a lesser extent, if the phospholipids are first sonicated.

If, on the other hand, the bile salt concentration is too high, the activity falls catastrophically. Different phospholipids varied considerably in their ability to engender reactivation. The mono-unsaturated phosphatidylcholine is most effective, and generates full activity at half the concentration of total lipid present in the original preparation. The saturated version, dipalmitoylphosphatidylcholine, by contrast induces no activity whatever. The doubly unsaturated dioleyl derivative behaves similarly to the mono-unsaturated species. There is some precedent for this type of specificity relationship in regard to other membrane enzymes, but the mechanism is obscure. The role of the bile salt in promoting reactivation must be supposed to reside in its ability to destabilize the phospholipid micelles, and so make monomers available for reaction with the protein.

A different path towards the study of lipid-protein interactions has been pursued by Marchesi and his colleagues, who have been studying the red cell membrane glycoprotein (so-called glycophorin), which carries cell surface receptor groups. This molecule probably has a molecular weight of about 50,000, contains 60 per cent by weight of carbohydrate, and, so the story goes, is the most integral of membrane proteins, in that it projects right through the bilayer, whereas the bulk of red cell membrane proteins are to be found at the inner surface.

Segrest *et al.* (*Biochem. Biophys. Res. Commun.*, **49**, 964 ; 1972) have now sequenced a large tract of this molecule, which is evidently the very part that is normally lodged in the lipid interior of the bilayer. They have obtained cyanogen bromide and tryptic peptides with a good overlap. Two fragments are sialoglycopeptides, and therefore from the N-terminal end of the protein, which lies on the outer cell surface. Another is the C-terminal tract, which overlaps with a long tryptic peptide. Between them they define a sequence of fifty-one residues, all but the C-terminal end of which must be presumed normally to reside within the membrane bilayer. Twenty-three successive residues in the sequence are hydrophobic. At either end there is a considerable cluster of charged side chains, and it is reasonable to infer that these may be the parts of the protein that project into the aqueous media on the inside and outside of the cell. Segrest *et al.* refer to evidence of their own, as yet undivulged, that the hydrophobic stretch is an α-helix. Its length in this case would be some 35 Å, which is about right to span the bilayer. If the authors can confirm this model, it will clearly be a result of great interest.

LASSA VIRUS

A New Disease of Man?

from our Medical Virology Correspondent

THE name "arenovirus" defines a group of RNA viruses with a mean diameter of 110–130 nm, a dense well-defined envelope covered with projections and containing a variable number of electron-dense granules, giving a sandy appearance from which the generic name is derived (*Arenosus*, L. sandy). Other characteristics separate the arenoviruses from RNA lipid solvent-sensitive viruses. The group includes lymphocytic choriomeningitis virus, the Tacaribe complex viruses (haemorrhagic fever viruses of South America) and the recently described Lassa virus, all of which cross-react antigenically.

The dramatic story of Lassa fever began when two missionary nurses from Lassa, in north-east Nigeria, died in 1969 from a mysterious illness, and a third nurse, who was gravely ill, was flown to the United States. This nurse recovered and convalescent plasma from her was effective in the treatment of a laboratory worker, who acquired the infection while working with tissue cultures infected with blood from these patients (J. D. Frame *et al.*, *Amer. J. Trop. Med. Hyg.*, **19**, 670 ; 1970). The virus was isolated and characterized (S. M. Buckley and J. Casals, *ibid.*, 680) and Lassa fever was established as a new virus disease of man.

A further outbreak of Lassa fever, with a high mortality of 52 per cent among twenty-three patients admitted to hospital, was reported in Jos, Nigeria, in 1970 (H. A. White, *Trans. Roy. Soc. Trop. Med. Hyg.*, **66**, 390 ; 1972). Dr Jeannette M. Troup, who performed two autopsies while investigating Lassa

Third Type of Pyroclastic Rock

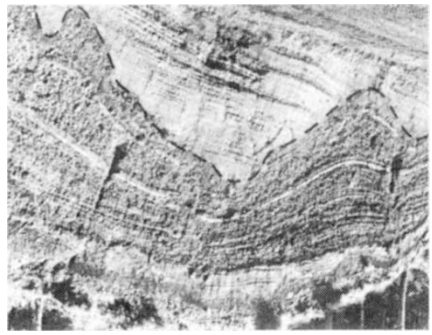
PYROCLASTIC rocks—fragmental volcanic products ejected from volcanoes in explosive events—have usually been divided into two categories, fall deposits and flows. But in next Monday's *Nature Physical Science* (January 15) Sparks and Walker propose a third category, that of ground surge deposits. This category includes some deposits at present classified as pyroclastic flows—frothy, gas-filled glassy lava which bubbles from a volcanic vent during eruptions—and some deposits of *nuées ardentes*, which include the glowing avalanches that dominate the popular picture of volcanic eruptions.

The ground surge deposits are thus characterized by flows along the surface of the Earth, and are clearly distinguished from fall deposits, which show the effects of their passage through the air after ejection, for example in their internal stratification (see figure). But why is it necessary to distinguish between the new category and the pyroclastic flow category?

Active pyroclastic flows are believed to be fluidized by dissolved magmatic gas or by air trapped beneath the advancing flow. They travel as a dense mass, and pumice floats to the top of the flow, where it is preserved when the lava cools to form solid rock. These characteristics result in a structure which mantles the topography around the volcanic vent with a roughly uniform layer of rock.

Although ground surge deposits also mantle the topography, their thickness is not uniform—"they show a pinch and swell structure", as Sparks and Walker put it. Furthermore, they have an internal stratification which is not parallel to the bottom and top of the layer, and they extend out to only a few kilometres from the source. They are relatively thin—less than 1 m compared with the thickness of 10 m or more commonly associated with pyroclastic flows—and they can occur on relatively steep slopes ($>10°$) where pyroclastic flows do not solidify.

The overall picture painted by Sparks and Walker is one in which explosive volcanic activity produces, in addition to the ejecta thrown high into the air, both a dense flow, which chiefly follows the valleys, and a relatively low density ground surge, or "ash hurricane", akin to the ground surge generated in a nuclear explosion. The resulting thin ground surge deposit is very susceptible to erosion, and survives only when covered by other volcanic deposits ; that explains why it has taken so long for the ground surge to be recognized as a separate category. Finally, the pinch and swell structure can be accounted for by a wave pattern, with wavelengths found so far in the region 4 m to 45 m.



Pyroclastic fall deposits. Dashed line is an erosional unconformity ; the fall deposit above it shows internal stratification common among such deposits.

fever and who was primarily responsible for drawing attention to the condition, contracted the infection and died of it.

In March 1972 further cases of Lassa fever occurred among four patients and seven members of the staff in a hospital in the Zorzor district of Liberia in West Africa, and four died. The index case was a pregnant woman admitted to the obstetric ward, and all cases among the patients and members of the staff were in this ward. One of the fatal cases was an American missionary nurse who had direct contact with the blood of the index case (*Morbidity and Mortality Weekly Report*, **21**, 237 ; 1972). A more recent report (*ibid.*, 386) records a further sixty-four cases of Lassa fever admitted to hospital in Sierra Leone. Twenty-three (36 per cent) died, and the case fatality ratio among pregnant women was 75 per cent (six out of eight). One of the sixty-four cases was a nurse who pricked her finger on a needle used for obtaining blood from a patient who subsequently died of clinical Lassa fever.

This is the largest yet reported epidemic, and, unlike the previous outbreaks in Nigeria and Liberia, it consisted primarily of community-acquired infection. Evidence was obtained of family outbreaks of the fever in which spread has occurred among those with the most intimate contact. Man-to-man spread of Lassa virus undoubtedly takes place through contact with blood or infectious secretions, but a reservoir of infection has yet to be identified. Lassa virus is antigenically related to the rodent-associated haemorrhagic viruses of South America and to lymphocytic choriomeningitis virus, usually an inapparent infection of wild mice, but an animal source of Lassa virus or antibodies to this virus in wild rodents has not been found.

It is interesting that many features of this infection are reminiscent of the green monkey disease or Marburg virus infection (see *Nature*, **233**, 236 ; 1971), although, fortunately, no further cases of Marburg disease have been recorded since 1967. In the meantime, however, Lassa fever looms as an awesome new viral infection in tropical Africa, and the epidemiological propensities of this infection may be very wide with the modern means of fast air travel.

MINERAL RESOURCES

Boron from the Sea

from our Soviet Correspondent

NEW work on the sorption of boron compounds may provide a way of isolating the element from seawater. Although the concentration of boron in seawater is relatively low (8 to 9 g B_2O_3 m^{-3} in the Black Sea and 15 to 16 g B_2O_3 m^{-3} in the oceans), the estimated total content of boron in the seas and oceans (2.2×10^{13} tonnes B_2O_3) has provoked a considerable amount of research on the subject. New findings by Nikolaev of the Institute of Inorganic Chemistry of the Siberian Branch of the Soviet Academy of Sciences and Ryabinin of the Hydrophysical Marine Institute of the Ukrainian Academy of Sciences suggest a means of recovering boron, using ZrO_2 as a sorbent (*Dokl. Akad. Nauk SSSR*, **207**, 149 ; 1972).

Nikolaev and Ryabinin carried out a detailed survey of salinity, *p*H and temperature conditions affecting the sorption of boric oxide on various hydrated oxides, for different initial concentrations of the boron. Best results were obtained using hydrated zirconium oxide as sorbent and a *p*H value of 8 to 9—close to that of natural seawater. The effectiveness of the process was found to increase continuously with the amount of sorbent, practically total extraction of the boron (98 per cent) being obtained for a ratio of ZrO_2 to B_2O_3 of 400.

The experiments were performed with water from the Black Sea, and the good results obtained, even at these low concentrations, lead Nikolaev and Ryabinin to think that the use of a zirconium oxide sorbent may be an economically realistic method of recovering boron from the sea.

SEMICONDUCTORS

Transistor Revitalized

from a Correspondent

IT seems that the transistor, which only a few years ago was considered by many people to have reached the limit of its performance, is now a serious contender in the microwave region and may well extend its range to about 10 GHz. This was the theme of a timely symposium held at Imperial College, London, on December 13, and arranged by the Electronics Group of the Institute of Physics in collaboration with the Institute of Electrical Engineers.

Many of the contributions reported significant advances in both silicon and gallium arsenide technology. In particular two speakers, D. J. Hinds (GEC Hirst Research Centre, Wembley) and Dr R. P. Arrowsmith (Post Office Research Department, Dollis Hill, London), discussed recent advances in the technology of silicon microwave bipolar transistors. It now seems that arsenic has replaced the more conventional phosphorus as the emitter dopant in npn devices. Improved cut-off frequency (f_T) and noise performance result in useful performance up to 4 GHz with promise of extending this to at least 8 GHz by reverting to an improved version of the old "mesa" design.

Many of the improvements can be attributed to great advances in optical photolithography, which mean that line

Laboratory-made Chert

THE flint-like rock called chert which has turned up in surprising quantities beneath the Atlantic to blunt the drilling bits of the Glomar Challenger research vessel continues to hold the attention of geologists. Last year Weaver and Wise of Florida State University reported that some of this chert, which is also found in other oceans, is composed of blades of cristobalite 300 Å to 500 Å thick gathered together in balls about 10 μm across (*Nature Physical Science*, **237**, 56 ; 1972).

These fascinating structures have now been reproduced in the laboratory. In an article in next Monday's *Nature Physical Science* (January 15), J. H. Oehler (University of California at Los Angeles) reports experiments in which aliquots of silica dispersed in water were subjected to temperatures of 150° C and pressures of 2 kbar for four weeks. The product, examined under the scanning electron microscope, consisted of 50–75 μm balls of platy, apparently hexagonal, crystals (see figure).

Oehler says that this hexagonal appearance of the artificial chert is characteristic of tridymite rather than cristobalite, which forms octahedral crystals, and he favours the view that what is being formed are hybrid crystals composed of layers of both tridymite and cristobalite, the tridymite structure dominating the morphology. X-ray diffraction data have so far been unable to confirm or deny the hypothesis. Oehler believes that this layered structure may well apply to the cristobalitic cherts recovered from the oceans.