Anhang (E). By George E. Hale.

Preliminary Observations of the Zeeman Effect, Due to the General Magnetic Field of the Sun.

I beg to present the preliminary results of a study of the general magnetic field of the sun, based upon the measurement of the Zeeman effect over a wide range of latitude. The detailed measures may be found in Contributions from the Mount Wilson Solar Observatory, No. 71, copies of which have been distributed recently by the Carnegie Institution of Washington. The principal results contained in this paper, together with certain confirmatory observations obtained since its publication, may be summarized as follows:—

Preliminary observations made in 1908 with the 60-foot tower telescope were inconclusive. The work was renewed with the 75-foot spectrograph of the 150-foot tower telescope in January, 1912, and continued throughout the year, using the third order of a Michelson grating of very high resolving power. The linear dispersion at $\lambda 5930$ is 1 Ångström = 4.90 mm. A Nicol prism and a compound quarter-wave plate, consisting of strips 2 mm. wide, mounted so that the principal sections of successive strips make an angle of 45° with the slit and 90° with each other, are supported above the slit of the spectrograph. If the observations were made in the direction of the lines of force the red component of a normal Zeeman triplet (here appearing as a doublet) would be extinguished by one set of strips, the violet component by the other. The displacements referred to below, which average less than one-thousandth of an Ångström, represent the relative shifts of the same solar line on adjoining strips of the quarter-wave plate.

Using the above instruments, and taking every precau-
tion to eliminate possible bias upon the part of a measurer, the following results have been obtained:

1. The lines $\lambda 5812.139$ ($Fe$, 0), $\lambda 5828.097$ ($\rightarrow$, 0), $\lambda 5831.821$ ($Ni$, 1), and $\lambda 5929.898$ ($Fe$, 2) show distinct displacements not shared by atmospheric lines nor by certain other solar lines.

2. The sign of the displacements is reversed in 77 per cent. of the measures when the quarter-wave plate, mounted above the Nicol prism over the slit of the spectrograph, is inverted.

3. The sign of the displacements is reversed when a half-wave plate, mounted between the quarter-wave plate and the Nicol, is turned through an angle of 45°.

4. The sign of the displacements is opposite in the northern and southern hemispheres of the sun.

5. The maximum displacements are observed about 45° north and south of the solar equator. From this point they decrease to zero at the equator and near the poles of rotation.

6. A curve representing the displacements as a function of the latitude corresponds closely with a theoretical curve, showing the displacements of a normal Zeeman triplet observed at various latitudes in the field of a magnetized sphere.

7. In view of this agreement and the apparent impossibility of accounting for the observed displacements on other grounds, it is probable that they represent the Zeeman effect due to the sun's general magnetic field.

8. Assuming this to be true, we find that the magnetic poles of the sun lie at or near the poles of rotation.

9. The polarity of the sun corresponds with that of the earth, i.e., the north magnetic pole lies near the north heliographical pole.

10. On the hypothesis that the magnetism of the sun is due to the axial rotation of a body acting as though it carried a residual volume charge, the sign of the charge comes out negative.
11. The preliminary results indicate that the general magnetic field decreases rapidly in intensity at levels in the solar atmosphere higher than those represented by the lines named in paragraph No. 1.

12. A first approximate value for the vertical intensity of the sun's general field at the poles is 50 gausses.

Since the completion of the above paper Dr. van Maanen has measured nine additional lines on the plates of the fourth series and four lines on a new series of plates. Of these lines, four show the Zeeman effect as follows:

<table>
<thead>
<tr>
<th>λ</th>
<th>Element</th>
<th>Intensity</th>
<th>Right sign</th>
<th>Wrong sign</th>
<th>Zero</th>
<th>Total No.</th>
<th>Discarded in final curve</th>
<th>Max. displacement in curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>5556.312</td>
<td>Fe</td>
<td>2</td>
<td>64</td>
<td>9</td>
<td>2</td>
<td>75</td>
<td>5</td>
<td>4.1</td>
</tr>
<tr>
<td>5528.013</td>
<td>Fe</td>
<td>2</td>
<td>74</td>
<td>18</td>
<td>2</td>
<td>94</td>
<td>12</td>
<td>2.8</td>
</tr>
<tr>
<td>6007.540</td>
<td>Ni</td>
<td>1</td>
<td>54</td>
<td>17</td>
<td>1</td>
<td>72</td>
<td>14</td>
<td>3.4</td>
</tr>
<tr>
<td>6079.227</td>
<td>Fe</td>
<td>2</td>
<td>94</td>
<td>12</td>
<td>2</td>
<td>108</td>
<td>9</td>
<td>4.2</td>
</tr>
</tbody>
</table>

As the method of reduction here employed is only approximate, the value of maximum displacement will be somewhat changed when the selection of the observations to be discarded is based upon Peirce's criterion.

The hypothesis mentioned in paragraph No. 10 is one that has been advanced to account for the earth's magnetism, on the supposition that the positive electrons of neutral molecules are more powerfully attracted by gravitation than the negative electrons. Full consideration must, of course, be given to other hypotheses. The view that the pores (the small dark spots between the brighter granules of the photospheric granulation) are electric vortices, which may account for the general field if their direction of rotation is opposite to the northern and southern hemispheres, must also receive more careful consideration than I accorded it in my paper. Observations now in progress on Mount Wilson should assist in clearing up this question.

The search for additional lines showing the general field is being continued, and a definitive investigation of the
entire problem, both on the solar and the laboratory sides, will be undertaken as soon as the necessary preliminary studies have been completed.

ANHANG (F). By H. DESLANDRES.

RÉSUMÉ DE LA COMMUNICATION FAITE AU CONGRÈS DE BONN.

J'exposerai brièvement quelques-uns des principaux résultats obtenus à l'Observatoire de Meudon dans l'étude du Soleil, depuis le dernier congrès de 1910.

1. On photographie journellement à Meudon les quatre couches successives actuellement distinguées dans le Soleil, à savoir: la surface ou photosphère et les trois couches superposées, distinctes par leurs propriétés optiques, que j'ai reconnues dans son atmosphère, de 1892 à 1894. Les couches basse et moyenne sont relevées avec un petit spectrohéliographe, qui est en service depuis 1893, et la couche supérieure avec un grand spectrohéliographe organisé en 1908. Il sera surtout question ici de la couche supérieure qui est nouvelle. Les épreuves de cette couche sont plus ou moins nettes suivant les jours et les plus nettes révèlent une structure granulaire. Les plages faculaires et les flocculi brillants apparaissent formés de petits grains brillants qui se détachent sur un fond relativement sombre. Cette structure par grains a été reconnue depuis longtemps déjà dans la photosphère de l'astre, et