therefore have occurred during or before the Pliocene. Other evidence has shown that West Antarctica was largely covered by an ice sheet by the late Miocene; and since the conditions necessary for this almost certainly prevailed in the east, too, it seems likely that the East Antarctica glacier had also been established by that time. This would presumably explain why eustatic sea level began a rapid decline during the Miocene. On the other hand, Tertiary sea level data give no indication of polar ice sheets before the Miocene. But this is not conclusive evidence; and the question of whether large glaciers existed in Antarctica before the Miocene remains open.

During the past 4 million years the Taylor-Wright glacier system has fluctuated in level several times, although the changes bore no relation to world-wide glaciations. At the moment the level is rising; and the ice is at its maximum height since before the Wisconsin glaciation as defined elsewhere in the world. Four Ross Sea glaciations can be recognized, all occurring within the past 1.2 million years. The recession of the most recent of these coincided with the rapid rise in sea level during the Late Wisconsin, but it is unlikely that this apparent correlation was climatically controlled because alpine glaciers in the area diminished in size during Ross Sea glacial advances. Further, the major Ross Sea glaciations were not synchronous with changes in level of the East Antarctic ice sheet. It is becoming clear that the three glacial systems in the McMurdo Sound area have fluctuated completely independently of each other.

CARBON

Glassy and Fibrous

from our Materials Science Correspondent

FOR some years, and especially since the Parliamentary Select Committee's report last year, attention in Britain has been focused on carbon fibres made by the British process developed at the Royal Aircraft Establishment. Much anguish has been aroused in political, engineering and industrial circles by uncertainties as to the proper manufacturing scale, price and applications of these fibres. The uncertainties are not eased by the fact, not widely recognized, that there are competing carbon fibres with an inferior technical specification but also a lower price.

Kawamura and Jenkins, who work at University College, Swansea, have described recently (*J. Materials Sci.*, 5, 262; 1970) a new glassy carbon fibre made by

pyrolysis of hexamine-tetramine dissolved in phenol, extruded to form threads. The extrusion and carbonization stages seem to be very simple and involve temperatures no higher than 1,000° C. A maximum tensile strength of 2 GNm⁻² (3×10^3 pounds/inch²) and Young's modulus of 70 GNm⁻² (10×10^6 pounds/inch²) for fibres 5 μ m in diameter are reported. The raw materials can be derived from coal or oil tar fractions and the method has been patented by the National Coal Board.

There has been intensive development of a somewhat similar fibre in Japan, by the Kureda Chemical Industry Co. Ltd, based on unspecified "hydrocarbon pitch", particularly during the past year. This, and related work on other forms of carbon fibre, have been described in a recent survey by A. J. McLaren (*Design Engineering*, 109; February 1970). The carbonization temperature in the Japanese process is again about 1,000° C. The mechanical properties quoted are similar to those of the Swansea fibre, though the strength seems to be somewhat lower, and the fibre, presumably glassy, can be heat-treated to graphitize it; the properties of graphitized fibre are not mentioned. Kureda has now constructed a 120 ton plant (per annum output is presumably meant), and McLaren has listed several current applications including those depending on the low friction and wear associated with carbon fibre composites, and not requiring high stiffness. Some uses are distinctly unexpected: thus a large tonnage use is predicted for low-grade carbon fibre in carpets made from artificial fibres. Apparently litigation-conscious American carpet manufacturers are afraid of claims arising from deaths of patients with weak hearts who shuffle across highly insulating carpets, build up a charge and perish when they touch a door handle.

Another related development is solid glassy carbon, usually called vitreous carbon, which is made by pyrolysis of an unspecified polymer. The material was first studied in Japan, but large-scale development to the industrial stage has been undertaken by Plessey in Britain and it is now commercially available. Vitreous carbon has remarkable chemical stability, extremely low porosity, low friction, adequate electrical conductivity and high hardness, and this results in several novel applications, especially in the electronics and process industries and in spare part surgery. The properties of vitreous carbon have been surveyed in detail and compared with those of competing materials, and various uses have been described recently by F. C. Cowland and L. E. Westmore (*Design Engineering*, 49, 52; March 1970).

PLANETARY SCIENCE

Smooth Surface of Mars

from a Correspondent

LUNAR mascons and the surface properties of Mercury, Mars and Venus evoked lively discussions at the NATO Advanced Study Institute on the Moon and planets held at Newcastle upon Tyne from April 9-16 (early sessions were reported last week, *Nature*, 226, 212; 1970). Dr W. L. S. Sjogren (Jet Propulsion Laboratory, California) dealt with the mascons, anomalous areas of locally higher gravitational field revealed by analysis of the orbits of Lunar Orbiter craft. He described the