physical sciences notes

PHYSICS

Liquid metals behave like solids

A method of determining the surface tension of molten metals without making physical measurements has been devised by Trevor Cyril Toye of the College of Technology at Swansea in Great Britain.

He has shown, from theoretical and experimental work, that liquid metals can be considered as crystalline solids having extra dislocations. They are similar to the solids but have more structural faults. Because of this, surface tension can be considered as being the result of the sum of the dislocation energies at the surface.

Viscous flow in a liquid is conventionally explained by the movement of atoms in an excited state, through about half an atomic spacing; this creates vacancies or holes into which the adjacent atoms slip. Although this gives a good interpretation of a liquid metal's properties, Toye says, the idea of a solid with extra dislocations works even better.

Toye has calculated the surface tension of several liquid metals by his method, then compared the results with those obtained by direct measurement, with satisfactory close agreement.

GEOPHYSICS

Program for the approaching solar maximum

The Inter-Union Commission on Solar-Terrestrial Physics has issued its first working document— a program for the years of maximum solar activity from now through 1970.

It consists of 12 fairly distinct projects with broadly defined scientific goals, in fields ranging from monitoring the solar-terrestrial environment to charting disturbances of the interplanetary magnetic field to the magnetosphere to auroras.

Dr. Herbert Friedman of the Naval Research Laboratory is president of IUCSTP, which is aimed at maintaining the international cooperation that proved successful during the International Geophysical Year and the International Years of the Quiet Sun.

CHEMISTRY

Compounds with trireticulate structure

Many framework crystal structures are known. They are called reticulate by chemists. In them the atoms are attached to one another by essentially covalent bonds to form a three-dimensional framework.

A simple example is diamond; a more complex example is Prussian blue, in which iron atoms at the corner points of a simple cubic lattice are joined together by cyanide groups extending along the edges of the cubes. Potassium ions and water molecules occupy alternate positions in the center of the cubes.

Cuprous oxide is an example of a bireticulate structure in which one lattice structure is crosslinked with another. Each of its copper atoms forms convalent bonds, at 180 degrees with one another, to two oxygen atoms, and each oxygen atom is bonded to four copper that surround it in the form of a tetrahedron. There are, however, two interpenetrating frameworks, not bonded to one another, each of which occupies the interstices of the other.

Now Nobelist Dr. Linus Pauling of the University of California, San Diego, at La Jolla, and his son, Dr. Peter J. Pauling of University College in London have found two compounds with a trireticulate structure.

In trihydrogen cobalticyanide and trisilver cobalticyanide, the atoms are bonded together to form three interpenetrating frameworks, they report in the June PROCEEDINGS of the National Academy of Sciences.

MATHEMATICS

Map problem solved—again

Whether four colors are always enough to tint the countries of any map on a sphere so that no pair of adjacent countries have the same color has long been a question that has fascinated mathematicians.

The problem was theoretically solved by P. J. Heawood in 1890 but a year later his solution was shown to be based on incomplete arguments.

In the June PROCEEDINGS of the National Academy of Sciences, Drs. Gerhard Ringel and J.W.T. Youngs of the University of California in Santa Cruz report that after a lapse of 78 years, the Heawood map-coloring conjecture has been verified: Four are enough.

The two mathematicians used essentially the same attack as Heawood and his critic did, but carried the soluiton further.

The solution involves on the fact that two jurisdictions are adjacent if they have a common line of frontier points, such as France and Spain. Arizona and Colorado, on the other hand, are not adjacent because, although they have one frontier point in common, they lack a line of common frontier points.

FLUID DYNAMICS

Liquid pillars surrounded by water

Liquid pillars in water form a continuous and stable structure from the bottom of a dish to the surface of the water in which they are immiscible or only partially miscible.

The pillars can be constructed very easily out of two or more liquids, according to Aristid V. Grosse of the Research Institute of Temple University.

One method, he says, is to place 500 cubic centimenters of distilled water containing a trace of fluorocarbon wetting agent in a glass, flat-bottomed dish about 13 centimeters in diameter. Ten cubic centimeters of colorless dimethyl silicon polymer oil are then pipetted onto the water surface, forming an insoluble lens.

Ten cubic centimeters of alpha methylnapthalene can also be pipetted in, about one-third attached to the bottom of the silicon lens. The remaining two-thirds is attached as a somewhat hemispherical lens to the bottom of the dish, which is greased in a circle of about four centimeters' diameter.

To form the pillar, the upper lens is positioned by a glass rod exactly above the top of the bottom lens, a simple siphon inserted on the side of the dish and the water level lowered until the two lenses touch each other. They then merge into a liquid pillar.