LARGE-SCALE NEGATIVE POLARITY MAGNETIC FIELDS ON THE SUN AND PARTICLE-EMITTING FLARES.

V. Bumba

ABSTRACT

Some observational facts about the large-scale patterns formed by solar negative polarity magnetic fields during the 19th and 20th cycles of solar activity are presented. The close relation of the position of occurrence of very large flares accompanied by cosmic ray and PCA events as well as other phenomena of solar activity during the declining part of the 19th cycle of the regularities in the internal structure of large-scale negative polarity features are demonstrated.

INTRODUCTION

During recent years a great interest of space physicists and geophysicists was evoked by the large-scale sector structure of the interplanetary magnetic field, which is closely related to the large-scale organization of photospheric magnetic field patterns. Many studies demonstrating this correlation were published [*Wilcox*, 1968; *Wilcox and Colburn*, 1969; *Wilcox and Ness*, 1965; and others].

In several papers we tried to study the regularities and recurrences in this large-scale distribution of solar magnetic fields [*Bumba and Howard*, 1965*a*; *Bumba and Howard*, 1969] and the dynamics of the development of such regular background field patterns [*Bumba and Howard*, 1965*b*; *Bumba*, 1970*a,b*]. In a recent paper [*Ambrož et al.*, 1970] we tried to demonstrate the tendency of certain giant regular structures to develop in streams of individual polarities, the morphology of which reminds one of very large cellular features. We call them "supergiant" structures and they are related to "active longitudes." They are best seen in the negative polarity magnetic fields. They have their own internal structure in which during the periods of best visibility we may recognize subordinate structures (30° to 35°; 60°) [*Bumba et al.*, 1969]. The length of the whole best-developed feature may sometimes reach nearly 180° not counting the tail.

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Here we present some more facts about these "supergiant" structures and show the close relation of the position of very large flares (flares with cosmic ray and PCA events) to the regularities in the internal structure of such huge features formed in negative polarity streams. This observational fact we think speaks in favor of the physical meaning of these formations. The close relationship of positive polarity streams to the geomagnetic disturbances is demonstrated in Chapter 2 (p. 151).

THE OBSERVATIONAL DATA

The basic observational data are those of the Atlas of Solar Magnetic Fields 1959-1966 [*Howard et al.*, 1967], supplemented by draft copies of magnetic synoptic charts of subsequent rotations also constructed from the daily magnetograms of the Mount Wilson Observatory. The data used extend through the first half of 1970. Because of the inhomogeneity of some of the magnetic charts the maps were integrated through the use of two or three sequential overlays. For some periods of time we studied only the equatorial strips (±20°) of maps as well as the whole maps, drawn separately for each polarity.

As a catalog of great flares the List of type IV bursts connected with the cosmic ray increases or PCA events, published by *Švestka and Olmr* [1966], for the time periods for which good quality synoptic charts were available, was used.

MINUS POLARITY DISTRIBUTION

In previous papers [*Bumba and Howard,* 1969; *Ambrož et al.,* 1970] concerning the preceding cycle of solar activity (no. 19), the better visibility and definition of negative polarity rows and streams in equatorial parts of synoptic charts was mentioned. During this 19th cycle the negative polarity was the following one on the northern, more active solar hemisphere. Studying the first half of the present cycle (no. 20) in which the negative polarity is the leading one on the northern hemisphere, we may see the same narrow and concentrated rows of minus polarity fields and the same tendency of positive polarity rows and streams to grow broader and more diffuse (fig. 1). And again we may observe not only the 27-day period of rotation in the inclination of these rows and streams (drawn in Carrington's coordinate system), but the successive rows and streams of negative polarity may be again seen to be intensified in succession, giving the appearance on the large-scale of a different rotation period (28 to 29 days).

In the first half of the present cycle as well as in the previous cycle, the formation of "supergiant" features during the greatest part of the time interval covered by our synoptic charts is observable in the minus polarity magnetic fields, although such clear separation of both polarities in two opposite longitudinal zones such as during the rotations 1437 through 1442 was not so often observed (fig. 2). The rules of the "supergiant" regular structures development in the opposite polarities separated in the individual active longitudes seem to be not very simple, and more systematic and exact methods of investigation will be needed to find them. In any case, it may be seen that the growth and the decay of these objects [which for the most long lasting one during the present cycle takes about 15 rotations (fig. 3) (1541 - 1555)] occur somewhat differently in comparison with the preceding cycle, and this difference seems to be related to the mutual relation of individual polarities and active longitudes in the formation of structures. Although only the morphological changes of these features have been studied, the consistency of the rules and recurrences during their development seems to speak against their explanation by pure chance.

Again in the present cycle as in the previous one the concentrations of solar activity inevitably coincide with concentrations of negative polarity fields on the large-scale, and the daily geomagnetic disturbances, shifted four days to account for the travel time of the solar wind plasma from the sun to the earth, show a fairly close correlation with positive polarity magnetic features, as will be demonstrated in Chapter 2 (p. 151).

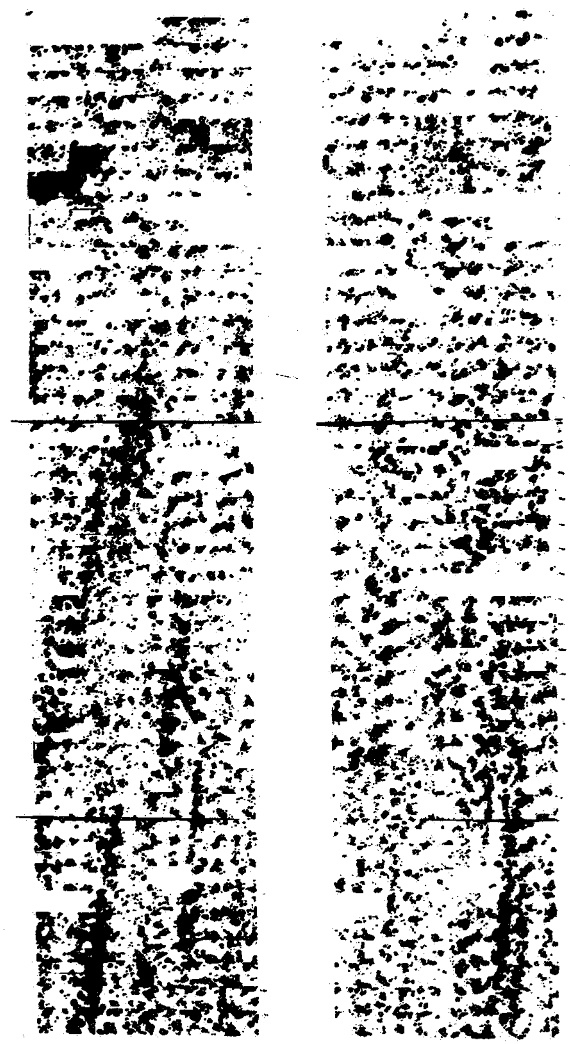

Figure 1. *Photospheric synoptic charts cut into equatorial strips (±20°) and mounted in chronological order for rotations 1522 through 1562 (1967 – 1970). Both polarities are drawn separately. Minus polarity is on the left, plus on the right of the figure. The main inclination of 27 days can be clearly seen especially in the left picture. On the minus polarity drawing may be found the intensification of subsequent individual magnetic rows, starting in the upper left-hand corner and going in a regular succession toward the lower right-hand corner, forming the 28-day active longitude.*

CORRELATION OF PARTICLE-EMITTING FLARES WITH "SUPERGIANT" NEGATIVE FEATURES

We may find one more argument in favor of the physical meaning of these large-scale formations if we correlate

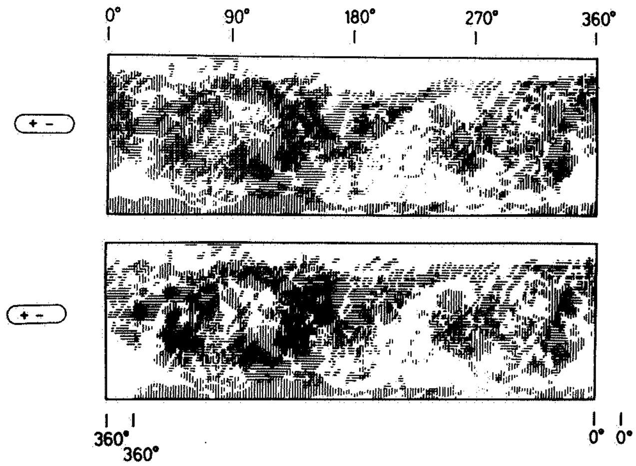

Figure 2. *Synoptic charts demonstrating the degree of symmetry of both polarities "supergiant" structures, developed during the rotations 1434 through 1444. The maximum stage of development of two "supergiant" regular structures is shown, each of them occupying practically one half of the Sun in both main active longitudes, formed from opposite polarities. The regularity and repeated internal structure of "supergiant" bodies of both active longitudes may be seen.*

the position of large flares followed by particle emission measured as cosmic ray, or PCA events, with the internal structure of these features. For this discussion we have used only part of our maps that concerns the 19th cycle of activity, because the lists of large flares for the 20th cycle are still incomplete. Table 1 gives the list of correlated flares taken from *Švestka and Olmr* [1966]. Altogether there are 46 flares in 22 active regions observed from August 1959 till September 1963. From this number about 32, or possibly 40 flares in 11, or possibly 17 active regions lie in a very specific minus polarity magnetic field configuration. (Four flares in three active regions cannot be correlated because of poor quality maps.) Figure 4 shows some examples of this very complex magnetic situation. On the left side of each part of the figure the large body of the "supergiant" negative polarity structure, drop shaped having its head to the west, is presented. This structure is about 90° to 100° in length and is a result of a long-lasting evolution (several rotations). The center of gravity of the largest solar activity is located at the eastern part of the structure, below its tail, in the center of each figure. This is the location of greatest probability occurrence of particle emitting flares. The right side of each figure is not so regular as its left part because of greater activity changes.

Figure 3. *Magnetic synoptic charts of the negative polarity fields for rotations 1544 through 1556. For integration two consecutive maps, one of which is repeated, are overlapped. The development of negative "supergiant" regular structures is shown. The positive large-scale features are formed between them.*

More specific and detailed characteristics of the development of such a situation are not possible here, but certainly this complicated process will be demonstrated in a more extended paper.

Another point of view on this close relation of large flares to the negative polarity formations on the sun may be obtained from one other observational fact. From Supplement II to the list of particle emitting flares published by Křivský (1969), concerning the first half of the

Table 1. *Flares followed by particle emission occurring in solar cycle 19 [taken from Švestka and Olmr, 1966].*

No	Date		Start of flare SID		Flare position imp.			Magn. storm delay	C.R. Start	PCA Delay	A.R. No	Correlation with MF
092	1959	Aug. 18	1014	1025	12N,	33W	3	42ms	–	0.5–1.5	49	+
095		Sep. 1	1923	1928	12N,	60E	2+	51ms	–	8.5	52	?(+)
100	1960	Jan. 11	<2040	2100	22N,	02E	3	46ms	–	1.0–10.0	55	+
101		Jan. 15	1336	1340	20S,	69W	2	31ms	–	13.5	56	+
103		Mar. 28	2042	2048	14N,	37E	2	[62S	–	[11.0–14.0	58	+
104		Mar. 29	<0640	0652	12N,	30E	2+	52S	–	1.0–4.0]	58	+
105		Mar. 30	0216	0220	09N,	15E	1+	34S]	–	7.0–17.5	58	+
106		Mar. 30	1455	1520	12N,	12E	2	28si	–	11.5–22.5	58	+
107		Apr. 1	0843	0850	12N,	12W	3	38ms	–	1.0–1.5	58	+
108		Apr. 5	<0215	0140	12N,	62W	2+	39m	–	2.5–8.5	58	+
109		Apr. 28	<0130	0120	05S,	35E	3	[48S	–	0.5–8.5	59	+
110		Apr. 29	<0107	0205	14N,	21W	2+	24S]	–	0.5–5.5	58	+
111		May 4	1000	1015	13N,	90W	2	54ms	1030	0.3–1.0	58	+
112		May 6	1404	1427	08S,	08E	3	38ms	–	0.0–11.5	60	?(+)
113		May 13	0519	0512	29N,	68W	3	53si	–	1.0–2.5	61	?(+)
114		May 26	0818	0914	14N,	15W	2	59ms	–	1.0	58	+
115		Jun 1	0824	0837	29N,	47E	3+	66m	–	5.5–59.5	62	?(+)
116		Jun 25	<1131	1530	20N,	06E	3	[32W	–	5.0	63	?(+)
117		Jun 25	1659	1659	19N,	01W	1	27W]	–	0.0	63	?(+)
121		Jun 27	2140	2345	21N,	25W	2+	33si	–	1.5	63	?(+)
124		Aug. 11	1916	1925	22N,	27E	3	68m	–	4.5–66.0	64	+
125		Sep. 3	0037	0045	19N,	88E	2+	26ms	0200	4.5–22.5	64	+
127		Sep. 26	0525	0534	19S,	64W	2	75m	–	–8.5–7.5	65	+
131		Oct. 29	1026	1029	22N,	26E	3	no	–	1.5	67	(+)?
132		Nov. 10	1009	1022	28N,	25E	3	[51S	–	8.0	68	+
133		Nov. 11	0305	0311	29N,	12E	2+	35S]	–	0.5	68	+
134		Nov. 12	1315	1325	26N,	04W	3+	21m	1340	0.5–1.5	68	+
135		Nov. 14	0246	0300	27N,	19W	2+	[72ms 34ms]	–	19.0	68	+
136		Nov. 15	0207	0217	26N,	33W	3	[43m 20m]	0227	2.0–9.5	68	+

Table 1. *Flares followed by particle emission occurring in solar cycle 19 [taken from Švestka and Olmr, 1966]. (Concluded)*

No		Date	Start of flare SID		Flare position imp.			Magn. storm delay	C.R. Start	PCA Delay	A.R. No	Correlation with MF
137		Nov. 20	1955	1938 2023	25N,	90W	2+	26si	2055	3.5–16.5	68	+
138		Dec. 5	1825	1830	27N,	70E	3+	47m	–	10.5	68	+
143	1961	Jul. 11	1615	1648	07S,	31E	2+	42ms	–	3.0–7.0	73	+
144		Jul. 12	0950	1023	07S,	22E	3	46m	–	1.0–20.5	73	+
145		Jul. 15	1433	1435	13N,	15E	3	52ms	–	1.2	74	+
146		Jul. 18	0920	0943	08S,	59W	3+	41m	1020	2.0–2.5	73	+
147		Jul. 20	1524	1530	06S,	90W	2+	no	1610	6.0–11.0	73	+
151		Sep. 10	1950	1942	16N,	90W	1	68m	–	0.5–3.5	76	bad qual. maps
152		Sep. 28	2202	2216	13N,	29E	3	47S	–	1.0–1.5	76	–"–
153		Nov. 10	1434	1436	19N,	90W	1+	no	–	0.5	78	–"–
163		Oct. 23	1642	no	03N,	70W	2	47si	–	0.5	87	–"–
166	1963	Aug. 6	0855	0859	13N,	12W	2	no	–	2.3	88	? –
167		Aug. 9	2234	2234	07N,	80W	1	no	–	0.7	89	? –
169		Sep. 16	1300	1303	11N,	49E	2	65m	–	6.3	90	+
170		Sep. 20	0713	0714	14N,	04E	2	31ms	–	3.0	90	+
171		Sep. 20	2314	2351	10N,	09W	2	14ms	–	0.0	90	+
172		Sep. 26	<0638	0709	13N,	78W	3	37ms	–	0.5	90	+

\+ means good correlation
?(+) possibly may be a correlation
? – probably no correlation

Table 2. *Flares followed by particle emission occurring in solar cycle 20 [taken from Křivský, 1969].*

No	Date	Flare Class	Position	Start	C.R. Start	PCA Delay min.	Polarity of Interplanetary magnetic field	
							0 d	+ 4d
1965	Feb. 5	2	8°N, 25°W	1750	–	>40	–	(0)/+
	Jun. 15	1+	22°N, 30°W	0735	–	?	+/(–)	
	Jul. 10	1+	19°N, 17°W	0940	–	?	–	0
	Jul. 13	1	20°N, 55°W	1046	–	?	–	–
	Oct. 4	2	23°S, 30°W	0935	–	(~125)	–	–
1966	Jul. 7	2B	35°N, 48°W	0022	0055–0100	~87	0	–
	Aug. 28	2B	21°N, 4°E	1522	1550	~64	–	–
	Sep. 2	2B	22°N, 57°W	0541	?	65	–	+
1968	Apr. 25	1N	15°N, 30°W	0035	–	+	–	–
	Jul. 9	2B	14°S, 9°W	0831	–	?	0	0
	Jul. 12	2N	12°N, 10°E	0000	–	+	–	–
	Sep. 29	2B	17°N, 50°W	~1616	+	?	+/(–)	0
	Nov. 18	2N	22°N, 87°W	<1030	1045		–	–

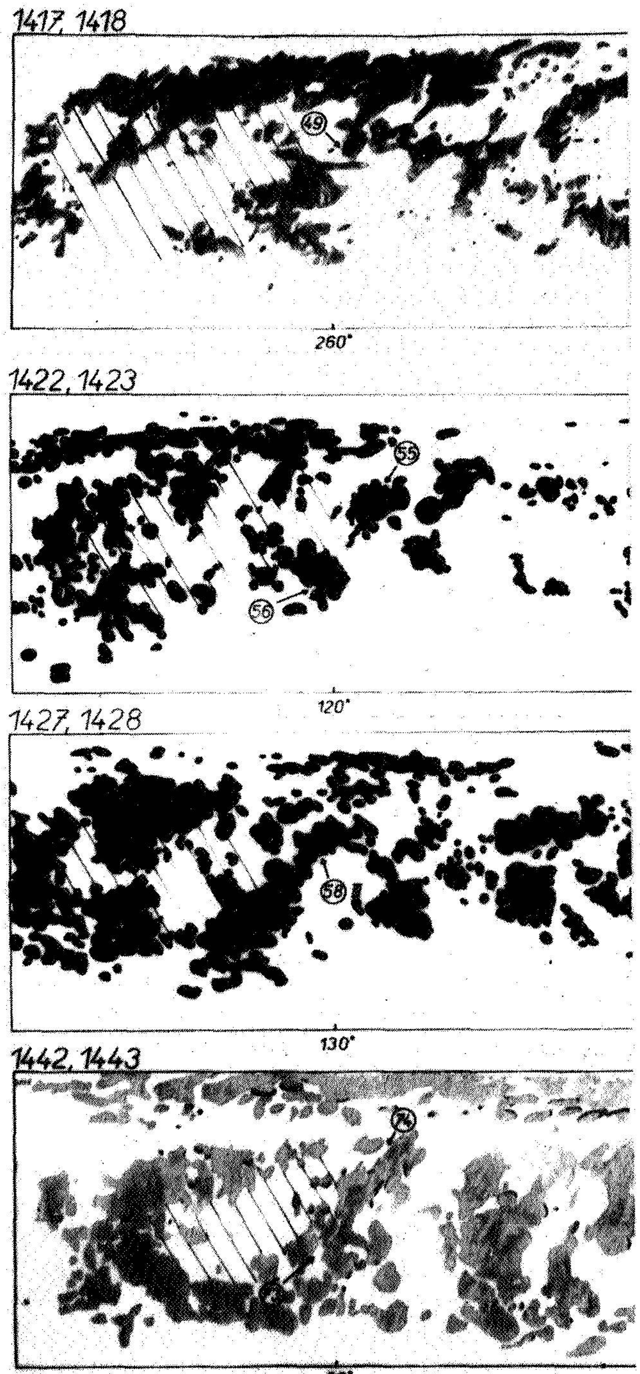

Figure 4. *Four examples of very complex magnetic situations in the negative polarity large-scale distribution within six active regions in which large particle-emitting flares developed. On the left side of each picture the large body of the "supergiant" negative polarity structure may be seen. In the center of each picture the position of the active region producing the large flares is indicated by an arrow and number of A.R. Again for integration two consecutive maps are overlapped.*

present cycle (no. 20) of solar activity we can correlate the occurrence of these flares with the already published [*Wilcox and Colburn,* 1969; *Severny et al.,* 1970] interplanetary magnetic field polarity data. Table 2 presents the very preliminary results showing again that in the present cycle the greatest flares are more often related to the negative polarity on the sun as well as in the interplanetary space.

CONCLUSIONS

The results presented here provide some new observational evidence for the existence of some difference in the behavior of negative and positive polarity of the photospheric magnetic fields, not only in the mode of their large-scale (and possibly also small-scale) distribution, organization, and development but also in their relation to solar activity and interplanetary magnetic fields. The development of large-scale features of both polarities takes place over a wide range of heliographic longitudes as well as latitudes and does not seem to be influenced by the differential rotation. It is still not possible to give the reason for the formation of "supergiant" structures, but the same forces responsible for the occurrence of active longitudes with different periods of rotation seem to play an important role in this process.

As was demonstrated, large-scale solar regions with predominant negative polarity are closely related to the regions with the more developed and progressive activity and greater frequency of large flares. This can also mean that during the period when the integrated magnetic field has the negative sign, the sun observed as a star will have more pronounced emission in some ionized calcium and hydrogen lines and greater absorption in helium D_3 line, and so forth. Greater radio emission can be expected during this period of time.

The present results are very preliminary. Still more systematic work is needed to find more physical relations between the individual polarities of solar magnetic fields and other solar and interplanetary phenomena, and the exact rules of the development of their various morphological features.

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DISCUSSION

J. M. Wilcox I would just make a brief comment. Some of the aspects of what Dr. Bumba presents seem similar to the proposed solar sector pattern. For example, he finds a preferred polarity over both northern and southern hemispheres, and he finds the same kind of structure over long periods of time, maybe even over several solar cycles, and he finds that it seems to be in a rigid rotation system similar to the solar sector pattern. So that perhaps when we understand these matters we will see more detailed connections.

P. McIntosh I would like to suggest that the persistence of the large-scale patterns is due to a preference for more frequent active region formation in some longitudes than in others. Since the same sources apparently produce the sector pattern, perhaps we will have to go into the interior of the sun to look for why we get more regions coming up in some places than others. We know from other studies in the literature that proton flares come from the combination of two or more active regions coalescing, so that this would of course be the case if you had more frequent regions in one longitude than another.

L. Carovillano In any attempt to make a hydromagnetic description of the solar wind flow, one must say something about the magnetic field. At the source is it dipole or quadripole or some kind of multipole field? If you do anything that makes the field very complicated, your equations which are already non-linear, become extremely difficult. I understood from a couple of comments this morning that the general feeling is that the multipole analysis indicated that the macrostructure of the field at the photosphere is quite predominantly dipolar or perhaps quadripolar. It might change from one to the other but that basically the dominant component is that.

It seems to me when I look at the synoptic charts of the photospheric magnetic field I see the field direction changing many times once around the sun. Sometimes I counted eight times, twelve times. And anyone who knows the simplest things about multipole fields realizes the number of times the field changes directly implies a multipolarity, and all of these charts imply very high multipolarity. I couldn't imagine how a dipole field could be a dominant component in any picture where a field changes direction twelve times going around the sun. Could you comment on just the general macrostructure with regard to the simple field configuration?

G. Newkirk I'm afraid that the configurations are not simple. The dominant term in the spherical analysis in 1959 and 1960 was dipolar in the plane of the equator, more or less. That came about at a time in the activity cycle when there was quite a bit of activity. A little later this activity trailed off a bit and the solar disk began to look a little bit more simple because you didn't see the regular alternations every 20° or 30° of longitude. In fact, the solution got somewhat more complicated and it became a quadripole.

J. M. Wilcox Just briefly, it seems to me the question touches on what has been a truly surprising result of the work of the last few years, particularly for the sector structure first seen in the interplanetary field. Namely, as you look at these synoptic charts of the photospheric field you see a situation in which the field appears to be changing very frequently. Yet, if you defocus this, or smear out the high frequency terms, you don't tend to go to zero, as we would have thought a few years ago, but you tend to go into the solar sector structure, which has predominantly either two or four sectors per rotation. And I think it is a surprising result. It's not what you see if you just look casually at the synoptic chart.

R. L. Carovillano Maybe I can add to my question, then. Let's put it this way, over what spatial scale on the surface of the sun do we have to perform an average in order to get a polarity which resembles what we see in the solar wind at larger distances? This correlation is the important one which must be relevant in the full structure.

J. M. Wilcox I would just like to thank Dr. Carovillano for asking this question. It is precisely what we are trying to answer in a future observational program. We'll have a little rectangular mask whose area can be varied and we'll run it across the solar disk and measure the mean photospheric magnetic field.

COMMENTS

P. H. Scherrer, Robert Howard, and John Wilcox The mean photospheric field has been compared with the interplanetary field polarity by crosscorrelating averages of Mount Wilson daily magnetograms obtained over a 2½-year period with the interplanetary sector polarity determined from the Ames Research Center magnetometers on Explorer 33 and Explorer 35. Agreement was found between the two measurements with a lag of about four and one half days.

The most interesting results were found when averages over different large areas of the disk were compared to the interplanetary field. These averages, referred to as "bull's eye" averages of daily magnetograms, were available as a result of another investigation for July 1967 through June 1970.

Figure 1 shows that the bull's eye averages consist of ten averages over disks of radii stepping from one-tenth the full solar disk radius to the whole disk in steps of one-tenth the full radius. We labeled the disks and the averages "disk 1" through "disk 10." Disk five, for example, shown shaded in the figure, has a radius one-half the full disk.

The cross correlation between these disks and the interplanetary field polarity was determined as a function of lag for various time periods. Figures 2 through 6 show the results of these calculations for the disks for the five 6-month intervals from July of 1967 through December of 1969; the 1970 interplanetary data are not yet available. Figure 2 shows that there is a correlation at a lag of about 4½ days for disk 3 through disk 6 for the last half of 1967, but no correlation for the larger disks. Note that the 4½-day lag corresponds to the transit time of solar wind plasma from sun to earth. Figure 3 shows quite different results for the first 6 months in 1968. In this period there are similar peaks for all the disks. Measurements by *Severny et al.* [1970] of the mean field in 1968 were made during about half of this period. The bull's eye correlations showed a similar pattern when the exact time interval was used during which Severny *et al.* had found good agreement with the interplanetary field.

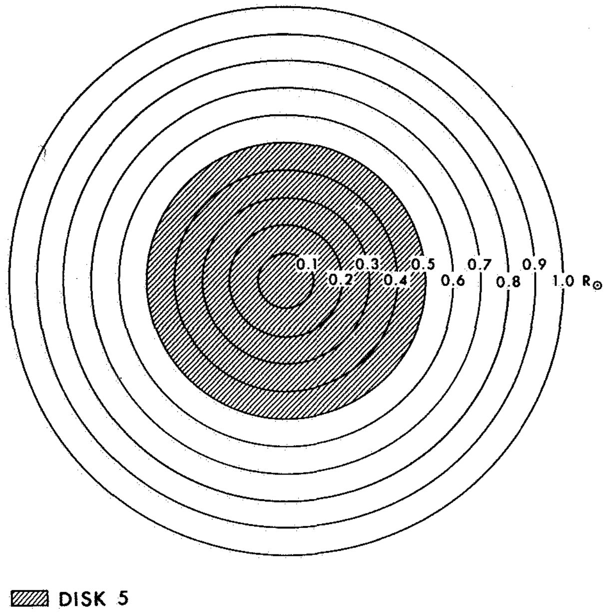

Figure 1. *Schematic drawing shown areas of disk averages of the photospheric magnetic field.*

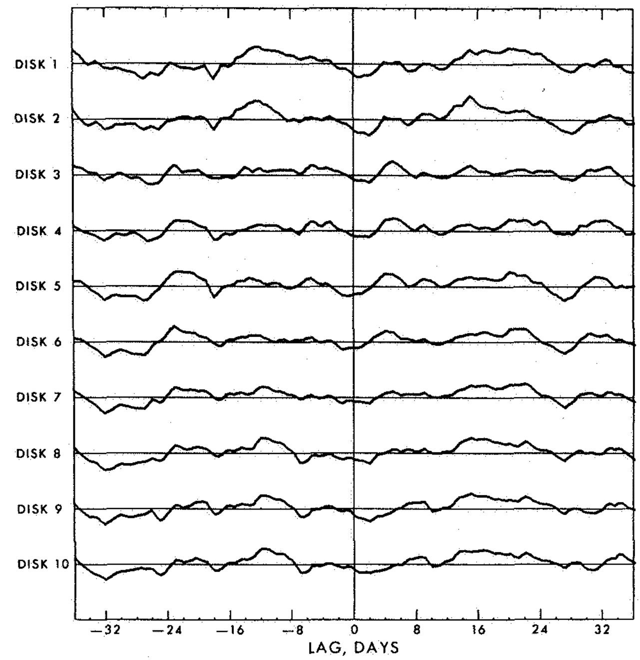

Figure 2. *Cross correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, July through December 1967. The curve near the line labeled "disk 5" represents the cross correlation of the disk 5 data for lags −36 to +36 days. The line labeled "disk 5" represents a correlation coefficient of zero. The line labeled "disk 4" represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled "disk 6" represents a correlation coefficient of −1.0. All the other disk and ring correlations are in the same format.*

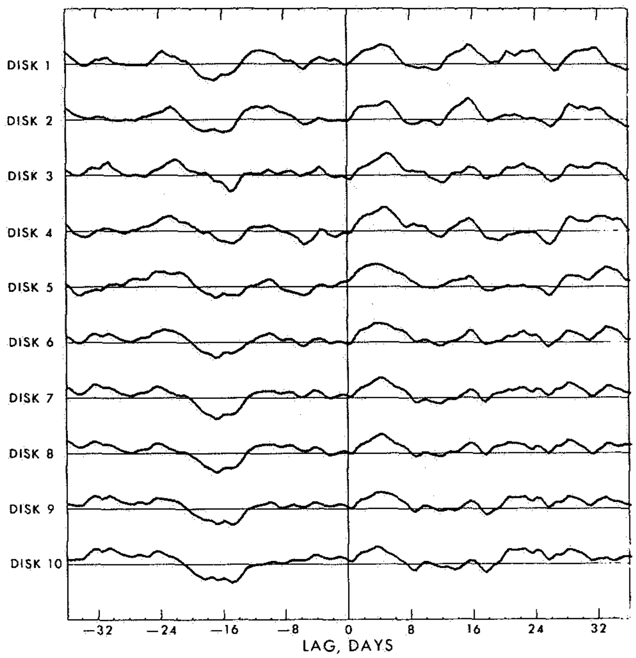

Figure 3. *Cross correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, January through June 1968. The curve near the line labeled "disk 5" represents the cross correlation of the disk 5 data for lags -36 to +36 days. The line labeled "disk 5" represents a correlation coefficient of zero. The line labeled "disk 4" represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled "disk 6" represents a correlation coefficient of -1.0. All the other disk and ring correlations are in the same format.*

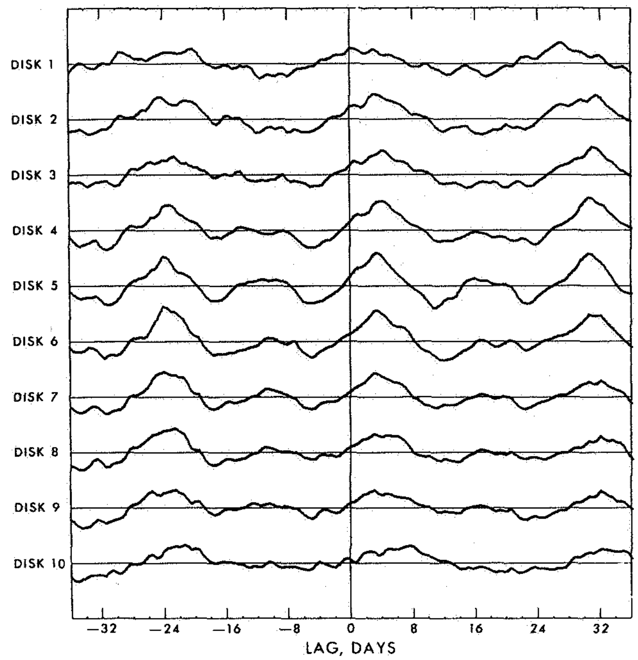

Figure 4. *Cross correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, July through December 1968. The curve near the line labeled "disk 5" represents the cross correlation of the disk 5 data for lags -36 to +36 days. The line labeled "disk 5" represents a correlation coefficient of zero. The line labeled "disk 4" represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled "disk 6" represents a correlation coefficient of -1.0. All the other disk and ring correlations are in the same format.*

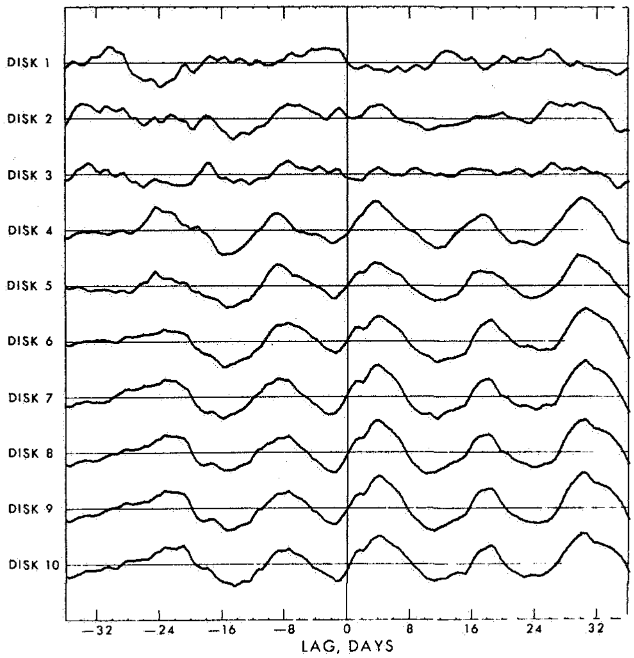

Figure 5. *Cross correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, January through June 1969. The curve near the line labeled "disk 5" represents the cross correlation of the disk 5 data for lags -36 to +36 days. The line labeled "disk 5" represents a correlation coefficient of zero. The line labeled "disk 4" represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled "disk 6" represents a correlation coefficient of -1.0. All the other disk and ring correlations are in the same format.*

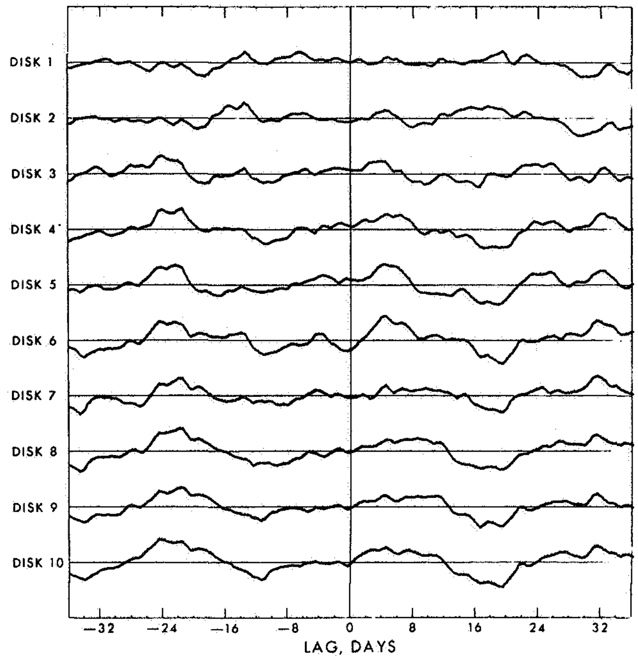

Figure 6. *Cross correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, July through December 1969. The curve near the line labeled "disk 5" represents the cross correlation of the disk 5 data for lags -36 to +36 days. The line labeled "disk 5" represents a correlation coefficient of zero. The line labeled "disk 4" represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled "disk 6" represents a correlation coefficient of -1.0. All the other disk and ring correlations are in the same format.*

The next three 6-month intervals also show that the amount of correlation at different disks fluctuates in time. In the last half of 1968 (fig. 4) there is some correlation for all disks, but the peak at disk five is the largest. In the first half of 1969 (fig. 5) the seven larger disks have similar peaks. Finally, the last half of 1969 (fig. 6) shows good correlation only for the middle disks, and is similar to pattern for the last half of 1967.

The main conclusion from these results is that the most consistent comparison between daily magnetograms and the interplanetary field is found when one averages the magnetogram over an area about equal to disk five. We interpret this to mean that the smaller disks do not show large scale features and are influenced by small scale active regions more than the larger disks. The large disks include contributions from more than one sector boundary and thus show smaller correlations, therefore, if too small an area is used, no correlation results; and if the whole disk is used, sometimes lower correlation results.

REFERENCE

Severny, A.; Wilcox, J. M.; Scherrer, P. H.; and Colburn, D.S.: Comparison of the Mean Photospheric Magnetic Field and the Interplanetary Magnetic Field. *Solar Phys.*, Vol. 15, 1970, p. 3.

DISCUSSION

H. Schmidt What was the size of those disks, angular size?

P. H. Scherrer They range from one-tenth the diameter of the disk to the full disk; so that, for instance, disk five then would be 30° from the center of the sun.

R. H. Dicke Has the same thing been done, changing latitudes on the disks, seeking correlation?

P. H. Scherrer We are working on it.

R. B. Leighton I take it your disks were not from any a *priori* feeling that that's what it should be, but that your data came in such a form that that was an easy thing to do.

P. H. Scherrer Yes, this was an easy way to start the analysis.

R. Howard Just to add to that, because the activities are spread in active latitudes across the sun, the upper latitude portion of the rings, in fact, doesn't contribute very much to the results of the rings. This is really like taking sectors along the equator, and easier to get in the computer.

D. E. Jones I was just wondering if there are any plans to perhaps weight the readings, that is, the averaging, by the brightness in H-alpha, or something such as this, to give more weight?

P. H. Scherrer Not right now.