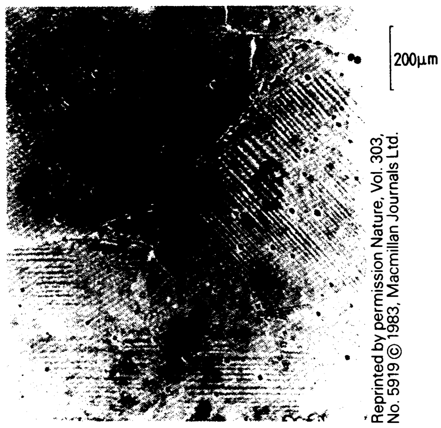
New way to see old magnetic domains

Seventy-six years ago the existence of domains — regions of magnetically aligned atoms — in ferromagnetic materials was first predicted; last week British scientists reported the first direct optical observation of these domains. The new optical technique will add to other knowledge, gained through commonly used but more indirect means, about magnetic domains, domain walls and their interactions with defects in the crystalline structure of magnets. Such information is crucial for assessing the suitability of different materials for use as magnetic devices, including electromagnets, transformers, microphones and information storage devices.

In ferromagnetic materials, individual atoms behave as small magnets and align themselves throughout the domains. In each domain, the atomic magnets are parallel and are separated by domain "walls" from regions having different magnetization directions. In order to reduce the energy of the material, domains will distort, usually contracting along the magnetization direction. This effect is known as magnetostriction. It is the major source of the humming sound in transformers as the rapidly changing magnetic field in them causes the material to vibrate, alternately stretching and contracting, producing sound waves.

Magnetostriction is also the effect that allowed physicists D. Y. Parpia and Brian K.



Although they can be detected in conventional unpolarized light, polarized light shows in greater contrast the crystal striations believed to be caused by surface tilts across magnetic domain walls.

Tanner of Durham University and Donald G. Lord of the University of Salford to view in ordinary incandescent light the domain structure of ferromagnets. Neighboring domains that have magnetization directions inclined to one another will distort in such a way as to buckle the surface of the material, causing a rippled appearance. These striations are enhanced by polarized light but "with care these structures could be detected with the naked eye," write the scientists in the June 23 NATURE. The availability of a good quality single crystal called terfenol aided in the observation since its magnetostrictions at room temperature are large enough to produce an observable tilt in the crystalline surface. *—P. D. Sackett*

Marine fossils hint Antarctic ice cycles

The discovery of marine microfossils in rocks found on the Transantarctic Mountains suggests that the vast ice shield that covers East Antarctica has advanced and receded several times in the last 65 million years. The finding also raises the possibility that 40 million years ago or earlier, an enormous seaway extended across the continent, connecting the southern Atlantic, Pacific and Indian oceans. The fossil finding indicates that the history of Antarctic glacial cycles is more complicated than many scientists had thought, and may lead them to revise views of global climate, sea level, and ocean circulation changes in the last 65 million years.

The rocks were found in 1964 by John H. Mercer, but the microfossils were discovered only recently by Peter N. Webb and David Harwood, all of Ohio State University and the Institute of Polar Studies in Columbus. The fossils are up to 70 million years old, and were embedded in rocks scraped up from the ocean basin by the receding ice sheet and carried up the mountains. When the ice again advanced toward the sea, the rocks were left along the 2,000-mile-long mountain range at elevations between 7,000 and 9,000 feet. Webb reports that the fossils were carted up the mountains in glacial cycles 70 million to 65 million years ago, 50 million to 40 million years ago, 30 million to 20 million years ago, and 7 million to 3 million years ago.

So far the scientists, who will return to collect more rock samples this summer, have analyzed only 12 rock samples—too few, they say, to warrant definite statements about the correlation between global sea level changes and the recession of the ice sheets. Logically, when the ice receded, the seas would have been higher as the melt water returned to the ocean.

Use of fossils in reconstructing the history of Antarctic glacial movements may elucidate a number of questions. The researchers hope to compare the Antarctic rock samples with some from the Arctic to learn whether the northern ice masses (formed about four million years ago) moved at the same time as those in the Southern Hemisphere, and whether those movements coincided with sea level changes.

The finding also opens the possibility for a new timetable for deep circulation between the southern oceans. Scientists generally have thought that as the continents broke apart, the seaway between South America and Antarctica opened about 22 million years ago, and that Australia's journey away from Antarctica allowed deep ocean circulation between the two continents about 37 million years ago. The seaway across Antarctica— roughly 200 to 300 miles wide and 1,800 miles long —would have allowed earlier circulation between the three southern oceans, and opened migration paths for marine animals. *—C. Simon*

Siberian site wins vote for boundary

After years of research and days of debate, paleontologists have agreed to recommend that a remote site on the Aldan River in Siberia be established as the standard boundary between the Cambrian and Precambrian geological periods (SN: 5/7/83, p. 300). The recommendation will be submitted to the International Geological Congress for final approval in 1984.

The boundary, about 570 million years old, marks the appearance in the fossil record of animals with preservable hard parts—skeletons or shells. The Aldan site is remarkable in part because its limestone rocks document the transition between the late Precambrian, when the seas were populated with soft-bodied, multicellular animals, through the early Cambrian, when shelled animals appeared. Most rock sequences underlying the early Cambrian lack traces of multicellular life.

The river bluff site, called Ulukhan Sulugur, has "excellent exposures," says Allison Palmer of the Geological Society of America in Boulder, Colo. In addition to its fine fossil sequences, the rock outcropping embodies a well-defined reversal in the earth's magnetic poles, allowing the possibility of cross-checking ages with other rock layers spanning the boundary.

Once the Cambrian boundary is set, paleontologists may try to resolve some of the problems in defining the period during which multicellular animals, or metazoans, evolved. It is nearly a century since a new period was established. Last year Preston Cloud of the University of California at Santa Barbara and Martin F. Glaessner of the University of Adelaide in Australia advanced a controversial proposal to designate formally a period just before the Cambrian, naming it the Ediacarian period.

While in recent years many rocks just below the Cambrian boundary have been found that bear imprints of metazoans, some scientists think it is not yet possible to determine when they first appeared. There are simply too few rocks preserved that encase traces of the earliest soft-bodied animals. *—C. Simon*