dustry was using germanium in the manufacture of crystal diodes and transistors at such a rapid rate that it was thought that domestic sources would soon be exhausted.

As an illustration of the potential importance of germanium in coal, only one aspect of the minor elements in coal search, the Geological Survey published a progress report, circular 272, outlining the known concentrations of germanium in the coal ash of American coals, as recorded up to that date.

It is only because new sources of germanium, other than that treasured in coal, were found here and abroad that the mining of coal for germanium was arrested. However, coal still remains a very vital and potential source of this metal.

To determine just what elements and how much of them are in a particular coal bed, the government geologists cut samples from the fresh face of a coal bed. After being cut, the sample is marked and sent to the laboratory. There each sample is divided. One half is saved for possible petrographic and chemical study, and the other half is powdered.

The powdered coal is then placed in a cold muffle furnace and subjected to a gradually rising heat, not allowed to exceed 450 degrees centigrade. The ordinary home furnace reaches temperatures of more than 1,000 degrees centigrade.

The pulverized coal is in this way ashed, and the loss of the elements by burning kept to a minimum.

After ashing, the coal is sent to the spectrographic laboratory, where photographic fingerprints of its composition are made on film plates. The laboratory also determines the percentage of each element found in the coal ash.

Ash Content Varies

Coal ashes have been found to vary greatly in their metal content and make-up, even from one seam to the next.

In this manner, the government geologists and spectrographers have identified and recorded 17 minor elements which they believe to exist in sufficient quantity to be economically important.

A spectrographic picture made from a 4.52% ash of a sample taken from an Indiana mine showed, for example, that the ash contained the following elements, given in grams per ton, estimated for the coal field: beryllium, 100; boron, 5,000; titanium, 2,000; vanadium, 90; chromium, 200; cobalt, 200; nickel, 1,100; molybdenum, 30; copper, 800; gallium, 40; germanium, 600; and yttrium, 100.

Spectrographic pictures of the elements, which appear as lines of varying widths on the film plate, can also be used by mining engineers probing for coal seams. Often, a seam will "pinch out," that is will disappear and crop up again somewhere above or below the worked out seam, being separated by bedrock. "Pinching out" had been caused by geologic forces at the time the coal was forming.

Mining engineers may find that spectrographic methods will give them a more perfect tool for correlating these old and new coal seams, as well as coal beds themselves.

The minor elements might also prove valuable in leading prospectors to new or extensions of old ore deposits.

During the Survey's work with germanium in coal ash, it was found that a factor of great significance in explaining the variations of mineral content is the presence or absence of mineralization adjacent to or within coal fields. There are, for example, zinc deposits near the germaniferous coal beds of Stark and Athens Counties in Ohio.

Plants need certain minerals for their systems. Oftentimes, soil in a particular area is deficient in certain of these minor elements. Because coal ashes may contain the elements needed by the soil and the plants, they can be directly applied as fertilizer.

It has been reported that in some areas of the Southwest, coal ashes are already being used for their value as a fertilizer on mineral deficient soils.

Coal is a form of mummified wood that has lain buried for millions of years. Plants then, as they do now, took in trace elements or minerals into their systems.

At first, the plants formed a peat-like swamp and it was during this time that the biochemical processes in the first step of coal formation took place. These biochemical processes were followed by a lignification process. Finally, the heat of friction and pressure exerted for a long time produced the coal as we know it today.

Seek Element Source

Scientists are now trying to determine whether these minor elements were inherent in the plant ash or introduced by sediments brought in from the surrounding land features. Or further, whether the plants were growing over concentrations of the minerals as they do today, and that this might lead to findings of mineralization near or under coal.

Historically, the study of minor elements in coal got off to a comparatively late start. Pioneer work was done during the 1930's by Victor Goldschmidt and C. L. Peters, who first called attention to the unusual concentrations of germanium and other rare metals in some European coals.

The major part of the research work in this country has been carried on largely by the Survey, the U. S. Bureau of Mines, the West Virginia Geological Survey and the Eagle-Picher Company.

It was recently reported that Germany, Japan and England are now operating plants for the recovery of germanium from fly-ash and the residual ash of coal.

Science News Letter, February 5, 1955

ASTRONOMY

Chance Meeting Reveals Unreported Meteorite

➤ AN UNREPORTED meteorite fall more than 18 years ago has been revealed by a chance meeting between a meteoritics expert and an Air Force mess sergeant.

Dr. Frederick C. Leonard, professor of astronomy and meteoritics expert at the University of California at Los Angeles, and Sgt. Laurend M. Mauersberger of Parks Air Force Base, Calif., recently met at the Barringer Meteorite Crater of Arizona.

Upon learning that Dr. Leonard was an authority on meteorites, the sergeant showed him a stony object he had in his pocket. Sgt. Mauersberger said he had found the object on his father's farm near Marlow, Okla., in 1936.

Dr. Leonard immediately identified it as a stony meteorite from a previously unreported fall and secured it for his U.C.L.A. collection.

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