suggested that oestrogens primarily determined receptive behaviour in female macaques, but Dr Herbert now believes that oestrogens are chiefly responsible for stimulating male sexual interest whereas androgens control the female receptivity. His sophisticated experimental techniques certainly provided convincing evidence of this, although some participants expressed minor reservations about his interpretations of the results. Dr G. S. Saayman (Port Elizabeth Museum, South Africa) showed how similar techniques could be applied to the study of free-living chacma baboons. His findings supported the conclusions of previous laboratory experiments.

One of the most stimulating contributions of the entire congress was presented by Dr B. A. Lapin (Sukhumi Primate Centre, USSR) in the symposium on pathology. His paper reviewed recent research undertaken in his laboratory on the possible transmission of a human leukaemia virus to monkeys. These experiments established that monkeys treated with human leukaemia material developed leukaemia and that this could then be passed on to other monkeys. Although there seems little doubt that leukaemia was transmitted virally from one monkey to another, there is as yet no direct evidence that a human virus was responsible, for a latent virus in the monkey could have been activated by the introduction of human leukaemic material.

SELENOLOGY

More Luna 20 Analyses

from our Soviet Correspondent

DETAILED analyses of the specimens of lunar rock collected by the Luna 20 probe are now revealing more than the element abundances previously reported (see *Nature*, **237**, 256; 1972). The Luna 20 specimens were collected from the eastern side of a slope (gradient 8 to 10°) in a typical highland area near the Apollonius C crater. In the immediate vicinity of the collection site there were only a few shallow craters of diameter 0.5 to 1.0 m and occasional rocks of diameter not more than 1 to 3 cm. The specimens were collected using a special hard-bit drilling and coring device. The mean diameter of the particles was 70 to 80 μm, although there were more particles of diameter more than 1 mm than in the Luna 16 (Mare Fecunditatis) specimens. There were far fewer fused specimens than in the Luna 16 sample. Experiments in ultraviolet, visible, and infrared light gave a much higher value for the albedo than for the maria specimens (Luna 16 and Apollos 11 and 12) and the colour of the Luna 20 specimens (light grey) was much lighter. Infrared spectroscopy showed the Luna 20 samples to have a more crystalline structure than that of the maria specimens; in general there was a close resemblance to the spectrum of terrestrial anorthite An_{100}, although there were some differences in the contours of the bands.

Perhaps the most interesting feature of the Luna 20 specimens, however, is their iron content. The sample collected consists predominantly of anorthosite-type rocks, in which metallic iron inclusions of various forms and dimensions are found. These inclusions occur, apparently, more frequently than in maria specimens, although Academician A. P. Vinogradov, writing in *Priroda* (No. 8, 1972), stresses that more reliable statistics would be required before a definite assertion could be made. The metallic iron particles from Luna 20 differ, however, from those of the Luna 16 specimens in that the latter contained more than 10 per cent nickel, whereas those from Luna 20 had only a negligible nickel content or no nickel content at all. Almost 50 per cent of the metallic iron from Luna 20 is finely dispersed. It does not suffer atmospheric oxidation at ordinary temperatures, and this, says Academician Vinogradov, is an "extremely remarkable fact". An experimental model for the formation of this dispersed iron has been worked out, based on the reduction of divalent iron to metallic iron during the heating of basalt to 1,500° C *in vacuo*. Iron dispersions produced in this way are also not subject to atmospheric oxidation.

In general, the nickel content of the Luna 20 material is high, particularly in the crystalline fragments, a feature which agrees with the data of the Apollo 14 specimens (Fra Mauro Highlands) but differs from the maria samples. The lack of nickel, therefore, in the metallic iron particles of Luna 20 is one of the "unsolved questions" posed.

Another interesting problem is that thrown up by studies of fossil particle tracks. Examination of olivine from the Luna 16 and Luna 20 specimens showed that the latter had a considerably lower track density ($\rho \lesssim (1 \text{ to } 3) \times 10^4$ tracks cm^{-2}) than those of the Luna 16 regolith ($\rho \lesssim 7 \times 10^7$ tracks cm^{-2}). This indicates that the Luna 20 olivine, and hence the entire rock specimen, has been exposed to cosmic radiation on the Moon for a relatively short time. As the highland rocks are considerably older than the maria in current selenological theories, this result is again puzzling. Considerable further study of the process of formation of anorthosites, both in terrestrial and lunar conditions, will clearly be necessary.

Is Cen X-3 a Neutron Star?

THE X-ray "pulsar" Centaurus X-3 has a period of 4.8 s, greater than the period of any known radio pulsar. This has led to suggestions that Cen X-3 might be a pulsating white dwarf—as pulsars were thought to be before the discovery of the Crab Pulsar with its period of 33 ms. But E. P. J. van den Heuvel and J. Heise, of Utrecht, believe that Cen X-3 can be explained in terms of neutron star models, and in next Monday's *Nature Physical Science* they develop details of some such models.

Because Cen X-3 is an eclipsing binary, there is much more information available about the system than about most pulsars. From simple geometry and orbital data provided by the eclipses (which occur at 2.087 day intervals and last for 0.488 day) van den Heuvel and Heise determine an upper limit of 0.7 $M_\odot$ for the mass of the "pulsar" component of the system. This upper limit is consistent both with white dwarf models and with neutron star models; if Cen X-3 alone is considered, there seems little *prima facie* reason to choose either sort of model. But there are other X-ray "pulsars" with periods shorter than that of Cen X-3, and if it is assumed that they belong to the same family, neutron star models become more plausible, unless overtone pulsations of white dwarf stars are invoked to explain the phenomenon.

Van den Heuvel and Heise assume that Cen X-3 does indeed contain a neutron star and go on to consider the possible evolution of such a binary system which could result in the presence of an active, yet slowly spinning, neutron star today. They suggest that, as the two stars originally forming the system have evolved, mass has been transferred back and forth. According to this model the more massive star evolved more rapidly at first, resulting in expansion and the transfer of mass to the secondary, then, about 1.7×10^6 years after this first stage of mass exchange, the original primary exploded as a supernova, leaving a neutron star remnant which became the new secondary. So the original secondary has become the primary (more massive) component, and has now evolved to the stage where mass is being transferred back to the neutron star remnant of the original primary. In such a model it is this mass exchange which has activated the neutron star, producing X-radiation as matter falls along magnetic field lines onto the poles of the neutron star, which is assumed to be rotating. The long period of the pulsar compared with other pulsars is then explained because the neutron star is old and has had time to slow down considerably since its formation as a rapidly spinning supernova remnant.