No.	Planet.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Mean Opp. Mag.
22	Calliope ..	11·4	11·1	10·9	10·9	11·2	11·5	11·8	12·1	12·3	12·4	12·5	12·5	12·4	10·6
23	Thalia ..	13·1	13·1	13·0	12·8	12·5	12·2	12·1	12·2	12·4	12·7	13·0	13·3	13·4	11·0
24	Themis ..	12·1	11·8	11·5	11·3	11·3	11·6	12·0	12·3	12·6	12·9	13·0	13·1	13·1	11·6
25	Phocea ..	11·7	11·9	12·3	12·6	12·9	13·1	13·2	13·2	13·2	13·1	12·9	12·6	12·2	10·5
26	Proserpine..	12·2	12·4	12·5	12·6	12·5	12·4	12·2	12·0	11·7	11·5	11·2	11·3	11·6	10·7
27	Euterpe ..	12·1	12·0	11·7	11·4	11·1	10·8	10·8	11·1	11·5	11·8	12·0	12·2	12·3	9·9
28	Bellona ..	10·6	10·3	10·1	9·8	9·8	10·0	10·4	10·8	11·2	11·5	11·7	11·8	11·8	9·8
29	Amphitrite	11·1	10·9	10·7	10·4	10·0	9·6	9·4	9·4	9·6	10·0	10·3	10·5	10·7	9·1
30	Urania ..	10·3	10·7	11·1	11·4	11·6	11·8	11·9	11·9	11·9	11·9	11·7	11·5	11·2	10·1
31	Euphrosyne	13·6	13·6	13·5	13·4	13·1	12·8	12·5	12·3	12·1	12·1	12·3	12·5	12·7	11·6
32	Pomona ..	12·1	12·4	12·7	12·8	12·9	12·9	12·9	12·7	12·5	12·3	11·9	11·5	11·1	11·0
33	Polyhymnia	11·7	11·6	11·5	11·4	11·3	11·2	11·1	11·0	10·8	10·6	10·4	10·5	10·9	11·4
34	Circe	11·3	10·9	10·9	11·2	11·6	12·0	12·3	12·6	12·8	12·9	13·0	13·0	13·0	11·5
36	Atalanta ..	15·3	15·1	14·8	14·5	14·1	13·7	13·4	13·3	13·5	13·6	13·8	13·9	13·9	12·9
37	Fides.. ..	12·7	12·6	12·4	12·2	11·9	11·5	11·0	10·6	10·4	10·6	10·8	11·1	11·3	10·5
38	Leda	12·6	12·7	12·7	12·6	12·5	12·3	12·0	11·6	11·2	10·7	10·4	10·3	10·6	10·9
39	Lætitia ..	9·8	10·1	10·3	10·5	10·6	10·7	10·7	10·6	10·5	10·3	10·0	9·7	9·5	9·3
40	Harmonia ..	9·6	9·4	9·4	9·8	10·2	10·6	10·9	11·1	11·2	11·3	11·3	11·2	11·1	9·1
42	Isis	12·2	11·8	11·7	11·8	12·0	12·3	12·5	12·7	12·7	12·7	12·6	12·4	12·2	10·6
43	Ariadne ..	11·1	11·6	12·0	12·3	12·5	12·7	12·7	12·7	12·6	12·4	12·1	11·7	11·2	10·0
44	Nysa	12·0	12·2	12·2	12·2	12·1	12·0	11·8	11·6	11·2	10·8	10·4	9·9	9·5	10·4
45	Eugenia ..	12·3	12·6	12·8	12·9	13·0	12·9	12·8	12·7	12·4	12·1	11·8	11·5	11·4	11·0
46	Hestia ..	12·6	12·8	13·2	13·7	14·1	14·3	14·6	14·7	14·7	14·7	14·6	14·4	14·2	12·4
47	Aglaia ..	12·1	12·3	12·7	13·0	13·3	13·4	13·5	13·6	13·5	13·4	13·2	12·9	12·6	11·5
48	Doris.. ..	11·1	11·5	11·8	12·1	12·3	12·5	12·6	12·6	12·6	12·5	12·3	12·1	11·8	11·4
49	Pales	10·5	10·6	10·9	11·4	11·8	12·1	12·4	12·6	12·7	12·7	12·7	12·5	12·3	10·9
50	Virginia ..	13·4	13·4	13·3	13·6	13·9	14·3	14·6	14·8	14·9	15·0	14·9	14·8	14·6	12·3

On Certain Phenomena in the Motions of Solar Spots.

By R. C. Carrington, Esq.

The present short paper is in continuation of a preceding one inserted in the number for November, my object being to illustrate graphically and otherwise the divergence of individual spots in groups of small extent, and to establish clearly the circumstance that instances occur of change of position of detached spots, not explicable by change of form, but due to drift on the photosphere. It will then be seen that in any investigation of the elements of rotation of the sun, the movements observed in groups must be excluded as liable to special perturbations; that the discordances of the periods of rotation of the photosphere found by many previous investigators are in great measure due to the omission of the consideration of the latitude of the spots discussed, and that we have arrived at some grounds for the recognition of currents on the sun. I am compelled thus to treat the subject by portions from want of leisure at the present time to enter upon it more completely.

In the first of the two lithographed sheets which accompany this paper, I have given three instances of the divergence of the components of groups, and the action thus illustrated by diagrams drawn to scale is common to all groups of small extent. The fourth example is of two neighbouring spots which have broken out at a sufficient distance apart for this action to be nearly imperceptible. The fifth set of figures is an example of a normal circular spot separating completely into two, which continue to diverge after separation. I have two other similar cases recorded, though not of so striking a character, nor so favourably observed; and the last plate but one (his Taf. IX.) of Mr. Schmidt's *Resultate* supplies another. In the lithographed sheet the observations of successive days are placed vertically under one another, commencing from the top when the spot came first into view, the middle diagram being the observation on the day when the group was nearest to the centre of the disk in its passage across from *right to left*, the figures and the apparent movements being reversed as in all my representations. The squares are of 10 degrees in longitude and latitude, and the longitude increases from right to left.

I have acknowledged before that Dr. C. H. F. Peters, now Professor of Astronomy at Hamilton College in the United States, has the right to claim priority of publication of this action upon one another of the individuals of a group of spots, though, as the examples now given will show, it could not have escaped me in the examination of my own records. There are two ways in which this action may be mechanically explained; firstly, by the centre of eruption beneath the photosphere being situated between the openings in the photosphere which we see as dark spots, and its emissions of gaseous or other expansive matter being thrown out obliquely, an explanation which is strongly supported by instances occasionally occurring in which an elliptical group of numerous small nuclei have all their penumbræ turned (or thrown) outwards; secondly, by the pressure of the necessarily superincumbent matter of the photosphere thrown out of the cavity of the spots, and which, as the emissive force dies out, must, in its efforts to resume its general level, exert a lateral pressure. The mechanics of the subject may, however, wait awhile till observation has further advanced; my object at present being chiefly to show that groups present peculiarities of internal commotion which unfit them for discussion in the correction of the elements of rotation.

In the second lithographed sheet are given some series of positions of neat single spots, favourably observed, in order to show in the briefest way, and at the same time conclusively, that no single value of the time of rotation of the photosphere will satisfy the successive observed longitudes of normal spots, and that the outstanding movements are such as are only referrible to proper motion of the nature of drift of the entire spot. The period of sidereal rotation with which the reductions have been effected is 25·380 mean solar days; and it will be seen that while spots (6) and (7) move to the left, or increase their longitude from the adopted fixed meridian, spots (8), (9), and (10), move to the right, their longitudes decreasing, and that these motions are of an amount which necessitates the supposition of bodily drift. It were easy to add the numerical positions of these five series, but I do not see that figures would here add anything to the force of the ocular demonstration.

I have proceeded to select out of my stock of results all series of observed positions of single spots recorded on more than two days, to which no *a priori* objection existed, and to deduce for each series the mean daily drift of the spot in longitude and latitude, expressed in minutes of arc on the surface of the sun, and arranged the results in order of the latitude of the spots from north to south. As I do not consider the subject fully ripe, I will only now give the mean results of contiguous values, remarking that the groups have been made as usual with reference to the tendency exhibited to change of sign, and that the signs within the limits of the several groups presented a remarkable consistency. The resulting means are as follow:—

Latitude.	Daily Drift.					
°	′		′			
30 N	− 25	in longitude	+ 5	in latitude, by	4	series
18 N	− 14	..	+ 1	..	4	..
8 N	+ 8	..	− 5	..	14	..
11 S	+ 10	..	− 3	..	6	..
19 S	− 10	..	+ 1	..	5	..
29 S	− 21	..	+ 4	..	8	..

There is a mean excess of retrogradation in longitude of 9′ a day with the period 25·380, which was employed provisionally in reduction. If we correct this period for the 9′, we have 14° 2′ for the daily sidereal rotation, and 25^{d}·652 for the corresponding period; but though this is the mean period which results, and happens to agree exactly with the mean period of Dr. C. H. F. Peters, it necessarily is affected by the mean drift, and may be not a whit nearer the truth than the one provisionally used, from the convenience of its ready subdivision. The numbers exhibited in the foregoing little table are however very significant, when the method of their derivation is duly borne in mind. They show that with a mean period of rotation there is an equatoreal current causing spots to move in the direction of the solar rotation, and a reverse current in the higher latitudes north and south, between 15° and 40°, causing the spots of those latitudes to apparently regress. It now appears at once, when the disclosure of my former map, in the November *Monthly Notice*, is remembered, how former observers may well have disagreed in their concluded periods, from having observed at different epochs when the limiting parallels were different in each case, and when the considerations of latitude and drift were omitted. It further results from the above table that between the parallels of 15° N. and S., the mean drift in latitude is towards the equator, and beyond 15° of latitude or thereabouts towards the poles in each hemisphere, and that the differences of drift in longitude are far larger than those in latitude. The effect of the mean drift in longitude is such that had I inferred a mean period of sidereal rotation from the observations of 1854 and 1855, there would have resulted $25^{d}\cdot11 \pm$, and from the subsequent period after the change of distribution exhibited in my map, a period of $25^{d}\cdot90 \pm$. A question may hence arise whether at the epoch of that striking change of distribution in latitude, a simultaneous change of currents did not set in, but our records are not yet sufficient to supply materials for the discussion of such speculations.

In Dr. Peters's Tables, A and B, there are materials for a similar investigation. We are at variance in at least one point, namely, that he finds the movement in latitude invariably towards the equator; and I am uncertain whether his general result for longitude is in accordance with my own or not, as I cannot make sure from his words in which direction he counted his meridians. I may have occasion to return to the subject when I have had time to correspond with him on this and some other points; and in the meantime may be permitted to call the reader's attention to a certain similarity of this distribution of currents with the diagram of the winds of our globe given in Plate III. of Lieutenant Maury's Sailing Directions.

1858, *December* 27.

Results of the Observations of Small Planets, made at the Royal Observatory, Greenwich, in the month of December, 1858.

(*Communicated by the Astronomer Royal.*)

Thetis.

Mean Solar Time of Observation.		Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1858, Dec. 29	12 3 3·3	6 35 38·24	70 45 26·20

Urania.

Mean Solar Time of Observation.		Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1858, Dec. 20	6 51 32·2	0 47 46·99	81 52 47·79