SOME MORPHOLOGICAL PARTICULARITIES OF THE
SOLAR CORONA ON 22 SEPTEMBER 1968

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The solar corona, at sunspot maximum, was
successfully observed during the total phase of the
eclipse of 22 September 1968, at 11:20 UT, at
Yurgamish (U.S.S.R.) by radial compensation of
the variation of the brilliance (Laffineur 1969).
Several excellent plates give a roughly uniform
spatial resolution of about 5 arc sec over a field
which extends about 3 solar diameters. The
morphology and the fine structure of the streamers
may be easily investigated; for example, by relating
them to the chromospheric structures recorded on
the same day at different observatories.

One plate, reproduced in Figure 1, shows the
intermediate corona, together with the ‘connections’
between the corona and the chromosphere. The
superposition of the different coronal structures is
particularly conspicuous on this plate, which
confirms the importance of the streamer-contribution
to the intermediate corona, the streamers being
visible out to 3 solar radii. The correlations at the
limb, between the streamers which have bases with
imbribated arches and quiescent prominences, also
allow one to locate the streamers in space, assuming
that they extend in a radial direction, near the plane
of the limb. If the minimum value of the range of
observable intensity $L_0/L_0$, limited by the noise of
the film, is around 30, and if the intensity which can
be imputed to a streamer is a monotonic function of
$\rho$ (the distance from the center of the sun in
units of solar radii), then $L \sim \rho^{-8}$ (Shklovsky 1962).
It is easy to show from this that one can distinguish
streamers with an inclination up to $\theta > 45^\circ$ to the
plane of the limb. It is necessary to take this into
account, in order to explain the apparent directions of
the streamers and their superposition.

When the general structure of the solar corona is
considered in space, the asymmetry of the polar
caps is striking; the northern area is morpho-
logically comparable with the intermediate zones
while the southern one is almost without activity.
This asymmetry also exists for the active areas of the
photosphere. As well as the types of streamers
described by Newkirk (1967) the plate shows new
types of structure. Figure 2 shows microdensi-
tometer tracings in polar coordinates for one of the
plates. These diagrams permit one to study the
structures. The streamer $J$ at $N 10^\circ$ has been
identified by Burnichon et al. (1969), as coming
from a very active area topped by two coronal
‘bulbs’; at the center of one there were chromo-
spheric flares, very close to the limb, some hours
before totality (Figure 3). This streamer has a
peculiar fine structure: it is divergent and almost
straight. It extends to more than $2 \times 10^6$ km and its
minimum average velocity of expansion projected
on to the plane of the limb was estimated to be
150 km/sec, which is lower than the value predicted
by Parker (1961) for a hydrodynamic blast wave.
Other streamers, coming from the same area, can
be noticed but they have less contrast; this suggests
that their direction has a large angle to the plane of
the limb. This type of streamer, formed not by
diffusion but by ejection, could therefore supply
energy to the corona and interplanetary space and
cause disturbances not only at 1 AU but, as the
plate seems to show, in the intermediate corona
as well. Dark filaments of considerable optical
thickness can also be seen in this area and this
type of inhomogeneity in the inner corona can
not be interpreted in terms similar to those used by
Vsekhsvjatsky et al. (1962) for similar phenomena
at greater distances. However, these zones are
only distinguishable from the coronal cavities, des-
ignated $k$ in Figure 2, because they do not occur
between prominences and coronal arches.

This maximum type corona shows few tapering
streamers. In Figure 2, a streamer ($j$) of this
type can be noticed. The cross sectional area is
FIG. 1.

*Upper:* Photograph of the solar corona at $\lambda = 6000$ Å, with $\Delta \lambda = 500$ Å, on 22 September, 11.20 UT.

*Lower:* The corona and the chromosphere at the same time. Data taken from different films and from the map of the Fraunhofer Institute.
FIG. 2. Microdensitometer tracings at various positions in polar coordinates, for one of the coronal films. The ordinate gives the distance to the center of the solar disk and the attenuation factor of the neutral radial filter. The abscissa gives the angular distances. Values of the absolute brightness, in units of average brightness of the solar disk, are given for some points. The letters in the diagram indicate the following: a = arch system; b = coronal bulbs; c = coronal condensation; j = tapering streamers coming from a neutral point; $J$ = streamers coming from bulbs; $J'$ = streamer showing brightening edge.
FIG. 3. The part of the corona above the active area that was the seat of chromospheric flares. The data were taken from the ESSA-ITSA Monthly Bulletin of Solar-Geophysical Data and from Sol. Dann.
constant beyond a certain radial distance, and its photometric profile is Gaussian in cross section. The streamer appears to have originated at a neutral point above a double-arch system, situated in the plane of the limb. As its apparent inclination to the axis of rotation is near zero, its minimum real inclination to the radial direction (at the neutral point) can be estimated as 30°, which is an inadmissible inclination for a theory of hydrodynamic radial outflow. The magnetostatic theory cannot either explain this peculiarity (Laffineu et al. 1969, Altschuler et al. 1969), Schatten et al. 1969). Indeed, the transition expected in the case of magnetostatic balance, where the effect of the transverse component of the magnetic field disappears to permit the outflow, always remains near the neutral point. The streamer then becomes radial. In the present case, if the effect of these components were to be invoked, it could be felt up to ρ = 3 at least since no deviation of the direction of the streamer is visible on the plate. Furthermore, it is unlikely that the region surrounding the streamer which could have inhomogeneities of temperature, could provoke this anomaly. The general magnetic solar field would have exactly the opposite effect.

In Figure 2, the streamer J° seems to show a particularly interesting fine structure. Beyond ρ = 1.80, it alone is recorded on the plate and the contribution of the background rapidly becomes negligible. The microdensitometric profile for this streamer shows a clear brightening at the edge. A simple model of an almost hollow streamer with an ovoid cross section can be deduced from the photometry (Koutchmy 1970). Indeed, it seems that the base of the streamer can be quite well identified with a broken-off 'chain' of quiescent prominences surrounding an active center (Figure 4). This 'cell' on the solar surface has a diameter of about 600 000 km; that is, a dimension which can be compared to these of giant cells (Simon et al. 1968).

This phenomenon, if it exists at the level of the photosphere, could play a fundamental part in all the physical processes of which the corona is the seat.

REFERENCES

FIG. 4. Part of the chromosphere situated at the base of the streamer, showing brightening of an edge. The area which appears on 25 September 1968 is surrounded by prominences in a broken-off 'chain' with an ovoid shape.


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