THE
ASTROPHYSICAL JOURNAL
AN INTERNATIONAL REVIEW OF SPECTROSCOPY
AND ASTRONOMICAL PHYSICS

VOLUME XLI JANUARY 1915 NUMBER 1

JULIUS SCHEINER

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After a long and painful illness, which had greatly restricted his scientific activity for many months, Julius Scheiner, a senior observer at the Royal Astrophysical Observatory at Potsdam, and extraordinary professor of astrophysics at the University of Berlin, died on December 20, 1913, at Potsdam. He was born at Cologne on November 25, 1858, the son of Jacob Scheiner, a painter of landscapes and architectural subjects of that city.

Julius Scheiner attended the elementary schools at Deutz, a suburb of Cologne, later entering the Realgymnasium in the city. His interest was early aroused in physics, partly by the genius of his teachers in that branch, to whom he acted as an assistant. Upon passing his *Abiturienten* examination in the spring of 1878, he entered the University of Bonn, devoting his attention chiefly to mathematics and natural science. He had as a schoolboy visited the famous observatory at Bonn, and the interest then developed soon led him to turn his attention to astronomy as a career. The traditions of the institution established by Argelander and then directed by Schönfeld doubtless had their full influence upon the young student. He was skilful in the use of instruments and after a couple of years at the

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university took part in the observations of the observatory. He took his Doctor's degree in the spring of 1882, with a thesis which discussed the observations of Algol made by Schönfeld at Mannheim from 1869 to 1875. He had already received the appointment as assistant at the observatory and was assigned to the zone observations with which Dr. Deichmüller was engaged.

At this period came the year of military service, which, contrary to expectation, proved to be of benefit to the health of the young man, who already had some heart trouble. He thereafter returned to his work and made himself valuable as well as personally attractive to Schönfeld and an interesting circle of scientific men at Bonn. The emoluments of his position at the observatory were not such, however, that he could forsee the realization of his hopes of marriage (having been engaged for some years), and he looked for an opportunity for work in the recently established astrophysical observatory at Potsdam under the efficient direction of H. C. Vogel. It was not for a couple of years that a position could be offered him that promised a living and gave hope of future advancement, but, on January 1, 1887, the young Rheinländer entered the service of the astrophysical observatory where for a quarter of a century he was destined to find a full opportunity for the exercise of his marked talents as an investigator and writer. Vogel had been a student in Leipzig of Zöllner, the first German professor of astrophysics, and thus Scheiner's intellectual pedigree in astrophysics runs back to as appropriate a source as it had in Bonn for the older branch of astronomy.

The work in progress at Potsdam was at a very interesting phase: the work on the astrographic chart was just beginning, and many new problems, both instrumental and theoretical, had to be worked out. Vogel was also planning to apply the photographic process to the measurement of stellar velocities in the line of sight, his earlier work by the visual method having convinced him of the prohibitive difficulties of that mode of observation. As the health of Vogel did not permit him to take much part in the actual observations with the new instrument which he had designed and named the spectrograph, Scheiner had an unusual opportunity to collaborate with his chief, and his zeal and skill contributed much to the suc-

cessful outcome of the experiments of the new method. In 1888 and 1889 observations were secured of the 50 brighter stars with the spectrograph attached to the Schroeder refractor of 12 in. (300 mm) aperture. The plates were measured by both Vogel and Scheiner, and the final results were published in Part I of the seventh volume of the *Potsdam Publications* in 1892. Aside from their value for determinations of velocity the spectrograms contained a wealth of information as to their classification, the identification and character of the lines, and their intensities, and precise wave-lengths. This part of the work was assigned to Scheiner by Vogel and appears as the second part of the same volume.

At this time also there was much interest in the observations of the motion in the line of sight of Algol. In the winter of 1888–1889 it was apparent that before a minimum the bright star was moving away from the sun, and toward the sun after a minimum; and plates taken in the following season fully confirmed this, so that a preliminary communication could be made by Vogel and Scheiner to the Berlin Academy on November 28, 1889, of the orbit of the star with an indication of the size and mass of the components.

Scheiner's relations to Vogel became very confidential at this period, and his position corresponded somewhat to that of "assistant to the president" in some of our business corporations. Since Vogel's health could not well undergo the strain of the international conferences, Scheiner was deputed to represent the observatory at the meetings of the delegates of the Astrographic Chart in Paris in 1891, 1896, and 1900. He also attended the meeting in 1909. He also relieved the director of much of the labor of preparing annual reports and generally attended to the numerous scientific visitors who came to Potsdam to learn the methods being introduced in the active institution which was the unquestioned leader in astrophysical work.

Scheiner fully appreciated the eminent services and abilty of Vogel in astrophysics, and Scheiner's work and writings reflected in a marked degree the views of his chief. Scheiner inherited from his father skill in drawing, and shortly after his arrival at Potsdam prepared a valuable set of colored charts exhibiting

Vogel's classification of stellar spectra, and spectra of planets, comets, and nebulae, which were published by a Vienna firm.

Meanwhile Scheiner was also occupied with a work on celestial spectroscopy which the firm of Engelmann of Leipzig (of which one member had been an astronomer) had long desired Vogel to undertake, but which he felt it necessary to decline. The book was *Die Spectralanalyse der Gestirne*, published in the latter part of 1890, with the indorsement of a preface by Vogel, whose views it fully represented. It was received with marked approval by those already interested in celestial spectroscopy and attracted the attention of many others to this branch of astrophysics. It brought to Scheiner considerable reputation as an authority in this field of science. A revised edition in English appeared about four years later and had a considerable sale.

As has been stated, Scheiner was also much occupied in the early nineties with celestial photography and preparations for the astrographic chart. Among the problems was that of reproducing the *reseaux* to be imprinted on the negatives. A method of doing this was worked out by Scheiner and then employed by the French and German instrument-makers. The question of permanency of the sensitive film and of the effect of length of exposure upon the accuracy of the positions were also studied. He investigated the law of the increase of the size of the image with increasing exposure; he also devised a sector sensitometer for testing the speed of plates. He tested the validity of the supposed law of photographic photometry, it=constant, upon which the conference of the Carte du Ciel had based some of its resolutions in 1889, and showed that it was incorrect,[1] and that a two-and-a-half fold increase of exposure caused a gain of nearer half a magnitude than a whole magnitude. He also proposed a simple photographic method for correcting the errors of adjustment of equatorial telescopes.

It should be mentioned that Scheiner was one of the first clearly to recognize what we now call the color-index of a star. In *Astronomische Nachrichten* (**124**, 273, 1890) he published the results of an investigation, "Ueber die Bestimmung von Sterngrössen aus photographischen Aufnahmen," in which he says: "As a result of

[1] He seemed to be unaware that Pickering had previously proved the same thing.

the comparison we may conclude that the differences between photographic and visual magnitudes lie between 1.5 and 2.0 magnitudes for the second spectral type, and certainly exceed 2.5 magnitudes for spectral class IIIa."

The Potsdam photographic refractor having the optical dimensions of the astrographic standard, but with important modifications of the mounting by Repsold to meet the requirements of Vogel, had been set up in 1889, and Dr. Scheiner was occupied with numerous experimental exposures with it. One of the results of this was the measurement (1891) of two negatives of the great cluster in Hercules, Messier 13, from which the positions of 823 stars were determined and the relative magnitudes inferred. The operations are familiar enough nowadays, but it was a new field at that time, and many points had to be worked out from the beginning. It was the writer's great privilege to be associated with Dr. Scheiner in some of this work in 1891 and 1892, and thus to learn to admire the insight and skill of Scheiner at the telescope, in the dark room, and at the measuring machine. In 1894 Scheiner undertook a triangulation of the principal stars (374 in number) and definable points in the Orion nebula, 128 in all, on several photographs taken with the astrographic refractor and with a Voigtländer euryscope. This should serve as a basis for future studies of motions of the nebula and the stars near it. When the routine work of the astrographic chart was begun the duty of its immediate supervision fell to Scheiner, and six large volumes have appeared under his care (I, 1899; VI, 1912), containing the rectangular co-ordinates and approximate places for 1900 of 123,712 stars of the zone from $+31^\circ$ to $+40^\circ$ of declination. The measures of revision and checks were made by Scheiner in many cases, and the scheme of measurement and reduction, described at length in the introduction to the first volume, of course devolved upon him.

The success of *Die Spectralanalyse der Gestirne* led him to undertake the companion volume, *Die Photographie der Gestirne*, which appeared in 1897. It was accompanied by a handsome atlas in heliogravure intended to represent the achievements of celestial photography up to that date. The author's aim, as stated in the preface, was to contribute all in his power to develop celestial

photography into a rigorous and exact science. G. Müller's admirable *Photometrie der Gestirne* completed the series of three works on astrophysics, but in 1899 Scheiner contributed through the same publisher, in a volume of a hundred pages, a monograph entitled *Strahlung und Temperatur der Sonne*. In 1902 Scheiner made observations on the solar constant and temperature of the sun with an Ångström pyrheliometer at the Gorner Grat in Switzerland and at Potsdam, the results of which were published in the eighteenth volume of the *Potsdam Publications*.

After the successful introduction of the spectrographic method of measuring radial velocity of the stars, it was most natural that Vogel should wish to continue that work with a large refractor. His efforts at length obtained the support of the Prussian government, and Scheiner and his colleague Wilsing were occupied in aiding the director in the plans for the new instrument. It was inaugurated with elaborate ceremonies, in the presence of Emperor William, in 1899, and to Scheiner was assigned the part of explaining to the audience some of the details of the great refractor (of 80 cm aperture, with a visual guiding telescope of 50 cm aperture) and of the dome. The high expectations for this splendid instrument, by far the largest in the empire, most unfortunately were not realized, owing to its optical imperfections.[1] The detection of the causes of these defects caused much labor and worry to the director and to the observers assigned to the tests, Messrs. Scheiner, Wilsing, and Hartmann. Unfortunate differences of opinion arose which impaired the close relations between Scheiner and his director, and thereafter executive duties were not often assigned to him. His work with the great telescope was henceforth done in collaboration with his colleague Professor J. Wilsing, with whom his relations were always close.[2] The first investigation, made at the suggestion of Vogel, was a photometric determination of the relative intensities of the three principal lines in the nebular

[1] Successive refiguring has much improved the 80 cm lens, and at this writing we understand that a final retouching has been completed which we may hope will bring it to a satisfactory degree of excellence.

[2] The writer is indebted to Professor Wilsing for a manuscript sketch of the life of his friend Scheiner, upon which much of the present sketch is based.

spectrum. The radial velocities of nine of the brighter gaseous nebulae were next measured visually, the dispersion being supplied by a grating. The results were in good accordance with those made by Keeler visually with the Lick refractor and with some other photographic determinations.

The next important piece of work, and one involving much observational skill, was also done in collaboration with Professor Wilsing and occupies 221 pages of the nineteenth volume of the *Potsdam Publications*, under the title "Temperaturbestimmung von 109 helleren Sternen aus spektralphotometrischen Beobachtungen," 1909. Little or no work had been done in this direction visually since observations were made by Vogel and Müller on a few of the brightest stars about thirty years before. Meanwhile much experimental and theoretical research had been devoted to the black body and the laws of radiation, so that indications could be given of the effective temperature of over 100 stars, many of them as faint as the fourth visual magnitude. To the writer it would seem that the full significance of this important research had not yet been properly appreciated by astronomers, still less by writers of textbooks. It is of the greatest importance to establish that the relation of spectral type and temperature follows the sequence of Vogel's classification, as shown in this extract:

Type	No. of Stars	Temperature ($c=14{,}200$)
Ib	8	11,500°
Ia1	4	11,600
Ia2	22	10,300
Ia3–IIa	16	7,100
IIa	7	5,900
IIa–IIIa	41	4,200
IIIb	7	3,300

Even if the values of the absolute temperature may be subject to a considerable uncertainty, the determination of the relative value is of the highest importance in any theory of stellar evolution. These results of Wilsing and Scheiner (the former did the work of deriving the temperature from their joint observations) have been

confirmed, relatively, by other investigators, whose determinations would seem, however, to be of far less reliability.

The twentieth volume of *Potsdam Publications* (1909) contains another spectral-photometric research by Wilsing and Scheiner, made in part with the large refractor, entitled "Vergleichende spektralphotometrische Beobachtungen am Monde und an Gesteinen nebst Albedobestimmungen an Letzteren."

In the same volume Scheiner published a catalogue of 1564 double stars found in the first four volumes of the *Potsdam Astrographic Catalogue*, with a statistical study of their relative frequency.

In spite of continuous occupation with research Scheiner still found time for more popular writing and for lectures as extraordinarius at Berlin, where his appointment dated from 1894. In 1908 Teubner published Scheiner's *Populäre Astrophysik*, a fully illustrated work of 718 pages, expanded from his Berlin courses on celestial spectroscopy, photometry, and photography. A second edition appeared in 1912. The style is direct, clear, and holds the reader's attention. In a marked degree Scheiner possessed the art of popularizing, and writing seemed very easy to him.

In 1909 appeared in Barth's series known as "Wissen und Konen" a small volume of 187 pages by Scheiner, entitled *Spektralanalytische und photometrische Theorien*. While not popular (it is printed in the Latin instead of the German type, which is the most obvious distinction in Germany between a scientific and a popular presentation of truth), this work was intended for those interested in astrophysics but not specialists in that branch. It serves a useful purpose.

Scheiner wrote frequently for the semipopular magazines and journals, and he contributed to Teubner's series "Aus Natur und Geisteswelt" a small volume entitled *Der Bau des Weltalls* (1900), of which the fourth edition appeared in 1913. He gave public lectures occasionally, once going by invitation to Lyons for the purpose. His achievements were rewarded by certain of the orders or decorations which are highly regarded by the subjects of monarchical forms of government. He was elected an associate of the Royal Astronomical Society in 1901.

Aside from his capacity as a teacher, Scheiner's most marked ability was on the experimental side of research. He was ingenious with apparatus and could quickly devise an experiment for settling a debated point. After it was settled to his own satisfaction, sometimes perhaps on inadequate data, he was persistent in upholding his view, and this led him into occasional controversies, in which he was sometimes in the wrong. But his faculty of interpretation of nature by experiment must be recognized as unusual; the writer would characterize it as insight.

Scheiner was a jovial companion, a capital story-teller, and enjoyed social gatherings with his colleagues and friends. His home life represented the typical German *Familienglück*. He was married in 1888, and in the first years lived in a modest way in one of the observatory houses on the Telegraphenberg. His wife devoted herself to the interests of her husband and their three daughters and during the illness of his last years he thus received the most constant and affectionate attention. He had always been subject to a nervous affection of the heart and as he had early grown too stout for his best health, it became somewhat difficult for him to take the exercise that was good for him. His eyesight was affected a few years ago so that work at the telescope had to be given up. It was a great satisfaction to the writer to find him in the spring in 1913 in better health than he had been for some time past, so that memories of earlier days could be pleasantly recalled. The apparent improvement continued after his annual visit to the Baltic seashore, and he essayed to resume his work at the observatory in the autumn, but a stroke of apoplexy suddenly ended his life at the far too early age of fifty-five years.