Amateur Astronomer

To be called an amateur does not detract from the quality of a man's work or his scientific ability. An accepted meaning of the term implies only that the individual does not receive extensive remuneration from his avocation, but rather earns his livelihood through other channels. Business men frequently turn hobbyists to break the monotony of their regular employment or to follow the urge to do creative work in some field in which they have become interested. Among both amateurs and professionals, the degree of their proficiency may range from mediocrity to excellence, depending among other things upon the seriousness of their purpose and their native ability. David E. Hadden was both serious and able. As a result, in the intensive lifelong pursuit of his hobby, he made a greater contribution to the cause of science than many a man whose science was his bread and butter.

To evaluate the life work of a man whose talents were so versatile as his, is indeed a difficult task. The range of astronomical science is so great that no man can undertake to cover all of it, and so most astronomers concentrate their at-

tention on one or two fields of specialization. Hadden's studies, carried on during the leisure moments of a business career, were mainly devoted to solar phenomena and the variable stars. From these subjects he strayed only on rare occasions, when something startling occurred, such as the appearance of a new comet.

His series of sunspot records were begun in August, 1890, and were continued almost without interruption for more than half a century. Suspecting that there might be a close correlation between sunspot maximum and minimum periods and certain climatological conditions on the earth, he made many careful observations. Fifty years ago such phenomena were little understood. It has been ouly through the studies of such men as Hadden that the effects of the solar disturbances have been interpreted.

Most of his observational work was done in a small observatory erected in his own back yard. His first astronomical instrument was an excellent three-inch telescope made by John S. Brashear of Allegheny, Pennsylvania, which was soon replaced by a four-inch instrument of the same maker. His principal auxiliary apparatus then consisted of a spectroscope containing an excellent Rowland diffraction grating. Afterward, on moving into his new observatory in 1910, he ac-

quired a five-and-one-half-inch telescope mounted equatorially upon an iron pillar-stand which was bolted firmly to the floor of his observing room under the dome.

Installed in this manner, it is said, the instruments were not seriously affected by vibration so as to interfere with observation. All but the severest shocks seemed to be absorbed by the rigid construction of the building. The telescope itself was unusually well equipped for the purpose for which it was intended — solar observation. It was supplied with clockwork mechanism and slow motion drive made by Gaertner and Company, and was also equipped with a special polarizer for solar work. An auxiliary grating spectroscope of special construction, a position micrometer, a camera for photographing sunspots, and other apparatus enabled him to make all the essential observations.

For special purposes Hadden owned a 9½-inch reflector-type telescope. This instrument, which was largely home-made, was fitted with "optical parts by Brashear, consisting of the 9½-inch mirror and a hyperbolical secondary mirror for use when the instrument was used as a Cassegrain, also a diagonal mirror to be used in the usual Newtonian form." The tube was of the open pattern and built up with three-fourths-inch

steel tubing. For convenience, this was kept in reserve in the lower office room of the observatory building. With this instrument, it was possible to view a wider sky field, and many a pleasant evening through the years was enjoyed by visitors and many small groups who were always welcome to come and share his facilities and hear of the wonders of the heavens, simply told in his own inimitable conversational manner. The acquisition of astronomical knowledge under his skillful tutelage was never painful.

One of the greatest truisms is that a man shall be known by his works. It is also true that some men are remembered by what they have written. What a man knows goes with him to the grave, but the knowledge he publishes becomes thus immortalized. Fortunately David Hadden took time in his busy life to write about many of the results gathered from the thousands of observations he made, and from these writings the pattern of his scientific life can be discerned.

Being a typical scientist, most of his written reports were boiled down to the essential details. Much of the information was shown in recapitulatory tables which he frequently employed at the close of his articles. It should be stated, however, that the information contained therein was always adequate. In so far as his writings are concerned,

it might be said that he was a man of few words and these were seldom embellished by rhetoric or superfluous language. His ability as a competent astronomer was widely recognized, and his articles were gladly received by the editors of the scientific journals to which he contributed.

Most of his astronomical notes and longer articles appeared in *Popular Astronomy,* published at the Goodsell Observatory of Carleton College at Northfield, Minnesota. It was perhaps a fortunate coincidence that the first volume of this magazine was issued in 1893 near the beginning of Hadden's work on solar phenomena. Indeed, what appears to be his first contribution on this subject, "Eruptive Solar Prominences", was printed in the second volume of *Popular Astronomy.*

It would be impossible to summarize the contents of all his written works in this brief resumé, but the titles of some of his articles will illustrate his varied interests — "Grating Spectroscope for Small Telescope", "Observations of Variable Star Mira Ceti", "Photographing the Sun" (an outstanding article, with illustrations), "Detonating Meteor", and "Observations of Nova Aquilae". Many of his scientific essays were excellent and have proved to be valuable contributions to the science of astronomy.

By far the greater number of his articles, however, dealt with the "Review of Solar Observations", at Alta, featuring his work on sunspots. This long series of reports commencing in the seventh volume of *Popular Astronomy,* were for a time made annually, but later, as the years passed and the increasing pressure of business encroached more and more upon his time, the intervals between publication became longer.

Gradually, by his consistent efforts, his reputation as an astronomer spread, not only throughout this country but to Europe, until he eventually became recognized as an authority upon solar weather. In 1934, he published what was perhaps his most illuminating article in *Popular Astronomy* on "Some Noteworthy Solar Disturbances Observed at Alta, Iowa, during the Period 1890 to 1929." Probably no better method could be employed to illustrate the depth and quality of his work than to quote liberally from this article.

"The writer has just recently completed a series of sunspot observations extending over a period of forty years and, in the hope that it may interest other amateurs to pursue this fascinating branch of astronomy, he is calling attention in this paper to some of the more noteworthy outbreaks on the sun's surface which he observed during the interval of forty years. . . . The daily detailed

count of the sunspots and the yearly reviews of the observations have been published in various astronomical and other publications from time to time.

"During all this period the observations have been made at the same place, while the writer has been engaged in an active business career and carried on other astronomical and meteorological studies, such as variable star work, observations of numerous comets, meteors, novae, and observed two transits of Mercury besides making two trips to observe total eclipses of the sun, also kept a nearly complete meteorological record of the station. All this is mentioned to indicate what may be accomplished by others who, like himself, find this form of recreation of intense interest and fascination.

"During the forty years four maxima in the sunspot cycle were noted and it is mainly in the year or two closely preceding and following the maximum dates that the largest and most interesting disturbances with associated electrical and magnetic phenomena were observed.

"The years 1891 and 1892 were noted for intense solar activity, auroras were brilliant and frequent; perhaps the largest spot visible on the sun's disc in many decades was seen in February, 1892, its length exceeded 100,000 miles and its surface

area 2,000,000,000 square miles, later in the same year enormous spots were present and were accompanied by some incomparably brilliant manifestations of the aurora; the maximum was reached during the early autumn of 1893 when the sunspot zones were dotted with spots and the climax of the curve was full of groups of tremendous magnitude with immense areas of penumbrae enclosing umbrae of all forms, — helical, wing-shaped, triangular, fimbriated, cruciform, pitcher-shaped, ell-shaped, tassel-like, etc.

"In June, 1894, a remarkable eruptive prominence was observed with the spectroscope; 'spikes' and 'flames,' 70,000 miles high, had in ten minutes nearly subsided leaving the region of the photosphere farther in on the disc violently agitated. The year 1894 was also noted for the persistence of large and very interesting groups, every month witnessed some giant disturbance. Notwithstanding the fact that 1896 was the third year following the maximum, some unusually large spots were observed. It is worthy of note that the descending curve of solar activity is frequently marked by sudden and enormous outbursts of the solar gases or other forms of energy which give rise to the formation and appearance of sunspots; so a great spot which underwent many changes passed across the disc in July,

1896, which had an area of nearly 400,000,000 square miles. . . .

"The next maximum period was in the closing months of 1905, but in 1903 solar observers were greeted with some outbursts of gigantic proportions; a superb group over 135,000 miles long and 39,000 miles wide and embracing an area of over 5,000,000,000 square miles made the transit of the visible disc. This great spot received much attention by the press and public, and the coincident terrestrial electrical and magnetic effects were marked and wide-spread.

"In 1905 during the latter part of January and early February occurred probably the largest single sunspot of the last thirty years. Its length was over 100,000 miles and width 60,000 miles, spectroscopically it was very active, with brilliant reversals and diagonal distortions of the hydrogen and other lines. The period of maximum activity surrounding the 1905 epoch was not so intense or prolonged as the preceding one of 1893.

"The third maximum epoch of the forty years was passed in the fall of 1917, but two years previously — April, 1915, — the forces concerned with the ushering in of the maximum activity began to assert themselves and a giant group in the form of a long train of large spots fully 175,000 miles in length and visible to the naked eye made

the transit of the disc, and later in the summer active regions of the surface were coincident with auroras and earth currents interfering with telegraphic service over the United States.

"On the night of August 26, 1916, the writer witnessed an aurora of surpassing beauty and interest — one of the finest seen in 25 years, — a Boreal crown with colored beams and streamers, double arches and curtains were part of the wonderful display. In this instance it is of interest to note that this aurora occurred when the visible disc was practically free of sunspots.

"The year of actual maximum, 1917, was noted for the presence of large spots almost continuously throughout the year, the ones seen in February, August, and September being of giant magnitudes. The one of August was especially noteworthy for its intricate penumbra containing numerous umbrae and nuclei, and for the auroras which accompanied its transit of the disc. This great group seems to have marked the peak of the 1917 maximum, but again about four years later — in May, 1921, — a wonderful group of the two-spot variety suddenly appeared and was accompanied by widespread disturbances to the telegraph, telephone, and cable lines of Europe and America. The writer's spectroscopic examination of the group on May 15 disclosed great

activity in the hydrogen lines around the vicinity of the spots. Another very active group was visible on March 22, the region surrounding an area of spots on the surface on March 8 being violently agitated.

"The last maximum epoch was probably passed in 1928 and preceding this by two or three years we find the beginning of the oncoming of greatest activity manifesting itself by the decided revival of giant groups and many associated brilliant auroras in 1926 to 1928. Some especially fine streams of spots were visible in late November and early December of 1929, but weather conditions did not permit the writer's detailed study of them."

In almost every period of Iowa history certain individuals who possessed unusual talent have, by the sheer force of their own zeal, accomplished remarkable things. Woodcarvers, ornithologists, musicians, artists, architects, archeologists, and astronomers have made their own particular contributions to the common welfare. David Hadden was such an individual and his life should serve as a pattern for all who have the urge to do creative work of any kind.

BEN HUR WILSON