we have no information on the number of the heavier nuclei, but the studies by Sputnik-3 will enable us to throw light on this important problem too.

The launching of the third artificial Earth's satellite equipped with instruments to conduct all-round studies of cosmic space will further the progress made by means of the first sputniks and will provide science with many new data.

GEOCHEMICAL SURVEY TECHNIQUES

GEOCHEMICAL methods of mineral exploration are based on the premise that diagnostic disturbances in the normal distribution pattern of chemical elements may exist in accessible material in the vicinity of concealed ore deposits. Such geochemical anomalies result from the natural dispersion of elements from the site of the parent deposit and are commonly sought by the systematic sampling and analysis of rock, soil, vegetation, stream water and stream alluvium.

Geochemical dispersion patterns are subdivided into two genetic categories, namely, primary dispersions formed in depth at the time of mineralization, and secondary dispersions, which are usually formed in the zone of weathering. Primary dispersion patterns may occur as regional variations in the trace element content of rocks and minerals, associated with metallogenic provinces, aureoles of impregnation in the wall-rocks surrounding individual deposits, or 'leakage' dispersions of trace metals in the channel-ways followed by mineralizing solutions. In all cases, the primary dispersion is genetically related to the oreforming processes. The interpretation of the geochemical anomalies in terms of the location of possible associated deposits is often difficult and is dependent on the understanding of the local geology. Secondary dispersions, on the other hand, are usually associated with the weathering cycle, and although the dispersion processes are complex, considerable progress has been made in the development and application of techniques having a proved practical value in prospecting. This is particularly true of geochemical soil surveys in areas of residual overburden, where the methods have been successfully used for detecting the presence of sub-outcropping deposits of copper, nickel, arsenic, gold, antimony, chromium, tin, tungsten, molybdenum and other metals.

At times, positive results have been obtained where copper, lead and zinc mineralizations have been concealed by transported glacial cover up to some tens of feet thick. Here, the metals have had the opportunity of migrating upwards into the overlying material by diffusion and other processes, including the growth of vegetation which has extracted the ore metals as part of its nutrient uptake. Although the systematic analysis of the plants themselves has been employed on occasions, it is normally found more practicable to sample the underlying soil wherein metal has accumulated over generations, in the biogeochemical cycle. Geochemical soil and vegetation anomalies are usually restricted to the immediate vicinity of the parent mineral deposit, but abnormal concentrations of metal may sometimes be detected in the surface drainage system up to several miles downstream from mineralization. Where such geochemical dispersion does exist, the systematic sampling of stream-water or alluvium may constitute a useful aid in the rapid mineral reconnaissance of comparatively large areas. Sampling and analysis of stream alluvium for metals extractable at normal temperatures have given particularly encouraging results in reconnaissance for copper and base metal deposits.

The practical application of geochemical methods has been made possible only by the development of extremely rapid, simple tests and there are now trace analytical techniques for a wide range of metals capable of being performed with adequate accuracy by semiskilled personnel. For the most part, these tests are simplified versions of classical colorimetric and chromatographic methods, although spectrographic, fluorimetric and other procedures may be utilized for particular problems.

Current research is active and aimed at broadening the scope of existing methods, extending knowledge of dispersion processes, investigating the regional approach to comprehensive geochemical reconnaissance and developing appropriate analytical techniques. Progress in the application of geochemical techniques indicates that, when used in conjunction with geological, geophysical and other sources of information, they will play an increasingly greater part in modern mineral exploration. (*Nature*, 181, 594, 1958.)
