site, the stamens are caused to develop and the ovary is reduced, while the form of the flower of a male which is infected is not altered. In order to test this suggestion, I planted some ustilaginized plants in my garden in the late summer of 1910, and put with them some uninfected plants which I attempted to infect by sprinkling them with spores and by rubbing spores into parts of the stem from which I had scraped away the epidermis. The results were as follows: Of seven females which I attempted to inoculate in August, 1910, one became infected, and had the typical "hermaphrodite" form of flower in October, but in June, 1911, was again quite free from *Ustilago*, and had typical female flowers. A second female plant showed infection in June, 1911, but only on part of the plant; one branch was quite clean and had typical female flowers, the rest of the plant was infected and had "hermaphrodite" flowers.

Of eight male plants which were inoculated in August, three showed some infected flowers before the end of September; the anthers contained *Ustilago* spores, but there was no change from the male type of flower. Three of these eight plants were dead in June, 1911; one of the remaining five was infected.

Of five ustilaginized plants transferred to the garden, four had the hermaphrodite type of flower and one the male. One of the hermaphrodites so far recovered in September, 1910, as to set some seed; in 1911 all were still infected. One of them had some branches with hermaphrodite flowers containing large ovary, short styles and stamens with little or no pollen, but without *Ustilago* spores, while the rest of the plant had flowers with anthers full of spores, and the ovary and styles more reduced.

These observations seem to prove that infection with *Ustilago* can turn the female flower into the apparent hermaphrodite, but that no production of female organs takes place in a male flower when it becomes infected.

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The occurrence of uninfected hermaphrodite flowers on one of Doncaster's original infected plants may possibly indicate that this plant was not a female previous to its infection, but a hermaphrodite. If it were possible to secure pollen from a ustilaginized female, certain genetic problems of very great interest might be solved. It is of great theoretic importance to know whether infection by *Ustilago* affects the genotypic nature of the host. If the effect is purely somatic, as seems to me the more probable, the offspring of a self-fertilized hermaphroditic female, or of a normal female fertilized by sperms from a hermaphroditic female, should consist only of females (if uninfected), and not of females and hermaphrodites, as I have shown to be the case when a female is fertilized by a hermaphroditic male. If infection by *Ustilago* produces a genotypic modification, it would be interesting to know whether such induced hermaphrodites are homozygous like the females by whose modification they are produced; they should in that case yield only hermaphrodite offspring. Hermaphroditic males produce both female and hermaphroditic male offspring, because the males are sex-heterozygotes.

As I have been fortunate enough thus far not to have a single infection from *Ustilago* among the many thousands of individuals of *Lychnis dioica* which have been involved in my cultures during the past seven years, I do not care to take up at present the here suggested line of investigation upon ustilaginized females. I do not wish to jeopardize by importing infected material, the solution of many other genetic problems now under investigation, but I hope that Professor Doncaster or some one else who is in a position to do so, will give attention to breeding from hermaphroditic females if this proves to be technically possible.

GEO. H. SHULL

SCIENTIFIC JOURNALS AND ARTICLES

CONTENTS of the September number of *Terrestrial Magnetism and Atmospheric Electricity* are as follows: "A New Type of Compass Declinometer," R. L. Faris; "The Physical Theory of the Earth's Magnetic and Electric Phenomena, No. VI.: On the Origin of the Earth's Magnetic Field," L. A. Bauer; "Magnetic Declinations and Chart Corrections Obtained by the *Carnegie* from Batavia to Manila, and Thence to Suva, Fiji, November, 1911, to June 5, 1912," L. A. Bauer and W. J. Peters; "Resultate der Inklinationsbeobachtungen der Deutschen Südpolar Expedition 1901 bis 1903," Fr. Bidlingmaier; "Regarding Magnetic Records Obtained in Cooperation with Captain Scott's Antarctic Expedition," C. Chree; "Magnetic Character of Days as Observed at the Cheltenham Magnetic Observatory, April 1 to June 30, 1912," G. M. T., O. H. Tittmann; "The Magnetic Character of the Year 1911," G. van Dijk; "Levé Magnétique der Bassin du Rio S. Francisco," H. Morize; "Observation of the Magnetic Declination at Warsaw during the Solar Eclipse of April 17, 1912," S. Kalinowski; "On the Movement of Inertia of Long Magnet H 26 at the Cheltenham Magnetic Observatory." R. L. Faris; Abstracts and Reviews.

SCIENTIFIC BOOKS

The Influence of a Magnetic Field upon the Spark Spectra of Iron and Titanium. By ARTHUR S. KING. Publication No. 153. Carnegie Institution of Washington.

It is assumed that the readers are familiar with line spectra produced by luminous rays from dissociated particles of the metals. Most readers will also be familiar with the following fact, viz., when these lines are produced in a magnetic field they break up into three or more components. This is called the Zeeman effect.

By reason of Hale's epoch-making discovery of a Zeeman effect in solar lines, this phenomenon has come to have a large interest to astrophysicists as well as to physicists. This iron and titanium study should particularly appeal to the former.

The Zeeman effect is much more complicated than the simple theory first indicated. The separations differ in magnitude, number of components, relative spacing of the components, relative intensity and relative sharpness. Farther, the intensity of some of the components is relatively increased (enhanced) with respect to the original line, others are relatively decreased. All of these items are important in the determination of spectral series and in arriving at the physical condition of the luminous particles. Each spectral series generally shows but one type of separation. Furthermore, some of these types repeat from substance to substance, showing an intimate electronic relationship in the molecule of different substances. The phenomenon grows very complex in the detailed study of the different elements. The "Zeeman effect" and spectral series stand almost alone in showing us what a wonderful complex structure exists within every atom. Not all the complexities of the phenomena have been explained. Still, theory has kept well apace with the observations and has often pointed out the way. So important in the latter respect has been some of the contributions by Ritz, that I should like to add at least one of his contributions[1] to the very complete bibliography given by Mr. King.

While all the above characteristics are important no observer has recorded them all, not caring to encumber his data with detail which is not immediately fruitful. Likewise there is much curtailing of the computations. In a paper published by the Carnegie Institution, it seems to me that items of possible future as well as present value might be recorded and save a great amount of labor.

The components of many lines lie so very close together that it is necessary to separate the two kinds of vibrations by some polarizing device, and photograph each separately. The very important relation of the intensity of these kinds of vibration can not then be found accurately since it is impossible to maintain light at the same intensity for the two exposures. But it occurs to me that, with the non-astigmatic Littrow spectroscope which Mr. King has used, one could focus the double image of an interposed calcite upon the slit and photograph both kinds of vibrations coincidently in juxtaposition.

Particularly among the several component lines, there seems to be a certain degree of order. They are often stepped off in uniform spaces. These steps differ in magnitude from line to line, but all seem to be simple fractional parts of a standard value, called the normal, *a*. Furthermore, this "normal" has the value we should expect from the ratio of

[1] *Ann. d. Physik*, 25, 660, 1908.