life-times, quasi-periodic variability, compactness) of the quasi-stellar sources, and might also explain the continued activity of the supernova remnants in the Crab Nebula.

The principal question left open is the extent to which results established for static fields can provide information at all relevant to an essentially dynamical phenomenon. For nearly spherical situations, it can be argued that, as far as the exterior vacuum field is concerned, the output of gravitational radiation is necessarily small, and therefore the non-static aspects cannot be important. It is well, however, to be cautious: recent results in the theory of gravitational waves[8] have hinted at unsuspected subtleties in the transition between stationary and non-stationary states. A full dynamical analysis of asymmetric collapse remains a problem for the future. Only such an analysis can determine how far the considerations presented here are true.

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THE SOLID STATE

Permanent Magnet Properties of Platinum–Cobalt Alloys

ALLOYS of platinum–cobalt near the equiatomic composition can, by suitable heat treatment, undergo a disorder to order phase transformation which produces extreme magnetic hardness. Coercivities up to 6,800 oersteds have been observed at room temperature. Walmer[1] has recently given a comparative table of magnetic properties since the discovery of the alloys in 1936 by Jellinghaus[2], in which the coercivities obtainable have risen from 4,000 to 4,300 oersteds (1961) and the energy product $(BH)_{max}$ from $4 \cdot 6 \times 10^6$ to $9 \cdot 5 \times 10^6$ gauss-oersteds. Walmer also includes a polar diagram which shows how the coercivity varies with crystallographic direction. A maximum of 6,800 is observed in <111> and 4,300 oersteds in <100>. Table 2 of Walmer's article lists the optimum magnetic properties as follows:

Intrinsic coercive force	H_c, 4,300 oersteds
Residual induction	B_r, 6,450 gauss
Maximum energy product	$(BH)_{max}$, $9 \cdot 5 \times 10^6$ gauss-oersteds
Multicrystalline intrinsic coercive force	5,300 oersteds
Single crystal intrinsic coercive force	<111> 6,800 oersteds

These properties have been further improved by Chaston[3], who obtained an energy product of $10 \cdot 3 \times 10^6$ gauss-oersteds, a remanence of 7,125 gauss and a coercivity of 4,430 oersteds.

The purpose of the present communication is to report work which has produced many more detailed results and considerably improved permanent magnet properties.

An alloy of platinum–cobalt containing 52·12 atomic per cent cobalt was prepared by melting the pure constituents in an argon arc furnace. The ingot was then homogenized in a vacuum furnace at 1,200° C for 12 h. The measured density of the resulting alloy was 15·55 g/cm³ which was in good agreement with that calculated by X-ray analysis.

A thin disk of the alloy (about 0·5 cm diameter × 0·03 cm thick) was disordered by holding at 1,000° C for 0·5 h. It was then quenched and aged for 20 min at 695° C. The resulting magnetic properties are shown in the table below.

Coercivity	H_c	= 4,900 oersteds
Remanence coercivity	H_R	= 5,200 oersteds
Remanence	B_r	= 5,280 gauss
Maximum energy product	$(BH)_{max}$	= $14 \cdot 1 \times 10^6$ gauss-oersteds

All the measurements were made at 24° C.

(The remanence coercivity is the reverse field required to reduce the remanence to zero, whereas the intrinsic coercivity is the reverse field required to reduce the magnetization to zero while the field is still on.)

As far as I know this value of $(BH)_{max}$ is the highest ever recorded for any permanent magnet material.

It should be emphasized that these properties were obtained by using a maximum magnetizing field of 15,000 oersteds. Because the uniaxial magnetocrystalline anisotropy of the ordered tetragonal phase is at least[1] of the order of 2×10^7 erg/cm³ it is clear that this field would not be sufficient to produce saturation. (More recent measurements by Brissoneau *et al.*[4] have shown that $K_1 \sim 5 \times 10^7$ erg/cm³.)

Investigation of the properties of single crystals of the alloy which has been carried out in some detail[5] has shown that there is considerable anisotropy of properties even when the specimen consists of a mixture of the cubic and tetragonal phases. Initially, of course, the specimen is a face centred cubic single crystal. Subsequent heat treatment produces platelets[1,5,6] of the high anisotropy ordered tetragonal phase on (110) planes. The optimum permanent magnet properties obtained with the crystal ((112) orientation) are given in Table 1.

Table 1

	$[11\bar{1}]$	$[1\bar{1}0]$
Coercivity, H_c	3,500 oersteds	3,000 oersteds
Remanence coercivity, H_R	3,800 oersteds	3,300 oersteds
Remanence, B_r	6,065 gauss	4,050 gauss
Energy product $(BH)_{max}$	$11 \cdot 0 \times 10^6$ gauss-oersteds	$6 \cdot 9 \times 10^6$ gauss-oersteds

More details of these properties, and in particular the temperature variation, from both an experimental and a theoretical standpoint have recently been discussed by McCurrie and Gaunt[5] and Gaunt[6].

From this work it seems very probable that the potential permanent magnetic properties of platinum cobalt alloys have not yet been fully realized. Further work will almost certainly lead to increases in the coercivity, but the most difficult problem is that of increasing the remanent magnetization—the absolute maximum is, of course, defined by the saturation magnetization of the cubic phase, that is, about 8,800 gauss depending on the cobalt content.

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Pre-yield Relaxation and the Yielding of Single Crystals of Iron

IN tensile tests on polycrystalline iron at the usual rates of strain, if the process of strain is repeatedly interrupted for intervals of three minutes at stresses below the usual upper yield stress, the load immediately falls because of relaxation. If, after this, the process of strain is halted at roughly the upper yield stress of an uninterrupted test, there is no immediate relaxation; instead the load is