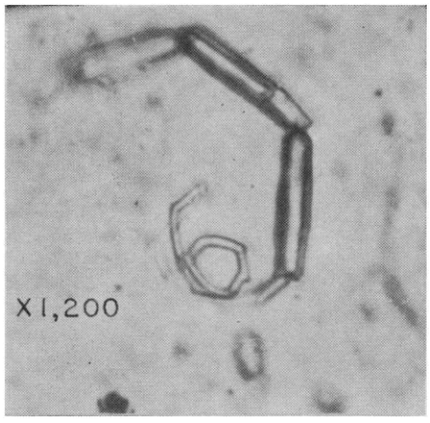

Fig. 1. Trichite in volcanic glass [from Ross (*2*)].

received generic assignments and species names.

However, the petrologist can show many inorganic structures that, with respect to morphology but not considering composition, are replicas of such simple organic remains. Minute vesicles, partially filled with a zeolite in palagonite (altered basalt), may have globular bodies with two or more walls; two or more of the bodies may be combined as "budding forms" or other interesting shapes. These are commonly separated with the disintegration of the matrix material.

One of the various forms of crystal trichites formed within a glassy igneous rock, illustrated in a paper by C. S. Ross (*2*), is reproduced here (Fig. 1). Another (No. 1) on the same plate, but not reproduced here, is perhaps a more striking example. With an expectable alteration of the volcanic glass to a clay mineral, and with the augite of the trichite "weathered" to some iron hydroxide mixture, such forms might seem identifiable to some microbiologist. Perhaps *Trichites trichiformis* is an appropriate name for this interesting form. However, I wish to leave this a *nomen nudum*, assigned to neither the plant nor animal kingdom.

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11 September 1967

Planetary Magnetic Fields and Rotation

In their presentation of the results of the particle-detector experiment on Mariner IV, Van Allen *et al.* (*1*) mention the possibility of testing the Blackett hypothesis (*2*), which states that planetary as well as stellar magnetic fields might be due to a hitherto unknown property of matter by which every rotating mass has associated with it a magnetic dipole moment. Blackett was led to this hypothesis from the observation that for both the earth and the sun the relationship between magnetic moment P and angular momentum U can be expressed in terms of the two fundamental constants G and c as

$$P = \beta \frac{G^{1/2}}{c} U \qquad (1)$$

where β is of order unity. However, in addition to the results from Mariner IV, which indicate that Eq. 1 is not valid for Mars (*1*, *3*), there is much other evidence that this equation does not describe a general property of rotating matter. Blackett himself carried out experiments in which he attempted to detect a possible magnetic field due to a mass of gold rotating with the earth; his results were negative (*4*). Experiments by Runcorn *et al.* in deep mines showed that the magnetic field of the earth is due to sources deeper in the earth and not dependent on the distributed mass of the earth (*5*). Finally, the magnetic dipole moment of the sun is now believed to be one (*6*) or two (*7*) orders of magnitude smaller than the value which first led Blackett to postulate Eq. 1.

Nevertheless, a fact which seems so far to have escaped notice is that interpretation of the nonthermal radio emission from Jupiter as being due to the motion of charged particles trapped in a planetary magnetic field (*8*) leads to an absolute value of the magnetic moment (*9–12*) that is entirely consistent with Eq. 1. The angular momentum of Jupiter is approximately 8×10^4 that of the earth, and the recent estimates of the magnetic moment of Jupiter lie in the range 3.5×10^4 to 1.25×10^5 that of the earth. The estimates of Chang and Davis (*9*) and Berge (*10*) are based on interpretation of the decimeter emission as synchrotron radiation from electrons trapped in radiation belts. The estimate of Warwick (*11*) is based on the interpretation of the decameter bursts as Cerenkov radiation from electrons precipitated into the upper ionosphere from the radiation belts, and that of Ellis and McCulloch (*12*) is based on the interpretation of the decameter bursts as Doppler-shifted cyclotron radiation. Thus, while the hypothesis that the magnetic fields of massive rotating bodies may be due simply to a hitherto unknown property of masses in rotation is certainly not true in general, Eq. 1 is valid, over a range of five orders of magnitude, for the two planets known to have magnetic fields.

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Although Brown properly cites prior evidence against the validity of the Blackett hypothesis, I continue to feel that our determination of an upper limit to the magnetic moment of Mars has a certain cogency in an astronomical context. The test on Mars is one which I have aspired to make since I first heard Professor Blackett lecture on this subject some 20 years ago.

In the face of all the negative evidence concerning the validity of the Blackett hypothesis, Brown's suggestion that it may apply to Earth and Jupiter seems untenable.

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