into the bedrock, and therefore could not have existed in their present position for any great length of time. The velocity of ice in the ice streams, about 1 km yr^{-1} , is comparable to that of the ill-understood surging glaciers. (Surging glaciers temporarily move, over a 1 to 2-yr period, at velocities that are one to three orders of magnitude larger than a normal glacier velocity.) Why do very fast moving ice streams form at the periphery of the West Antarctic Ice Sheet? Why do they move so swiftly? Is their existence a premonitory phenomenon to a large scale surge of the whole ice sheet? Are the ice streams the start of a process that may cause the West Antarctic Ice Sheet in the near future to flow very rapidly and to discharge about one-third to one-half of its total volume of ice into the oceans over a short time period of the order, say, of 100 years?

Geological evidence that was studied by Denton, Armstrong, and Stuiver (in *Late Cenozoic Glacial Ages* (edit. by Turekian) 267, Yale University Press, 1971) and by Denton and Borns (*Antarctic J.*, 9, 167; 1974) indicates that before 10,000 years ago the West Antarctic Ice Sheet was much larger and covered the area, now below sea level, presently occupied by the Ross Ice Shelf. The Ross Ice Shelf, although about 300 to 500 m thick, is afloat. Thus, the edge of the ice sheet has retreated about 1,000 km with an average rate of retreat of the order of 100 m yr^{-1} .

It is not likely that this large scale retreat was produced by any change in the climate. There is at present a net accumulation of snow on top of both the West Antarctic Ice Sheet and the Ross Ice Shelf; in fact, the accumulation rate is larger on the ice shelf than on the ice sheet. Studies of the ice cores from drill holes in both the ice sheet and the ice shelf have produced no evidence at all of any long lasting period of widespread ablation that would have caused the shrinkage of the West Antarctic Ice Sheet. A more likely explanation of the retreat is that it was caused by the large rise in sea level, 100 to 130 m, that occurred when the ice sheets in the northern hemisphere melted at the end of the last ice age. According to theory (Weertman, *J. Glaciol.*, 13, 3; 1974) the size of an ice sheet whose base is below sea level is a very sensitive function of changes in sea level. Whether the ice sheet can even exist over a long period of time is dependent upon the sea level.

The geological evidence of fossil coral-reef terraces in the Barbados (Broecker *et al.*, *Science*, 159, 297; 1968) indicates that 120,000 years ago the sea level was 6 m higher than it is today. Old coral-reef terraces in New Guinea (Chappell, *Geol. Soc. Amer.*

Metallic glazes

from Robert W. Cahn

A NUMBER of alloys based on transition metals—notably nickel and iron—can be made in the form of glassy ribbons by ultra-rapid quenching of a molten jet on a rapidly spinning roller (see *Nature*, 252, 100, 1974; 259, 271; 1976). Iron-based glassy ribbons containing chromium have the further distinguishing feature of being extremely corrosion resistant. These materials, however, have to be in the form of thin (0.05 mm), narrow (1–2 mm) ribbons, and there is not a great deal that the most ingenious designer can do with them. Much interest therefore attaches to a report of a novel method that allows the surface of bulk material to be converted into glass without affecting the interior.

A group of metallurgists at the United Technologies Research Center in Connecticut, led by Bernard H. Kear and Edward M. Breinan have described to the American Society for Metals how a continuous carbon dioxide laser can be used to “glaze” the surface of nickel or cobalt-based alloys. The Center is linked with a factory that makes aircraft engines, and the implications of the choice of alloys are clear enough.

A finely focused beam from the CO_2 laser is passed over the surface of the bulk material; the surface is rapidly melted and as rapidly refrozen as the hot spot moves on. A cooling rate exceeding a million degrees per second was claimed, during resolidification, and this suffices to generate a glassy (non-crystalline) phase at the surface. The alloy compositions used are not specified: it would be interesting to know whether they contain metalloid solutes such as P, C, B, Si, as do the alloys used to make glassy ribbons.

It is particularly worth noting that the underlying crystalline grains do not act as nuclei for the resolidifying surface film.

The investigating team reports that the surface glaze is harder than the base alloy, and adds that it is “potentially more capable of resisting corrosion than the original alloys”: the cautious choice of words leaves one uncertain whether the potential had been realised.

This is not the first time that a laser has been used to effect rapid quenching from the melt. Laridjani, Ramachandrarao and Cahn (*J. Mater. Sci.*, 7, 627; 1972) used a stationary beam from a pulsed ruby-laser to produce metastable crystalline phases on the surface of Ag-Ge alloys, and Elliott, Gagliano and Krauss (*Metallurgical Trans.*, 4, 2031; 1973) used a pulsed neodymium laser to create a continuous series of solid solutions in a range of Cu-Ag alloys which are only partially miscible in equilibrium. The United Technologies metallurgists have improved on this earlier work in two ways: they examined alloys based on transition metals which, unlike copper and silver-based alloys, are apt to form glasses on melt quenching, and they used a moving beam from a continuously acting laser to scan the surface. What is not clear from the report is whether it was feasible to make a series of overlapping passes in such a way to cover a surface entirely with a glazed layer. If this can be done, the industrial potential is very considerable; it should in principle be possible to “coat” even the inside of a vessel with the aid of a guided moving mirror. There is also potential for the design of wholly or partially glazed bearing surfaces.

Bull., 85, 553; 1974) also support this conclusion. A 6 m rise in sea level requires the total removal (and melting) of ice from an ice mass of about the size of the West Antarctic Ice Sheet or the Greenland Ice Sheet and its emplacement into the world's oceans. This observation of a 6 m higher sea level 120,000 years ago suggests that the West Antarctic Ice Sheet can largely disappear under conditions that do not lead to the destruction of the East Antarctic Ice Sheet. The destruction of the latter ice mass would have raised the sea level by another 40 to 50 m.

Terence Hughes of the University of Maine has strongly advocated the

view (and put forward supporting evidence) that the West Antarctic Ice Sheet is still disintegrating (*J. geophys. Res.*, 78, 7884; 1973). He thinks that the rate of retreat of the edge of the ice sheet where it joins the Ross Ice Shelf is of the order of 70 m yr^{-1} . This rate of destruction of the ice sheet would cause the sea level to rise with a velocity of the order of 0.5 mm yr^{-1} . The long term increase in mean sea level occurring now has been estimated from various measurements to be 1 mm yr^{-1} (Lisitzin, *Sea Level Changes*, 183, Elsevier, Amsterdam, 1974). Thus, a slowly occurring destruction of the West Antarctic Ice Sheet could account