas

Despite brilliant theoretical work by such physicists as Drs. Hideki Yukawa, Sin-ichiro Tomonaga and Kazuhiko Nishijima, Japan is still isolated from Western science. But moves are under-way to narrow, if not bridge, the gap. Particle physics is becoming more and more important in Japan whose physicists hope, until the coming 200 and 300 Bev machines are built, soon to have the world's second largest atom smasher—bigger than the present CERN and Brookhaven giants.

**Keystone** of Japan's fast-developing high energy physics activity is the Institute for Nuclear Study established in 1953, and started formally in 1955 with five research divisions: low energy, high energy, cosmic ray, theory and chemistry divisions. The main facilities of this institute are a 160 cm cyclotron; a 1.3 Bev electron synchrotron and a large station for observing cosmic rays.

The electron-synchrotron was built partly to obtain the necessary experience to construct a 40 Bev proton synchrotron (SN: 8/5).

Says Dr. Gyo Takeda, director of the institute: "As the sole high energy accelerator in Japan, this has provided us unique opportunity for gaining experience both in accelerator physics, and in experimental high energy physics. The many young physicists educated in this field will certainly be a prime source of manpower for the 40 Bev synchrotron."

The INS budget is small, only about \$1 million annually, on average, and its accelerators came into existence many years after similar accelerators were built abroad. Thus, its main stress has been on relatively inexpensive projects such as study of nuclear properties and nuclear reactions by low energy accelerators and qualitative study of super high energy phenomena by cosmic rays.

**Probably** some 100 foreign physicists working in the high energy field visit the U.S. every month, but only about 10 per year visit Japan. The problems of high equipment costs and relatively limited sums of money available are unusually great in this country.

Even for theoretical studies research conditions were quite poor until the early 1950s. There have been isolation from physics and foreign physicists, few personal contacts and year-long delays in even receiving overseas journals. Nuclear physics in Japan for years was still new and not of enough interest to most university physics departments.

"Now," Dr. Takeda continues "after several years' operation of the electron synchrotron, we are ready to build the 40 Bev proton synchrotron, and the quantitative study of high energy physics by accelerators will be accessible to us in the near future. We aim, overall, at well-balanced progress in research in the low energy, high energy

and super high energy (cosmic ray) fields."

Three large joint projects in cosmic rays between Japanese physicists and physicists abroad are going on in Bolivia, India and Brazil. Osaka City University, through Dr. Saburo Miyake, has undertaken a large cosmic ray underground experiment with the New Delhi Government. In a second cosmic ray project Dr. Yoichi Fujimoto of Waseda University is working with Brazilian technicians on 15,000 foot Mt. Chacaltaya in Bolivia, where the U.S. has also had a team.

A third project finds Dr. Koichi Suga of the INS working with the Bolivian Government on the Bolivia Air Shower Joint Experiment (BASJE), also on Mt. Chacaltaya.

**A key** domestic project has been the study of high energy nuclear interactions with a large emulsion chamber, by Hirosaki University, and eight other universities, Japanese and Brazilian.

The project leader, Dr. Jun Nishimura of Tokyo University's Institute of Space & Aeronautical Science, says the study investigated nuclear interactions caused by particles with energy around 100 Bev, by means of large emulsion chambers exposed on mountains, on Mt. Chacaltaya in Bolivia and Mt. Norikura in Japan.

There is a similar project, by Dr. Masatoshi Koshiba of Tokyo University, in California. *Stuart Grtffin*