NEWS AND VIEWS

Making Clouds in Space

A 2·5 kg "bomb" of barium is one item of equipment on board HEOS-A, the European satellite launched from Cape Kennedy on December 5. Planned by the Max Planck Institute for Extraterrestrial Physics, the bomb is to be ejected at an altitude of roughly 20,000 km when the satellite is crossing the boundary of the magnetosphere. It is the latest in a series of experiments by the institute to measure magnetic and electric fields in space, which until now have been based on rocket firings.

The Max Planck Institute for Extraterrestrial Physics, at Garching, near Munich, was set up in 1964 with the aim of studying physics by using space as a laboratory. It is one of more than fifty institutes run by the Max Planck Society which are similar in their function to the units run in Britain by the research councils. Much of the effort at Garching is directed at plasma physics and in particular the study of plasmas in extra-terrestrial space. (Plasmas are completely ionized gases made up of electrons and positively charged ions, which as a whole are electrically neutral.) This work had its beginnings in the study of plasmas in comet tails by Professor L. Biermann at Munich, and is continuing at Garching using artificial plasmas injected into space by rockets and, more recently, satellites. But much of the interest in the technique now developed by the Garching team is the information it gives on electric and magnetic fields in space.

When barium is ejected from a high-altitude rocket, a cloud of vapour is left behind which becomes photoionized by sunlight. Visible from the ground because of the sunlight it scatters, such an artificial plasma cloud drifts under the influence of the electric and magnetic fields in space. The strengths of the fields can thus be estimated from ground-based observations. The Garching team has been involved in more than 30 rocket firings, releasing plasma clouds at altitudes from 125 to 2,000 km. As many as three clouds have been ejected from a single rocket, and quite rightly there has been heavy opposition from critics pointing out the danger of polluting the space environment. The reply from Garching is that the barium rapidly sinks through the atmosphere to the ground. In any case, the argument goes, there is a great disincentive to the release of larger and larger quantities of barium in a single cloud because the space charge then becomes enough to disturb the local electric field.

About 10^{24} particles will be produced by the barium bomb in HEOS-A, scattering some tens of megawatts of sunlight. Observing stations are at the Kitt Peak Observatory, Arizona, and at the site of the European southern hemisphere observatory in Chile. Because of the danger of damage to delicate solar cells, the bomb is not to be exploded until it has separated from the satellite by 50 km or so. Conditions for the experiment are stringent. The cloud must be sunlit while the ground stations are in darkness, and there must be good weather at the two ground stations and no moonlight to degrade the observations. And before the release date can be fixed, taking these factors into account, the precise orbit must be determined—something which cannot be predicted in advance for a satellite in a highly elliptical orbit subject to several perturbing influences. After several weeks of tracking, the position of the spacecraft will be known to within ten kilometres. It is unlikely therefore that Garching's experiment will take place until HEOS has been in orbit for weeks or even months.

The Institute for Extraterrestrial Physics backs up the plasma cloud experiments with laboratory work. So far, the laboratory has been concerned with the mechanism of barium release through a nozzle (so as to obtain the maximum barium yield from a given weight of payload) and with the spectroscopy of plasmas of astrophysical interest. The institute has recently been branching out into high-energy astrophysics. Four balloon payloads equipped with spark chambers, scintillation counters and ionization spectrometers have been flown to measure 100 GeV cosmic rays, and there are also plans to search for celestial gamma rays. The problem here is to sort out the gamma signal from the background of charged particles, estimated to be a million times as plentiful as gamma photons. The institute says it has developed anti-coincidence counters and wire spark chambers which are light enough to be flown in satellites and which can pick up the gamma component.

At a time when experimentation is becoming more and more complex, the scientists at Garching like to think that the plasma work which is the mainstay of the institute is a kind of space research which could have been done fifty years ago. Plasma clouds need no telemetry or radio tracking, and the barium could have been lobbed into the upper atmosphere by the artillery of the First World War.

IMMUNOLOGY

Immune Responses

from our Social Medicine Correspondent

KNOWLEDGE of the genetic control of immune responses has increased by leaps and bounds in recent years and is now sufficient to allow meaningful genetic analysis of the underlying reactions. This is the conclusion of a report called *Genetics of the Immune Response* just published by the World Health Organization (Technical Report No. 402, 7*s*).