NEWS AND VIEWS

Phyllosilicates and the Solar System

INTERPLANETARY space contains a considerable amount of solid material, and the Earth on its journey around the Sun continually collides with this debris. Recent observations show that about 1000 ton is being accreted annually. This debris has a mean geocentric velocity of 130,000 km h^{-1} and so most of it is vaporized by frictional heating in the Earth's upper atmosphere. A few objects are sufficiently large to penetrate the atmosphere without being completely destroyed, and they arrive at the surface of the Earth as meteorites. One of these will hit an area the size of Britain every 2 to 3 years, that is, about 500 reach some part of the Earth's surface each year.

Meteorites contain the most primitive material known. They have remained almost unchanged since the formation of the solar system, and are a thousand million years older than the oldest known rocks on Earth. Meteorites have not suffered the high degree of differentiation that has taken place in the Earth's crust, and thus they are much more representative of the composition of planetesimals, the primitive rock fragments which coalesced to form the planets Mercury, Venus, Earth and Mars and the rocky cores of the outer planets. Asteroids are perfect examples of planetesimals—small irregular rocky bodies similar in form to Phobos, the moon of Mars which was photographed recently by Mariner 9.

Several thousands of these tiny minor planets move in orbits between those of Mars and Jupiter. The total mass of all the asteroids is of the order of 0.03 per cent of that of the Earth, so, unlike the planetesimals which coalesced gravitationally to form the Earth, the mass of the asteroids was too small and they still remain as individual bodies. Meteorites, being asteroidal planetesimals on orbits that intersect that of the Earth, provide the chief clue to the composition of planetary interiors and to the composition of the non-volatile elements in the condensing nebula which formed the planets in the solar system. The study of meteorites forges a vital link with the preplanetary solar system.

By far the most common class of meteorites are the chondrites, which make up more than 75 per cent of known meteorite falls. These stony bodies usually contain chondrules, spherical grains of iron magnesium silicate a few millimetres across, but the most primitive members of this class, the type I carbonaceous chondrites, do not even contain these.

Most cosmochemists have assumed that these type I carbonaceous chondrites are in fact the primitive essence of the solar system and that the abundance of condensable elements in this class of chondrites is the same as the primitive abundance in the original contracting nebula. But certain of the minerals in type I carbonaceous chondrites were not there originally; for example olivine and pyroxene are thought to be mechanical additions and certain sulphates and carbonates are obviously late deposits. Phyllosilicates, on the other hand, have been there all the time.

Phyllosilicates are the most common material in carbonaceous meteorites; they constitute about 65 per cent by weight and occur as submicroscopic foils or flakes, which are typically about 1000 Å in diameter, 100 Å thick and polycrystalline. John Kerridge, of the Institute of Geophysics and Department of Chemistry of the University of California, has concluded—in a communication on page 44 of this issue of *Nature*—that it is the phyllosilicates in type I carbonaceous chondrites that are the "primitive essence" of the solar system, and not the whole chondritic material. One of the fundamental problems that must be solved before it can be definitely established that it is only the phyllosilicates that are the basic building blocks of the planets is the inter-relation between these phyllosilicates and magnetite, which makes up about 15 per cent by weight of the meteorite.

Kerridge finds that the phyllosilicate-magnetite association is not the result of a hydration of the original condensates in the nebula in equilibrium with solar gases at temperatures of less than 315 K (that is they were not formed at the same time), but that phyllosilicate is a basic unaltered material which has been mixed up with the altered magnetite actually in the meteorite, and that these two substances have never been in equilibrium.

The reasons propounded are that the phyllosilicate has retained its iron and has an unusually high nickel content, and that it has not been aqueously altered or hydrated since formation; it also contains rare gases of a planetary and not solar wind type, like the magnetite. In other words the silicate and magnetite obtained their gases in different environments and were subsequently mixed at such a low temperature that equilibration did not occur. Also the composition of phyllosilicate matches the abundance of the principal elements in the Sun. A problem arises here, however, because data on solar abundances, particularly in the cases of iron and silicon, are rather uncertain.

Kerridge concludes that the Sun, the planets and the chondritic meteorites were all formed from the same nebular cloud, and that the phyllosilicate material found in type I carbonaceous chondrites is the "primitive non-volatile essence" of the solar system, which formed the rocky cores of all the planets and satellites. In the light of this hypothesis he also concludes that the cosmic ratio of iron to silicon is 0.53 ± 0.06, a finding that should be of great help to solar astrophysicists in their interpretation of solar spectroscopic data.—D. W. H.

Starting off DNA with RNA

ONE of the most pressing problems of DNA replication has been how the synthesis of new strands of DNA is initiated, for all of the known DNA polymerase enzymes of both bacteria and the cells of higher organisms appear to be able to extend a DNA chain which has already been started; but none can commence synthesis of a chain anew. Although hints have been appearing in the literature for the past few months that RNA may be involved in DNA synthesis, the first direct evidence of such an involvement in replication of the DNA of