LETTERS TO NATURE

PHYSICAL SCIENCES

Symmetric Cosmology

Hoyle[1] and Steigman[2] have criticized the symmetric cosmology, or rather their personal impression of it. Certain of their statements are incorrect, and we wish to reply to them.

First, without reference or justification they claimed that Klein's metagalactic model turns inside the Schwarzschild limit. This is not correct. A general relativistic treatment of the model has been worked out by Laurent and Söderholm[3], who discussed in detail the turning and the Schwarzschild limit.

Second, they claimed, again without reference or justification, that in Klein's metagalactic model the path of photons is long compared with the linear size at the turning. This is not correct. In fact, Klein uses the condition that the metagalaxy must be opaque at the turning to derive Eddington's relations[4–11].

Third, they claimed that we have postulated processes giving rise to magnetic fields of the order of 1–100 gauss. If these values refer to a magnetic field in free space (in a dilute plasma) we have neither explicitly nor implicitly made such an assumption. On the other hand, because stars are known to have fields of the order 50,000 gauss, we have not hesitated to assume that star-like objects have strong fields. In the Ekspong–Yamdagni–Bonnevier ambiplasma mechanism of radio stars[12], fields of the order of 1 gauss are necessary. This mechanism is reconcilable with the ambiplasma model of quasars[13].

Finally, of the objection in the cited papers the only one to be taken seriously is Woltjiers's argument about the general galactic magnetic field. This raises several interesting and difficult problems about antimatter and the galactic structure, and we hope to discuss this later.

The discussion about the symmetric cosmology should not only be focused on the existence of antimatter. An even more essential point in Klein's approach is perhaps to what extent new laws of nature should be postulated. Hoyle has never shown any reluctance to introduce as many new laws of nature as he needs for the moment. In striking contrast to this, the symmetric cosmology can be regarded as an attempt to investigate how far we can understand astrophysics only by the help of laws found in the laboratory. Klein has developed these principles in an article[11] which is apparently unknown to Hoyle and Steigman. It should be read by everybody who wants to understand how drastically different Klein's approach is from the continuous creation hypothesis.

We note that Hoyle assumes that "pair creation occurs in the condensed nucleus, and that particles are then expelled away from the nucleus and 'antiparticles' are retained at the nucleus". He does not say by what process such a separation should be accomplished, and seems not to realize that the separation of an ambiplasma is a difficult process, unless a new law of nature is provided to accomplish the separation.

HANNES ALFVÉN

Royal Institute of Technology, Stockholm

Received August 21, 1970.

1 Hoyle, F., *Nature*, **224**, 477 (1969).
2 Steigman, G., *Nature*, **224**, 477 (1969).
3 Laurent, B. E., and Söderholm, L., *Astron. Astrophys.*, **3**, 197 (1969).
4 Klein, O., *Mémoires in 8e de la Société Royale des Sciences de Liège*, Quatrième Sèrie, **13**, Fasc. III, 42 (1953).
5 Klein, O., *Onzième Conseil de Physique*, 33 (Inst. Intern. de Physique, Solvay, 1958).
6 Klein, O., *Werner Heisenberg und die Physik unserer Zeit*, 58 (Vieweget, Braunschweig, 1961).
7 Klein, O., *Astrophys. Norveg.*, **9**, 161 (1964).
8 Alfvén, H., and Klein, O., *Arkiv för Fysik*, **23**, 187 (1962).
9 Bonnevier, B., *Arkiv för Fysik*, **27**, 310 (1964).
10 Alfvén, H., *Rev. Mod. Phys.*, **37**, 652 (1965).
11 Klein, O., *Nature*, **211**, 1337 (1966).
12 Ekspong, A. G., Yamdagni, N. K., and Bonnevier, B., *Phys. Rev. Lett.*, **16**, 664 (1966).
13 Alfvén, H., and Elvius, A., *Science*, **164**, 911 (1969).

Possible Newly Recognized Meteorological Phenomenon called Crown Flash

ON July 2, 1970, at about 1945 h EST a thunderstorm cell passed a few miles north of Ann Arbor, Michigan. The column of cumulus cloud towered in the light of the setting Sun, far above the dark mass below, which occasionally flickered with lightning. Thin lamellae of cirriform cloud began to form above the peak of the cumulus column and streamed off to the north-east, in advance of the storm cloud. The cumulus column impinged on these lamellae as it boiled upward, causing the horizontal layers of thin cloud to become somewhat dome-shaped in the region of the rising column (Fig. 1). At and just above the peak of the storm cell the cloud mass seemed to be undergoing sudden changes in brightness lasting for several seconds at a time. J. C. G.'s wife and two children also noticed the effect when it was called to their attention. M. E. G., a meteorologist, also verified the observation. The phenomenon continued to occur repeatedly at intervals of 30–60 s during the next 15 or 20 min, providing the basis for the following description.

The sudden brightening effect began concurrently with lightning strokes in the main cloud mass, but continued after the lightning flash was over. It had the appearance of a ripple-like upward and outward spread of radiance from the region just west of the peak of the cumulus column, resembling somewhat a fan-like display of aurora borealis. It lasted a substantial fraction of a second with each lightning stroke. On one or two occasions it had the appearance of a bright ring moving rapidly outward and upward above the cumulus peak. On these occasions it was clearly observed to extend beyond the cloud and into blue sky. A linear shadow, apparently cast by one of the cumulus masses, appeared to shift its position suddenly up or down with each occurrence of the event (Fig. 1*a*).

While the effect was observable, the portion of the cloud mass most immediately involved seemed considerably brighter than the remainder of the cumulus peak, which was still in sunlight. This area of the cloud seemed to glow from within; the individual puffs of cumulus cloud did not seem to cast shadows but glowed with equal intensity in all portions; the zones between puffs were not dark as in the remainder of the cloud, but bright as if light were escaping through them. The colour of the entire phenomenon was white.

Hourly radar log reports from Detroit Metropolitan Airport,

© 1971 Nature Publishing Group