different, and for NGC 7027 values of log n_e of 3·8, 3·7, 4·3, 5·3 and 5·1 are reported from the doublets SII, OII, ClIII, ArIV and KV respectively. The electron density seems to be larger at high excitation levels, and no unique electron density can be assigned to these objects.

ROCK MAGNETISM

Oxidation and Hysteresis

from our Geomagnetism Correspondent

THE correlation between the petrographically determined oxidation state and the polarity of natural remanent magnetization (NRM) in some igneous rocks remains a puzzle. If most reversely magnetized rocks are due to field reversal—and the evidence for field reversal is too strong to be denied—there should be no correlation between polarity and the nature of the magnetic minerals present. The strength of the NRM, on the other hand, depends on the properties of the magnetic material, some of which can be assessed petrographically. Clearly the intrinsic magnetic properties of a rock are an important link between the NRM and the optical properties, and much more needs to be known about the whole chain before oxidation-polarity correlations can be understood.

The problem in trying to correlate intrinsic magnetic properties with oxidation state is that many of the properties (the Curie point, for example) can only be determined by heating, which may alter the oxidation state. Moreover, room temperature properties, such as saturation magnetization, are difficult to interpret because it is impossible to obtain from the rocks highly refined extracts of the various magnetic minerals. But Day *et al.* (*J. Geophys. Res.*, **75**, 375; 1970) have successfully demonstrated that there is another indicative magnetic property, determination of which involves neither heating nor extraction. This is rotational hysteresis, the work done against irreversible magnetization processes when a sample of magnetic material is rotated through 360° in a magnetic field.

Day and his colleagues have measured the rotational hysteresis (W) as a function of magnetic field (H, up to 21,000 Oe) for natural rock samples and synthetic titanomagnetites, magnetite, maghaemite and haematite. The W–H curve from each rock was then examined in relation to the rock's oxidation state (classes 1 to 5, using the scheme of Wilson and Haggerty, *Endeavour*, **25**, 104; 1966) determined petrographically. This revealed that each oxidation class has its own characteristic W–H curve. All W–H curves possess a peak at low fields with a tail extending to the highest field available; but the width and position of the peak and the size of the tail vary with the oxidation state. By comparing the rock and synthetic sample curves, Day *et al.* were able to identify the operative magnetic minerals present in the rocks (see table).

MAGNETIC MINERALS FOUND IN ROCKS BY DAY *et al.*

Oxidation class	Magnetic mineral content
1*	Titanium-rich titanomagnetite
1†	Iron-rich titanomagnetite
2	Cation-deficient spinel phase
3	Iron-rich spinel phase
4	Magnetite and small amount of haematite
5	Haematite and small amount of magnetite

* Low Curie point.
† High Curie point.

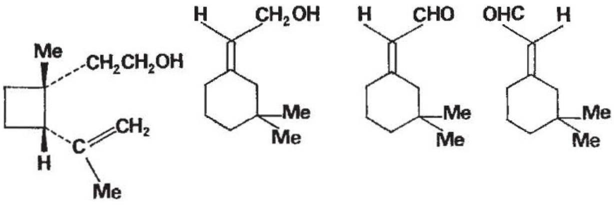
An obvious consequence of these results is that it should be possible, with a little care, to use rotational hysteresis to determine oxidation class without resort to laborious petrographic techniques. A more fundamental point to emerge, however, was that the most stable rocks fall into class 3. In other words, surprisingly, maximum stability is not associated with haematite which is known to be highly stable, and more stable than titanomagnetites. But the general point is that it is now possible to determine the magnetic mineral content of a rock without destroying it chemically or physically.

PHEROMONE SYNTHESES

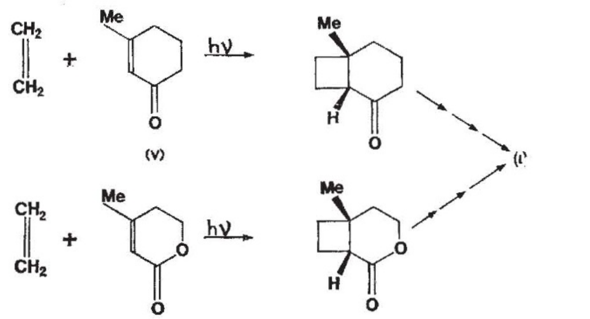
Trapping the Boll Weevil

from a Correspondent

COTTON growers who read the *Journal of the American Chemical Society* will be cheered to learn that the pheromone of the pestilential boll weevil has been synthesized. Pheromones, the chemicals secreted in minute quantities by insects to influence the behaviour of other members of the same species, have great potential value in the chemical control of insect pests. The procedure would be to attract insects to traps containing insecticides by baiting the traps with pheromones.



(I) (II) (III) (IV)



(VI)

The American cotton boll weevil does some $100 million damage annually to the US cotton crop. The male of the species secretes a pheromone which contains the four terpenes (I–IV) in faecal concentrations of 0·76, 0·57, 0·06 and 0·06 p.p.m. respectively. Stereospecific syntheses of the more complex alcohol (I) have been completed recently by research teams at the Zoecon Corporation in California and in the US Department of Agriculture's Boll Weevil Research Laboratory in Mississippi (R. Zurfluh, L. L. Dunham, J. L. Spain and J. B. Siddall, *J. Amer. Chem. Soc.*, **92**,