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BY

BENJAMIN BOSS

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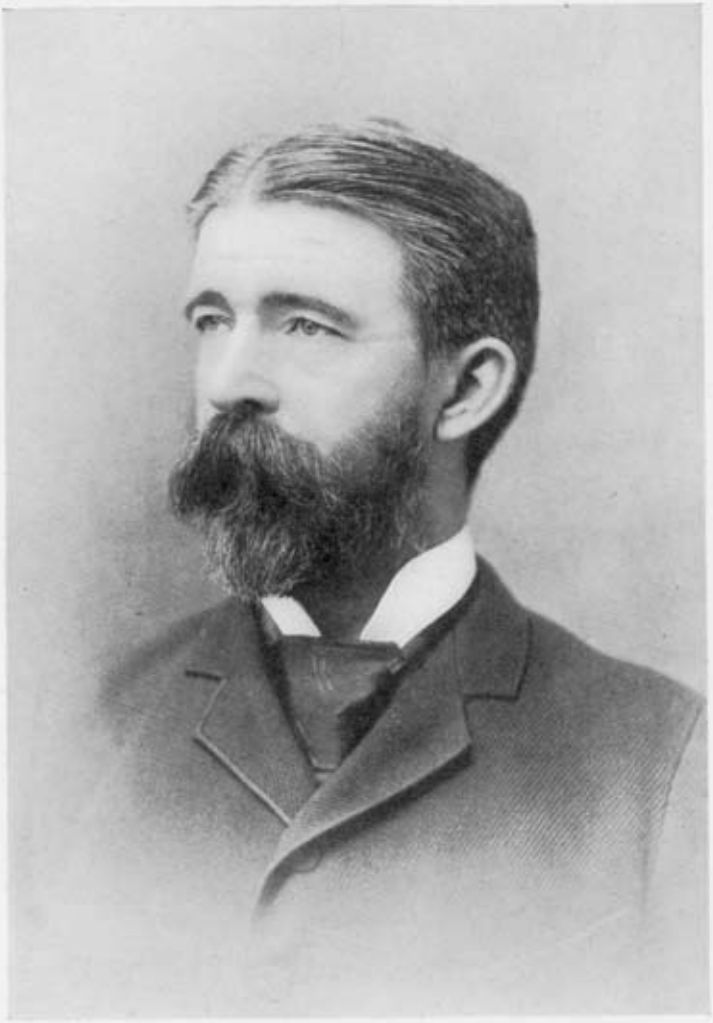

Lewis Boss

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Lewis Boss, astronomer, was born at Providence, R. I., on October 26, 1846, the son of Samuel P. and Lucinda (Joslin) Boss. He died at Albany, N. Y., on October 5, 1912. Though there is no record of scientific forebears, nor any trace of scientific tastes in his brothers and sisters, Lewis Boss evidenced a strong inclination toward a scientific career even in early youth, as was manifested by his keen power of observation and by his desire to prove for himself truths generally accepted without question by the great majority. The habit of accurate representation, so necessary to the scientific man, is attributable to his father and mother, descendants of old New England families.

After a preparatory education at boarding school he entered Dartmouth College in 1866, graduating in 1870. Though his college training was classical, he showed a marked preference for scientific subjects, and this tendency was encouraged by Prof. Charles A. Young, who, at the time, held the chair of mathematics and astronomy at Dartmouth College. Through frequent visits to the college observatory, Professor Boss became acquainted with the manipulation of astronomical instruments and with the methods employed in the reduction of observations.

It was during his leisure hours, and purely as a matter of interest, that he undertook an exhaustive survey of the college grounds. In later years Professor Boss learned that this survey had served as an ideal of attainment for the students of following classes.

At the end of his college course he accepted a clerical position in the Census Office at Washington, and later moved to the Land Office. But he had not renounced the idea of a scientific career. Whenever opportunity offered he visited the

Naval Observatory. There he borrowed a sextant and chronometer and commenced a series of observations which were carefully recorded and reduced. He also investigated the errors of his instrument with great thoroughness. The results, which were of no particular scientific value, were far-reaching.

When in 1872 the U. S. Northern Boundary Commission undertook the survey of the 49th parallel boundary line between Canada and the United States, extending from the Lake of the Woods westward to the Rocky Mountains, application was made to the Naval Observatory for the services of an astronomer to be employed as civilian astronomer on the coming expedition. As there was no one available at the observatory, the commission was advised to examine Professor Boss's work. The neatly kept record of sextant observations, as well as the excellency of the observations, secured him the appointment.

On December 30, 1871, Professor Boss had married Miss Helen M. Hutchinson, of Washington, who, though a bride, consented to the separation, for a large part of several years, necessitated by the new appointment. This spirit of a willing sacrifice of her personal feelings to promote her husband's scientific needs was characteristic of her whole married life and undoubtedly contributed in large measure to her husband's success.

The years of the boundary survey were years of great unrest among the Indians. The expeditions were heavily guarded, and thus escaped attack, though several serious situations arose when it became necessary to arrange for proper defense. Only a year after the last expedition, General Custer and his force were annihilated by the same Indians who on one occasion had threatened to attack the survey party. Many tribulations resulted from the roughness of the virgin territory over which the expedition passed.

It was Professor Boss's duty to first locate the working camps by sextant observations, and then to determine accurate latitudes with the zenith telescope. The survey parties followed, setting boundary marks with reference to the latitude stations.

Not long after the enterprise started Professor Boss, in deriving the latitudes, saw the need of revising the positions

of the published declinations of standard stars. Consequently he undertook to treat the observed declinations of these stars in a manner which should free them, as nearly as possible, from all systematic corrections due to imperfections in the instruments used or to imperfect reductions, finally uniting them in a homogeneous system. The computations for the catalogue were largely accomplished at night, after a hard day in the field, under very adverse conditions. His perseverance and insatiable appetite for hard work, as evidenced in this undertaking, were most characteristic of the man. But, despite his diligence, the catalogue of standard declinations was incomplete when the boundary survey terminated in 1876.

Fortunately the work was not interrupted; for the offer of the directorship of the Dudley Observatory at Albany, N. Y., by its board of trustees, followed the closing of the survey and enabled Professor Boss to complete the work of standardizing declinations.

But the long strain to which he had subjected himself told in the end, and a general breakdown resulted. Perhaps the worst phase of this was the inability to use his eyes. Undaunted, he enlisted the services of his wife, to whom he dictated his thoughts; and thus with her aid the preparation of the introduction to the catalogue was accomplished. The manuscript was reread to him, was corrected and amended where necessary, and finally was sent to the printer.

The completed catalogue of standard declinations was published in 1878 as an appendix to the Report of the U. S. Northern Boundary Commission. Professor Newcomb in his Spherical Astronomy remarked: "The declinations were so thoroughly worked up by Boss that the continued use of the A. G. system of declinations until 1900 is to be regarded as unfortunate." The system was adopted in the American Ephemeris 1883 to 1899. Its publication gave Professor Boss immediate recognition at home and abroad.

A short rest was sufficient to restore the use of his eyes and his bodily strength, so that he was able to accept the invitation of the U. S. Government to join the total solar eclipse expedition at West Las Animas, Colorado, in 1878. The results are published in the Government Report of the Eclipse. In

the report the significant curved rays in the corona, near the poles of the sun, were recognized and described.

Professor Boss accepted the directorship of the Dudley Observatory at the lowest ebb in its history. The new director was chosen in hopes that something might be done to place the institution on the astronomical map. Partly in order to arouse more popular interest in the institution, and partly to fill in during the preparation of a more extensive program, Professor Boss began cometary observations.

But an invitation to join the work of the Astronomische Gesellschaft curtailed the comet work.

In 1878, after correspondence with the Zone-Commission of the Astronomische Gesellschaft, Professor Boss undertook the observation of one of the zones into which the northern sky had been partitioned for a comprehensive scheme of position-measurements, under international co-operation. The project was to secure an accurate determination of position, in duplicate, for every star in the northern sky as bright as the ninth magnitude. Such a star is about one twenty-fifth the brightness of the faintest star visible to the unassisted eye. The sky was divided into eighteen parts, and that assumed by Professor Boss embraced the zone from one to four degrees north of the celestial equator.

When the zone project was inaugurated, there had been vain hopes that all the observations could be begun and completed at approximately the same time. Unfortunately, among the many participating observatories some were unable to complete their allotted portions of the work, so that a few zones had to be reassigned. It was one of the abandoned zones which Professor Boss agreed to observe. His late start made it all the more necessary to push the observations to completion in order to comply with the general scheme.

With customary zeal, though with little assistance, Professor Boss attacked the observations and reductions so vigorously that the observations were completed in about three years from the start; the catalogue was essentially completed in 1886, and was presented for publication in 1887, the first zone to be completed. Because of the slow process of printing, the catalogue was not ready for distribution until 1890. The

observations were not only quickly completed, but proved very accurate, due to the infinite care taken that every source of error should be investigated and eliminated. Altogether there were about twenty thousand observations taken of 8,241 stars.

This was the first astronomical publication containing an extensive contribution of results to emanate from the scientific exertions of the Dudley Observatory.

The successful completion of the work was not solely due to his scientific efforts. The observatory was at a low ebb in its financial history. Consequently, in order to obtain the requisite support for the undertaking, he devised ways and means of procuring additional revenue. This was accomplished partly by raising subscriptions amounting to about $2,700, partly by furnishing time to the city of Albany, and partly by turning into the treasury of the institution his salary as Superintendent of Weights and Measures of the State of New York, a position to which he was appointed in 1883 and which he held continuously until 1906.

The cometary work which Professor Boss wove into his regular work stimulated him to compete for and win a prize presented by Mr. H. H. Warner, of Rochester, for the best essay on the physical nature of comets. It evidenced his interest in the physical development of the science. In later years he often complained that the demands of astrometry upon his time did not allow him the desired amount of leisure to become more familiar with astrophysical problems, though in a spirit of fun he was wont to chaff his astrophysical friends on the general uselessness of their pretty pictures, as he termed their observational photographs.

From September, 1882, to February, 1883, he was occupied with the duty of observing the transit of Venus, December 1882. For this purpose he had been placed in charge of the Government party sent to Santiago, Chile, to observe the transit. The weather was clear on the day of the transit, and the observations were entirely successful. More than 200 photographs of Venus in transit were obtained. Curiously enough, neither Professor Boss nor his scientific assistant, Mr. Miles Rock, were at all familiar with photography, while the two

professional photographers had no experience with celestial photography.

From the very day of landing the Chilian Government extended the greatest care and courtesy to Professor Boss as a representative of the U. S. Government. His equipment was transported free of charge and his party were tendered a private car from Valparaiso to Santiago. The President of Chile placed his box at the theater at the disposal of Professor Boss, and the leading citizens of the capital vied with each other in providing hospitable entertainment. Nevertheless he felt constrained to refuse all entertainment until after the successful conclusion of his enterprise, when he gave himself over to a brilliant train of social functions. In return for the hospitality he had accepted as a representative of the U. S. Government, he gave an elaborate banquet. What was his dismay when on his return to Washington this item was stricken from his expense accounts. At length the matter was amicably adjusted by nominally continuing his services until sufficient salary had accumulated to defray the expenses of the banquet.

During the period of comparative inactivity following upon the completion of the zone catalogue, Professor Boss accepted the position of editor and manager of a daily newspaper, the Albany *Morning Express,* which had sadly run down. Under the stimulus and good business judgment of the new manager, the paper was rebuilt. His editorials were widely read and quoted, especially his editorial on the death of General Grant, which was favorably commented upon by the press of the entire country.

At about the same period he took an active part in politics. He strongly espoused the candidacy of James G. Blaine for President in the campaign of 1884, when Grover Cleveland was elected, though his personal relationship to Mr. Cleveland was most friendly. He also devoted much time and energy to the senatorial campaign of William M. Evarts. Senator Evarts attributed much of the success of his campaign to the efforts of Professor Boss.

The city of Albany celebrated the bicentennial of the city's incorporation in 1886, with much pomp and ceremony. Professor Boss was one of the original committee of twenty-five

appointed by the mayor to carry out the plans of the celebration. He was chairman of the Committee on Historical Pageant and was a member of three other committees. His unremitting labor and great enthusiasm stimulated the whole organization.

The cometary observations, which were taken in a somewhat desultory manner during the prosecution of the zone work, figured notably during the ensuing years and continued to absorb a large part of the labors of the observatory until 1895. The Dudley Observatory became a recognized center for securing early information in relation to comets, to be diffused in this country and in Europe by a bureau of astronomical telegrams. For these years there was rarely a newly discovered comet for which the first orbit was not computed at the Dudley Observatory. These first orbits were usually supplemented by revised calculations made at the observatory and printed in the astronomical periodicals.

In March, 1882, a new comet was discovered by Mr. Charles S. Wells, an assistant of Professor Boss. This comet turned out to be of unusual interest. It was visible for a long time, and was the first to give unmistakable evidence of the presence of sodium in its composition, therein proving that comets are not constituted solely of a narrowly restricted number of purely gaseous elements. Professor Boss prepared a special catalogue of about 500 stars to be used in comparing the positions of this comet.

In the year 1887 and again in 1889 he visited Europe, partly to accompany his family, who remained abroad during that period, and partly to visit European observatories, where he learned much regarding the future plans of astronomers. This enabled him to avoid unnecessary duplication of results in laying out a new program of work.

It will be surprising to many of his contemporaries to learn that the ideas leading to his later efforts had assumed concrete form as early as 1887, and were an outgrowth of the zone work. When the results of measurements upon the positions of about 8,000 telescopic stars had become known, a detailed and critical comparison of these with observations made in the past showed that the faint, telescopic stars participated in

the parallactic effects of the solar motion in space to a degree before unsuspected. With reference to the great mass of faint, telescopic stars a general impression has prevailed that their motions were really so small that no measurable tendencies to systematic motion could be detected through a comparison of the oldest with the latest observations of such stars. Professor Boss's investigations, 1887-9, cleared up that point. They showed that the average star of the ninth magnitude is really much nearer to us than had been generally supposed, although this conclusion was accepted with marked reluctance at the time.

As the zone work neared completion he had already begun preliminary investigations in relation to an undertaking of much more ambitious scope than any in the previous history of the observatory.

The principal feature of the work was to be a critical and independent inquiry in regard to the motions of certain of the so-called fixed stars. The investigation at the time was of fresh interest, since on account of the forbidding character of the great labor involved, very little had been done by astronomers. It was known that certain stars are endowed with motions far exceeding in velocity any which are known in the solar system, but practically nothing was known in regard to the laws of these motions; and since Argelander's time no astronomer had undertaken to gather even the existing evidence in regard to them, which is scattered in hundreds of bulky volumes issued from time to time by the leading observatories. Professor Boss thought that the evidence, which was mostly of a fragmentary nature, should be collated and supplemented by a special investigation through the most refined and searching observation of which astronomical science was capable. Using Professor Boss's words: "Growing out of this problem are numerous others relating to the structure of the universe of worlds which lie beyond the solar system. Upon these problems it is proposed to bring to bear all the light which is afforded by the combined labors of astronomers during the last hundred and fifty years, which constitutes the period of exact researches relating to the stars, and to add as much as may be found practicable with the resources of the Dudley

Observatory. A successful completion of this task as a whole is to be hoped for, but cannot, of course, be promised."

Two great obstacles presented themselves to block the way of progress: First, the considerable financial backing needed for such a large undertaking, and, secondly, the need of better observing conditions than could be secured at the observatory. Unsurmountable as these obstacles must seem to the dispassionate observer, Professor Boss attacked them with characteristic energy and confidence.

The original location of the Dudley Observatory, in close proximity to the four tracks of the New York Central Railroad, proved decidedly inconsistent with the higher uses of astronomical instruments, because of the jar and smoke to which they were subjected. In addition, the room in which the meridian circle telescope was mounted was entirely unsuited for delicate observations on account of its thick masonry walls and its proximity to the main building.

For these and many other reasons Professor Boss suddenly determined, in 1891, to attempt to negotiate provisional arrangements with the city authorities by which an exchange of property between the city of Albany and the observatory might be effected. The proposition was that the city should cede to the observatory a tract of land in the western part of the city and the sum of $15,000 in exchange for the real estate then owned by the observatory.

He approached the trustees of the institution with his proposition and earnestly recommended that efforts be made to secure the removal on the terms proposed. The arrangement, however, could not be consummated without contributions from private sources.

Fortunately, in the spring of 1892, Professor Boss, after a number of conferences with Miss Catherine W. Bruce, of New York city, received from her an offer of $25,000 to increase the permanent endowment of the Dudley Observatory, provided the proposed exchange of property with the city be effected and additional funds be subscribed by other friends of the observatory sufficient to defray the cost of re-establishing the observatory on the new site.

Contributions in excess of the required amount were col-

lected in a surprisingly short interval. Mr. Robert C. Pruyn and Mr. Charles L. Pruyn donated a new equatorial telescope, while Messrs. Dudley, Frederic P., and John Olcott provided means for modernizing the Olcott meridian circle, and for re-establishing it upon the new site in a building of special construction admirably adapted to its purpose. Miss Catherine Bruce added $10,000 to her original donations, in view of the spontaneous reply of the citizens of Albany to meet the requirements of her previous donation.

On November 8, 1893, the observatory was formally opened for inspection, and in honor of the occasion the National Academy of Sciences and many prominent scientific and educational men were present.

Thus the Dudley Observatory, well equipped for its special work, found itself prepared in 1894 to enter upon a renewed career of astronomical activity under greatly improved conditions.

During the interval made necessary for the purpose of arranging a new campaign, the observatory again became active in the observation of comets and minor planets and in computations relating to them. The minute instrumental errors of the telescope to be used were also thoroughly investigated during this period.

Since the financial condition of the observatory did not warrant as extensive a plan of observation as had gradually been crystallizing, Professor Boss, practical to the extreme, was governed by two rules: first, that the program of work should be organized in distinct, successive steps, in such a manner that each should contribute to the problem sufficient in value to warrant the undertaking of it in and for itself; second, that he should not in advance promise to accomplish more than one of these steps. In this way he hoped to escape the charge of undertaking what some might consider manifestly too great a task for his comparatively small resources; and, on the other hand, he had the advantage of working along the lines of a systematic, connected, and cumulative program with all the incentive and inspiration resulting from a lofty aim.

As a preliminary step in this program he began observations upon stars, suspected of sensible motion, in the belt of

sky between 20° and 41° south of the equator, with a view to the more accurate determination of their motions. The field chosen was one practically inaccessible to the principal observatories of Europe, owing to their more northerly latitude. While the computations in the preparation of the catalogue were for the most part finished within a few years after the last observations were taken, the catalogue of 8,276 stars has not yet been published, though it is now (in 1917) going through the press.

Another item contributed toward the contemplated whole was completed in 1898. It dealt with the positions and motions of 289 of the principal stars of the southern hemisphere, and was followed in 1903 with a catalogue giving the positions and motions of 627 principal standard stars. This catalogue was derived through a thorough and painstaking treatment of the systematic errors of catalogues, the corrections of the catalogues for these errors, and the consequent combination of the whole material in a fundamental system.

Meanwhile, the results of many years of study relating to the problems of proper-motion had led Professor Boss to the formation of a manuscript card catalogue comprising about 26,000 stars, selected either because of known or suspected proper-motion. It was his intention to secure observations of all of these stars, to form a catalogue from the observed positions, and then to compare these modern observations with those taken at intervals in the past by many other observers. From a comparison between the ancient and modern positions of a star, its precise direction of motion and the amount of that motion could be determined.

Though appropriations from the Bache Fund of the National Academy of Sciences, together with generous private contributions by the trustees of the Dudley Observatory, had financed his plans thus far, the undertaking of so stupendous a project as the observation and accurate determination of the positions and proper-motions of 26,000 stars would have been impossible had not the Carnegie Institution, in 1903, decided to lend financial aid to the undertaking.

The great demand for preliminary results for some of the brighter stars led to the preparation of a catalogue of 4,300

of the brighter stars whose positions and proper-motions were designed in the first place as a foundation for an exact determination of precession and solar motion, and in the second place as a normal of reference in relation to the stars visible to the unassisted eye. This catalogue in the end grew to include 6,188 stars. The work was, essentially, a collection and mathematical discussion of all the meridian observations of precision that had been made upon the stars visible to the naked eye during the entire history of astronomy, in order to determine the relative motions of each, as well as their positions—past, present, and future—as exactly as they could be calculated from existing measurements.

In this catalogue, entitled the "Preliminary General Catalogue of 6,188 Stars," there is epitomized for each star all that is known of its history as a moving body. It is therefore designed to be and has proved to be a useful work of reference. The catalogue was not completed and printed until 1910.

Even with the aid furnished by the Carnegie Institution of Washington, dating from 1903, and a donation of $25,000 to the Dudley Observatory by Mr. Frederic P. Olcott, the main project seemed too large to accomplish.

It was therefore an immense relief to Professor Boss to receive news in 1906 of the establishment by the Carnegie Institution of Washington of a Department of Meridian Astrometry, whose sole aim was the prosecution of his work under his direction.

In preparation for the observational program the Olcott Meridian Circle was renovated, chiefly through the substitution of newly graduated circles, and the errors of division of the regraduated circles were thoroughly investigated, as were all other instrumental corrections.

In 1907 the observations of the big list of 26,000 stars were begun, and for two years this work was continued at Albany.

As the completion of the plan necessitated the observation of those stars in the southern hemisphere not accessible from Albany, an expedition was launched on August 20, 1908, to establish an observatory in the southern hemisphere. The new branch observatory was located at San Luis, Argentina, about 500 miles west of Buenos Aires, on the lower plateau of

the Andes. The expedition was equipped with the same instruments used at Albany and was manned principally by the same staff employed at Albany. Professor R. H. Tucker, of the Lick Observatory, was placed in charge of the station. The expedition was so well planned that within two days after the arrival in San Luis building operations were under way.

Messrs. Tucker and Varnum were left in San Luis to carry on the building operations, and Professor Boss sailed from Buenos Aires October 10, 1908, on the return trip. He was shipwrecked on a dark night at the southern end of San Sebastião Island. The consequent wetting, exposure, and want of food for two days left him apparently unaffected.

With his usual thoroughness he made necessary instrumental investigations before dismounting the equipment at Albany prior to shipment to San Luis. Undaunted by the shipwreck experienced on the recent homeward voyage, he sailed with the second section of the expedition on January 20, 1909, and remained at San Luis until the instruments were in working order and their errors once more determined as a test of their escape from injury. Satisfied that no sensible harm had befallen the equipment during transportation, he sailed for Europe to attend the meetings of the Astrographic Chart Congress at Paris in 1909.

The staff at the branch observatory at San Luis commenced observing in March, 1909, at the unprecedented rate of about 60,000 observations per year. Upon the completion of the work, in January, 1911, the instruments were promptly dismounted, carefully packed, and shipped to Albany, where they arrived in April, 1911. Subsequent investigation proved that the equipment had once more escaped injury in transportation. It was again set up in Albany and employed upon observation of the stars accessible from that latitude.

Meanwhile, Professor Boss had attended the Astrographic Congress at Paris, and with part of his family had made an extensive tour of Europe, visiting the principal observatories. Upon his return to Albany and in connection with consultations with other members of the committee on proposed fundamental observations desired by the Paris Congress of April, 1909, he prepared a "List of 1,059 Standard Stars for 1910."

The purpose of the catalogue was to furnish a list of standard stars homogeneous in character, whose places and proper-motions could be materially strengthened by further observation.

The Preliminary General Catalogue already referred to was published in 1910. It was expected that its chief value would be found in throwing a clearer light upon the structure and operations of the universe of stars, including the motion of the sun in space. Partly before its appearance and partly after that time, a thorough study was made of the solar motion and those problems related to such a discussion. These investigations were published in a series of papers in the *Astronomical Journal.* The last part of the series deals with the systematic motions of the stars arranged according to spectral types, and as our present ideas would seem to indicate that change of spectral type takes place as a result of a change in the age of the stars, a treatment of the motions of stars arranged according to type corresponds to a treatment of their motions with reference to the age of the stars. This investigation yielded many interesting results.

It confirmed the investigations of Prof. W. W. Campbell derived from the radial velocities of the stars, that with the progression of spectral types the star's motion is apparently accelerated, very rapidly at first, and then gradually, until in the later types the average speed of the stars is practically uniform.

It was demonstrated that the actual linear velocity of the class of stars designated A rapidly increases with the distance of the star from the Milky Way.

The paper in general was a remarkable treatise on some of the peculiarities in the structure of the sidereal universe and an admirable justification of the stand taken by Professor Boss that studies based upon the old astronomy were destined to throw as much light upon the problems of the sidereal structure as those based upon the new astronomy. It was also a justification of the task he had been foresighted enough to undertake.

A further paper dealing with the direction and relative distribution of stellar velocities has not been published. It indicates that while the distribution of the velocities in direction seems to be virtually at random, the linear velocities in the

general direction of the constellation Orion bear to the linear velocities at right angles to this direction the ratio of 7 to 4.

Professor Boss contributed many small articles in addition to his larger publications. While ordinarily his work was of the non-spectacular type, his discovery of a large stream of stars in the constellation Taurus excited universal attention. The members of this group were found to be moving through space at a uniform velocity in practically parallel paths.

Late in the year 1909 the editor of the *Astronomical Journal*, Dr. S. C. Chandler, a warm personal friend of Professor Boss, transferred the editorship of the paper to him. The *Astronomical Journal* was founded by Dr. B. A. Gould in 1856, to serve as a scientific organ of astronomy in the United States. Professor Boss manifested a keen interest in the publication, not only because of its relation to American astrometry, but because it became a matter of pride with him to restore to its original flourishing condition a journal supported and successively edited by two intimate astronomical associates.

Professor Boss was an extremely hard and tireless worker, whether in the interest of his chosen work or when engaged upon outside projects. Every body of men with whom he was associated became aware of the force of his personality and his keenness of vision. He had a perfect fatality in putting his finger on the weak point of any proposition. On the other hand his constructive reasoning proved of immense value to his associates. These characteristics bore an important relation to his work and to his attitude toward the members of his staff; for he was never content to implicitly trust his associates with the conduct of any department of his work, but must personally supervise even the small details, though it increased his burdens many fold. Thus he held in his fingers all the loose ends and wove them into a carefully thought-out pattern.

Naturally such strict supervision was not calculated to bring out the originality of his associates, but they did acquire an insight into the problems presented and an enthusiasm for the work which materially aided its accomplishment. While intolerant of the sluggard or the failure, he was very patient with those who were struggling for a footing. He was at his best

in the company of keen minds. To others he was quite unresponsive.

Commenting editorially on the death of Professor Boss, The Albany *Evening Journal* of October 5, 1912, said in part: "Though devoted to his science, he did not live aloof from his fellow-citizens, but always took a keen interest in matters affecting the welfare of the city. Being of thoroughly kindly disposition, he was beloved as well as esteemed by all who in the course of many years had come to know him. He became great as a scientist; he was good as a man. He will be sadly missed by those who enjoyed his friendship, and those who read of his doings that won him fame will regret that henceforth his name will be only a memory. To the world of science and to this community in particular his death is a loss that will be keenly felt."

Toward the end of his career the disregard of his physical self told, and gradually the exhausted system grew weaker and weaker, though the mental activity continued. About two years before his death his general condition became more serious. A series of attacks of varied nature assailed him, yet through it all he clung to the hope that he would soon recover sufficiently to complete the great undertaking which practically amounted to a life's effort.

While it was not granted to him to bring this work to completion, it is pleasant to recall that he carried it far enough to obtain a very fair idea of the benefits to be derived from it, and to foresee the trend of astronomical research for the coming century or two. He was a pioneer in the new developments.

Professor Boss received the gold medal of the Royal Astronomical Society, London, in 1905, and the Lalande prize of the Paris Academy of Sciences in 1911. He was elected a member of the National Academy of Sciences, the American Philosophical Society, the Astronomische Gesellschaft, and the American Academy of Arts and Sciences; foreign associate of the Royal Astronomical Society; corresponding member of the British Association for the Advancement of Science, the Prussian Academy, and the St. Petersburg Academy. He received the honorary degree of A. M., Dartmouth, 1877;

LL. D., Union, 1902; Sc. D., Syracuse, 1910; Sc. D., Dartmouth, 1912.

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