method, in which a particular emission spectrum was explained in terms of enhanced radiation at harmonics of the gyro-frequency, led Kakinuma to a value of 600 gauss at 20 000 – 30 000 km.

It has been suggested by Denisse and others that certain features of the spectrum of enhanced radio emission from active regions are most readily accounted for as synchrotron radiation from relativistic electrons spiralling in a magnetic field. The spectrum of this radiation has a broad maximum at a frequency proportional to HE^2 where E is the electron energy. Takakura has recently accounted for the radio spectrum in this way and with an assumed electron energy of the order of 0·1 MeV he obtains field strengths of 1000–2000 gauss in the chromosphere and 20-40 gauss in the corona.

It should be emphasized that the above estimates are tentative, since the spectrum of the radio emission cannot yet be understood with certainty.

The Polar Field. In the presence of a general bipolar magnetic field, thermal radio emission from the undisturbed solar corona will contain circularly polarized components whose sense is different in the northern and southern hemisphere. Smerd utilized a partial eclipse to isolate the component from one hemisphere and hence showed that the general field in the vicinity of the pole was less than 8 gauss.

More recently the method was refined by Conway who used an interferometer to separate components from the two hemispheres and showed that the field was smaller than 2·5 gauss — a value consistent with Babcock's measurements.

The Far-Out Field. The scattering of radio waves from the Crab nebula during their passage through the outer portion of the corona can now be detected to distances of the order of 100 solar radii. Measurements by Högbom and by Gorgolewski and Hewish have indicated that the ray scattering which occurs is due to a filamentary structure in which the filaments are aligned approximately radially. This result strongly suggests that the general magnetic field is radial to very great distances.

No evidence has been detected for the presence of looped lines of force, as in the common dipole field, but the radial alignment appears to be more disordered towards sunspot minimum. Such a magnetic field might be maintained by a general outflow of material from the corona, the outflow becoming less pronounced and hence more easily disorganized at sunspot minimum.

DISCUSSION

P. A. Sturroch. One may also infer the strength of the magnetic field in the corona from observations of Type II bursts. Each of the spectral lines of these bursts is often split into two, the splitting amounting to a few per cent. This may be ascribed to the excitation of the two resonance frequencies w_p and $(w_p^2 + w_g^2)^{1/2}$, where w_p and w_g are the plasma and gyro-frequencies, respectively. For a given model of density variation with height, one may infer the variation of the magnetic field strength with height. Field strengths of up to 30 gauss are indicated for the heights at which Type II bursts are first observed.

6. VARIATIONS OF THE SUN'S POLOIDAL MAGNETIC FIELD

M. Waldmeier

The polar streamers of the corona have generally been interpreted as magnetic field lines. These streamers are inclined to the radial direction at an angle β. The inclination β is proportional to the angular distance α from the Sun's axis: $\beta = c \times \alpha$. This law holds up to $\alpha = 25°$ or even up to $\alpha = 30°$. The constant c depends on the distance from the Sun's limb at which the inclination is measured. In addition, c may be different for the northern and the southern polar region and depends also on the phase of the sunspot cycle. The measurements of the inclination have been obtained from large-scale photographs of the corona at the eclipses of 1952, 1954, 1955 and 1961. The following mean values of c have been observed:

Year	1952	1954	1955	1961
c	0·69	1·23	0·90	0·90

The measurements refer to the distances r = 1·1 and 1·3 from the Sun's centre, and to both the northern as well as to the southern hemisphere, except for the 1961 corona which has shown the polar streamers in the northern polar region only. From the figures given, one may conclude that the inclination of the polar streamers increases as the sunspot minimum (1954) is approached and decreases again after sunspot minimum.

DISCUSSION

V. V. Vitkevitch: I wish to call attention to the Russian eclipse expedition back in 1936. Detailed description of the polar rays have been published in 1939 by E. J. Bugoslavskaya (Sternberg Dissertation). In Kiev further studies have been made of the polar and the equatorial rays and their connection with the Sun's magnetic field. I shall report about them at the Cloudcroft symposium.

7. FILAMENTARY CURRENTS AND THE MAGNETIC CONDITIONS ON THE SUN

H. Alfvén

It is an observed fact that cosmical plasmas often exhibit filamentary structures. Examples of such structures are prominences, polar plumes, coronal rays, supercorona (**1**, **2**, **3**) and filaments in interstellar clouds. Structures of these kinds have been studied recently by Kippenhahn and Schlüter (**4**), Jensen (**5**), Lüst and Zirin (**6**) and others.

Filamentary structure may be an essential and general property of low-density cosmical plasmas. This view can be supported by theoretical arguments. From analysis of a simple model, it has recently been concluded (**7**) that currents in a low-density plasma tend to approach

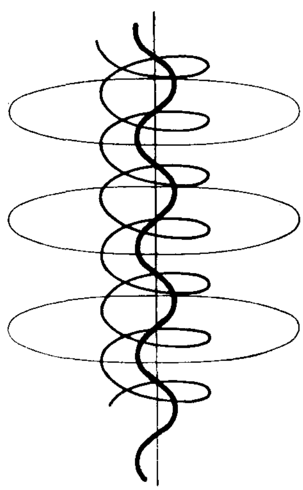

FIG. 1. Magnetic lines of force in a 'magnetic rope'.

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