Fig. 1. *A*, Glassy carbon; *B*, normal graphite; *C*, high-density graphite. (All × 50)

Table 1. SOME PROPERTIES OF GLASSY CARBON

	Impregnated carbon	Glassy carbon	
Heat-proof up to (° C.)	1,300	1,300	3,000
Apparent density (gm./c.c.)	1·75–1·92	1·46–1·50	1·43–1·48
Apparent porosity $(D^*-AD)/D$ (per cent)	8–15	0·2–0·4	—
Hardness	45–55 (Shore)	4–5 (Mohs)	—
Flexual strength (kgm./cm.²)	400–500	500–1,000	—
Electrical resistivity (10⁻⁴ ohm, cm.)	9–11	35–50	30–35
Ash content (per cent)	0·2	0·1	0·05†
Gas permeability (cm.²/sec.)	10⁻⁵–10⁻⁶	10⁻¹¹–10⁻¹²	10⁻⁹
Thermal conductivity (kcal./m. hr. ° C.)	100–120	3–4	13–15
Coefficient of thermal expansion (10⁻⁶ ° C.)	2·0–2·5	1·8–2·2	—

* *D*, Real density by benzene immersion method.
† After high-temperature chemical treatment, the ash content of this was 0·05 per cent, consisting of 2·0 p.p.m. manganese, 0·1 p.p.m. magnesium, 0·12 p.p.m. silicon, 2·59 p.p.m. nickel, 6·4 p.p.m. aluminium, 140 p.p.m. iron, 13·0 p.p.m. calcium, 4·9 p.p.m. copper; boron, 0·08–5 p.p.m.

Table 2. COMPARISON OF OXIDATION-RATE

	Reaction time (min.)			
Weight loss	70%	80%	90%	100%
Normal graphite	68	95	110	140
Pyro graphite	120	138	175	250
High-density graphite	160	185	225	275
Glassy carbon	205	255	270	365

$(N_2 : O_2 = 81 : 19$ by volume) at $800 \pm 5°$ C. Each sample was cut as large as $15 \times 15 \times 1$ mm.

Pore-size distribution of the glassy carbon by mercury method was quite different from the normal graphite. For example, the pore volume percentage to the whole sample volume between 10^2 Å. and 7×10^4 Å. is as shown in Table 3.

Table 3. PORE-SIZE DISTRIBUTION BY MERCURY METHOD

	Total pore volume (per cent)	Pore-size distribution (per cent)			Maximum pore size (≤1,000 kgm./cm.²)
		7×10^2– 7×10^4. Å	1×10^3– 7×10^3 Å.	1×10^2– 1×10^3 Å.	
Normal graphite	32	27	4	3	7×10^4 Å.
High-density graphite	11	3·5	1·5	6	7×10^4 Å.
Impregnated impervious graphite	5	—	2·5	2·5	7×10^3 Å.
Glassy carbon	0·35	—	—	0·35	1×10^3 Å.

It is of interest that dependence on temperature of the internal fraction coefficient of the glassy carbon was observed similarly as in the case of the normal glass being different from many kinds of graphite which coefficient was independent of the temperature[2].

The photomicrograph of the glassy carbon is as shown in Fig. 1*A*, comparing with those of the normal *B* and high-density graphite *C*.

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¹ Davidson, H. W., Brit. Pat. 860,342 (1961).
² Tsuzuku, T., Fifth Carbon Conf. (1961).

Electrical Conductivity of Manganin and Iron at High Pressures

THE properties of materials at high pressures can be measured either in static compression apparatus or dynamically, using explosively induced shocks. Pressure measurement is indirect for static methods, but a reliable figure for temperature can usually be obtained. With dynamic methods, however, absolute pressures can be found from velocity measurements, but at the moment there are no known methods for the accurate determination of temperature. Resistance is probably the simplest measurement to make in static presses at high pressures, and it was thought that a useful contribution might be the extension of this measurement by dynamic methods.

A specimen in a static press is subject to approximately uniaxial compression with some variation of pressure along its length due to plastic flow and deformation of the anvil faces. In the corresponding dynamic situation the compression is initially uniform uniaxial, but is accompanied by a rise in temperature. For the more incompressible metals in the range 0–300 kilobars this rise in temperature is not expected to be very large—250° C. as a maximum.

Initially manganin and iron have been studied. Thin wires of each material were mounted between two conducting supports and embedded in a thermosetting resin, so that they were parallel to the plane of the shock front. This simple configuration eliminates tension effects which are difficult to avoid in static apparatus. Each wire was pulsed from a constant current supply starting a few microseconds before it was shocked. The change in resistance was calculated from high-speed oscillograms of the voltage across each wire as the pressure pulse passed over it. Conductivity in the resin was checked in separate experiments and found to be unimportant to 200 kb.

The resistance pressure curve obtained for manganin is shown in Fig. 1. This alloy, which has the composition 86 per cent copper, 12 per cent manganese, 2 per cent nickel, appears to have a linear relation between pressure and relative resistance up to 300 kb. Manganin is known to be unusual in that it has a positive pressure coefficient of resistance. Bridgman used it as a secondary pressure gauge statically, and has reported a linear resistance change to 30 kb.[1] He also found that the pressure coefficient of resistance varied from batch to batch and this may account for some of the scatter in Fig. 1. However, the evidence is sufficient to indicate that the extension of Bridgman's linear result from 30 kb. to 300 kb. is justified, particularly if the same piece of wire can be used. Manganin would seem to represent a useful secondary pressure gauge, referring for absolute calibration to known transitions such as
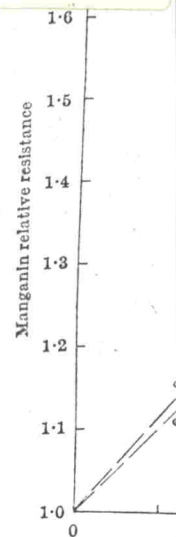

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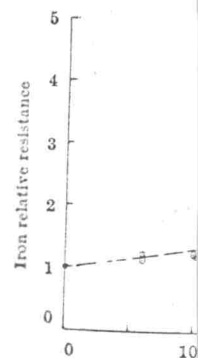with that found...
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