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ART. XV.—*Friedrich Georg Wilhelm Struve.**

FRIEDRICH GEORG WILHELM STRUVE was born at Altona, in the Duchy of Holstein, April 15, 1793; his father, Jacob Struve, for forty years filled with great distinction the directorship of the High School in that city, and was widely known for his classical and mathematical acquirements. His mother was the daughter of Pastor Stinde, who went to Russia as chaplain to Peter III; it was this circumstance which subsequently led to the settlement of many of the Struve family in Russia; until then the Struves had from time immemorial lived as respectable yeomen in the Duchy of Holstein. Thus our old and honored associate was descended from the original stock of the Anglo-Saxon race; a descent which many of us remember distinctly expressed itself both in the personal appearance and in the moral qualities of the man. Struve was happily trained by his father into no precocity in his early childhood, but in due time, when removed to the High School, he made such advancement in his studies as at the age of fifteen to be qualified for entrance at the University. In those days of trouble the young student had but little prospect of continuing his studies undisturbed. A constant sense of the oppression of the foreigner and the dread of the French conscription decided his parents, in 1808, to send young Wilhelm to Russia, at that time probably the quietest country in the world, and where his elder brother Carl occupied the post of Classical Lecturer in the University of Dorpat. This university, so soon to be illuminated by the ex-

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ample and fame of Wilhelm Struve, had been recently founded by Alexander I, immediately after his accession to the throne, and was intended by him not only to be the intellectual center of the German Provinces of Russia, but to serve as a civilizing link between Europe and Russia proper. Here Wilhelm Struve, in accordance with his father's wishes, applied himself exclusively to classical subjects, and it was in this branch of learning that the young student earned his first literary laurels, by an academical exercise "De systemate metrico apud Alexandrinos;" this essay was honored by a prize, and by being printed at the University expense. It was by this wise and fortunate arrangement of his studies that Wilhelm Struve acquired the power of fluently and accurately expressing himself in the Latin language, thereby enabling him, at a subsequent period, to communicate the results of his researches to men of science living in other parts of Europe, where Struve's native tongue, the German, was at that time but little understood. These early literary pursuits also contributed, in no slight degree, to secure that balance and breadth of mind for which our lamented associate was afterward so remarkable.

In 1811 Struve took his first university degree in Philology, and it was only after having thus fulfilled his father's desire that he passed to that branch of science which henceforth became the principal object of his life. No doubt, while he was a student at Dorpat, the able scientific lectures of the elder Parrot excited a warm interest in his mind; but it was rather an inner call than any external circumstance which led Struve at length to devote himself to astronomy. Parrot's influence was not confined to the mental stimulus thus afforded to his young philosophic pupil, but by the representations which he made to the University authorities relative to young Struve's promise of future eminence, and his present straightened pecuniary resources, he obtained for him the means of still longer prosecuting his studies at Dorpat. It was partly in this way that Struve from the early age of fifteen ceased to be a burden upon the scanty fortune of his father; but the boy's own exertions and self-denial contributed greatly to the same end. It was brought about in this way. Shortly after Wilhelm Struve had entered the University, he applied for and obtained the post of private tutor in the family of Mr. de Berg, a wealthy nobleman of Livland, and his first pupil there was the Count de Berg, the present Viceroy of Poland. By this arrangement the young student was necessarily debarred from a regular attendance on the lectures of the place; but this untoward necessity served, as was natural with one of Struve's mind, only still further to quicken his zeal to make the best of such advantages as remained to him, and to animate his self-reliance.

In 1811, while thus engaged, partly in attendance on the family of the De Bergs, and partly in the prosecution of his own studies at Dorpat, Struve passed on to the class of Astronomy. The Professor at that day was Huth, a man for whose worth and eminent attainments our old associate ever retained an affectionate and respectful memory. Huth's health was too infirm to permit him to assist his pupil to any great extent, and hence young Struve was, by a happy fatality, or in truer words by the discipline of Providence, once more thrown upon self-reliance and the resources of his own efforts. The Professor himself was scarcely ever able to visit the Observatory, but he permitted his pupil to make what use of it he could. This Observatory was at that time but scantily supplied with instruments, and even those for the most part were not in a condition for actual use. Among these instruments was a Transit by our countryman Dolland, and the excellence of the object-glass attracted the special notice of the embryo astronomer. The pillars of this instrument were, it is true, erected, but upon them there was no provision existing for the attachment of the Y's and the other subsidiary apparatus, while the body of the instrument itself had never been removed from the case in which it had been packed. For the mounting of this instrument young Struve could obtain no adequate assistance in the city of Dorpat, but was thrown entirely on the workmanship of his own hands, and the guidance of his own inexperienced judgment. Nevertheless, the work was done, and well done; and in after days Struve would often recur to the fortunate difficulties under which his earliest efforts were made. We must not forget that Struve at this time was only in his nineteenth year.

Early in the autumn of 1813 Struve took his degree of Doctor of Philosophy, and on that occasion wrote his first memoir on an astronomical subject, namely, *De geographica Speculæ Dorpatensis Positione.* In this paper, among other matters, he gave the first determination of the longitude of that Observatory, deduced from occultations observed by himself during the preceding year. In November, 1813, a few weeks after this thesis, he was appointed extraordinary Professor of Mathematics and Astronomy, and two years later, upon the death of Huth, he was advanced to the ordinary professorship. In this capacity his duty was not only to attend to the Observatory, but to lecture also on Astronomy and the higher branches of Mathematics; each subject no doubt suffering from this combination of duties, notwithstanding the efforts of the Professor to prevent it. In 1822, nowever, the two offices were happily separated, and Struve was henceforth enabled to devote his zeal and his abilities exclusively to the proper work of an Observatory.

Having thus arrived at that point in our venerated associate's career when he was appointed the chief of an Observatory, soon to be rendered by his labors famous to all time, we may for a few moments not improperly revert to the circumstances which years before, indicated the bent of his mind, and, in a certain degree, shaped the after-course of his life. In August, 1811, young Wilhelm Struve, while yet a student, and with extremely slender means at his disposal, verified the orbital motion of the two components of *Castor*, predicted by the elder Herschel in his immortal memoir of 1803, and which by this time was completed to the extent of thirty degrees. This first success had a decided influence in directing Struve's mind to the abundant harvest which he foresaw might be reaped from a zealous devotion to Sidereal Astronomy. Nearly at the same time, while spending the summer at Sagnitz, in the house of his friend, Mr. de Berg, Struve's attention was drawn to Geodesy; and the early success which here again attended his first attempts, laid the foundation for that other gigantic work upon which, together with his labors in sidereal astronomy, rest the fame and the scientific services of this great observer. Although provided with the feeblest conceivable instrumental means, he made excursions in the neighborhood of his friend's house, in order to see if it were possible to make a triangulation of that part of Livland. While practising himself in the use of the sextant, for that purpose, a singular accident befell him, and for some time put a stop to his geodetical studies. The French army at this time was invading the Russian frontier, and against it a Russian corps had been despatched to Livland in order to prevent the French army from penetrating through the Baltic provinces to St. Petersburg. Some officers of this corps seeing young Struve engaged with an instrument and a note-book, mistook him for a French spy, and, notwithstanding his protestations, marched him off, for full a hundred miles, as a prisoner to head quarters, and there, not without some difficulty, he was liberated by the commander-in-chief, on the express understanding that as long as the war continued he would not again, by similar pursuits, expose himself to suspicion. Three years after this occurrence, Struve, at the invitation of the Economical Society of Livland, undertook to make a triangulation and map of the entire province; and this work he accomplished with great ability, although he had no instrumental means at his disposal beyond an excellent 10-inch sextant, by Troughton. This work, thus commenced with a comparatively insufficient instrument, forms the starting-point and the nucleus of that noble survey of the Russian empire, which for nearly half a century occupied the thoughts and the abilities of our lamented associate.

From 1813 to 1839 Struve continued at his post at the Observatory of Dorpat. As we have already seen, the means at his disposal were wholly inadequate to the most modest requirements of an astronomer. It was not long, however, before the success of his labors attracted the attention of the Russian government, and through the benevolent intercession of Prince Lieven, then Chancellor of the University, and as an acknowledgment of the services of the professor, the Observatory was furnished with such instruments and pecuniary means as soon raised it to the rank of a first-rate establishment. Thus, in 1821, the Meridian Circle was obtained from Reichenbach and Ertel, and in 1824, Fraunhofer's famous 9-inch Refractor was added, at once the masterpiece of that great artist, and the commencement of a new era in the history and employment of the telescope.

Struve at first worked alone in the Observatory thus munificently furnished; occasionally, indeed, he was assisted by a few volunteers from among his pupils, and notably so by *Knorre*, who subsequently and for forty years, was the well-known director of the observatory of Nicolaiff; but it was not until the year 1826 that he obtained, in the person of M. Preuss, a permanent observer, who by applying himself with much ability to the meridian circle, enabled Struve to devote his attention to the observation of double stars with the great refractor.

In taking even a cursory survey of Struve's labors at Dorpat with this noble instrument, it becomes necessary to revert, in some degree, to the state of sidereal astronomy before he commenced his work. In 1803, Sir William Herschel had announced the binary nature of several of the double stars; nevertheless, partly from the extreme novelty of the views set forth by that great philosopher, partly from the deficiency of the optical means then existing, and partly from the great difficulty of manipulating the micrometrical measurements, the subject remained in abeyance and almost untouched during the succeeding fifteen or sixteen years. In 1816, Sir John Herschel did, however, commence at Slough a review of his father's double stars, but owing to some of the difficulties already alluded to, he made but inconsiderable progress. Some of these measurements so taken are recorded in the joint communications made by Sir John Herschel and his colleague, Sir James South, to the Royal Society in 1824: among others will be found a remarkable measurement of *Castor*, when the two component stars happened to be on the same parallel. We have already adverted to the then young Struve's measurement of the same remarkable star, and to the effect which it had on the direction of his energies: this, however, was but a single and isolated result, and it was not until some years later, namely, in 1819, that the record of measured angles of position

and distance began to be at all consecutive at Dorpat, though differences of right ascension and declination had been pretty copiously observed. In 1820 appeared Struve's first Catalogue of 727 double stars, arranged in the order of their right ascension, together with their corresponding declinations. This Catalogue was expressly intended to facilitate the observation of these objects, either with meridian or with equatorially-mounted instruments, and effectually revived the subject as one of general astronomical interest.

Nevertheless, praiseworthy and valuable as were these new attempts, it was not until the erection of the great Fraunhofer Refractor in 1824, at Dorpat, that Mr. Struve became possessed of an instrument worthy of the subject, and competent, not only to afford facility and precision in respect of measurement, but to add largely to the list of known double stars.

The result of the first two years of his observations with this famous telescope was that most remarkable work, *Catalogus novus generalis Stellarum duplicium et multiplicium*, which appeared in 1827, and will for ever be considered as forming a memorable epoch in Sidereal Astronomy. Nor is this great work remarkable alone for its copious and valuable lists of 3112 double or multiple stars duly arranged in their order of right ascension, and 2343 of which had not been previously described by any astronomer, but still more so for a great physical fact which it announced for the first time. In this catalogue it is shown that the closer classes of double stars, namely, those whose mutual distance is less than 4″ exceed out of all proportion, not only what might be expected from a calculation of chances on the hypothesis of casual or optical juxtaposition, but even in point of numerical majority, those of either of the other classes. The existence of such a fact affords, in the opinion of those competent to form it, a convincing proof of a real physical connexion, and (independently of any question as to orbital motion) places these juxtaposed objects before us, neither as casualties of situation as seen from the earth, nor as mere exceptions to a more general rule of isolation, nor as mere *curiosities* of the sidereal heavens, but as entering largely into the general plan and constitution of the universe. Later observations, carried on both by Mr. Struve himself and by others, with even larger instruments than the great Dorpat refractor, have confirmed this most notable result, and have shown that it is but an ordinary circumstance to find stars previously regarded as single, to be in reality composed of two *very close* individuals. It will enhance our respect for the memory of our lamented associate, and enable us to form some idea of the labor and devotion required for the formation of this catalogue, to remark that in the preface to the Petersburg Catalogue it is stated to have been the result of the

examination of 120,000 stars, and that it was one individual who executed this examination with his own eyes and hands.

The formation of this Catalogue was, after all, the commencement only of a work of far greater labor in this department of astronomy. Struve's next undertaking was the determination of the angles of position, distances, magnitudes, and colors of all the objects therein enumerated, together with their exact right ascension and declinations, each resulting from several nights' observation. The results of this immense undertaking he published in the year 1837 in a magnificent work entitled, *Stellarum compositarum mensuræ micrometricæ*, followed, in 1852, by another work, bearing the title, *Stellarum fixarum, imprimis duplicium et multiplicium, Positiones mediæ*, with their proper motions computed when practical from earlier observations.

Another branch of what, with some propriety, may be called the *Physique du Ciel sidéral*, to which Struve directed much of his attention, was the determination of the *law of density* in the distribution of the stars with respect to the plane of the Milky Way. His researches on this subject were not indeed published until after he had removed from Dorpat, as we shall speedily see, but it is here, perhaps, that we can with greatest convenience refer to the fact. The great work which contains the result of his labors, is entitled *Etudes d'Astronomie Stellaire*, published in the year 1847. By a series of calculations, founded on the number and distribution of stars of sufficient lustre to admit of being individually catalogued, as well as by the star-gauges of Sir W. Herschel subjected to a careful and systematic analysis, he has in this work clearly shown that in the northern hemisphere at least, (northern, that is, when referred to the bisection of the heavens by the Milky Way) the distribution of the stars exhibits a distinct and unequivocal relation to their angular distance from the plane of that sidereal ecliptic. Nor is this view wanting in confirmation. In the same year that Struve published his researches on this great problem, Sir John Herschel gave also the results of his own investigations of the *southern* hemisphere, and the numerical expression obtained by him for the gradation of stellar density is singularly coincident with that resulting from Struve's investigations of the northern heavens. As the two results were obtained from observations made with telescopes strictly comparable, and were each arrived at independently and without the knowledge of the other, it seems that this great physical generalization may be regarded as perfectly established.

Such are some of the great results which form the high rewards of Struve's loyalty to his duties at Dorpat. The year 1833 brought a great change in his life. In the autumn of that year the Emperor Nicholas resolved to erect a great central observatory for the empire of Russia; it is honorable to the

Czar's memory to record that the suggestion was wholly spontaneous, and we feel no surprise that our associate was a most influential member of the commission entrusted with the execution of the Emperor's noble design. The prosecution of this work occupied much of Struve's attention, and necessarily compelled frequent and long visits to the capital, until the spring of 1839, when the building having been completed, Struve took up his permanent residence at Pulkowa as director in chief of the Central Observatory of Russia.

The creation of an Observatory to be, from its commencement, established for well-defined and specific purposes, distinctly set forth in a formal document; and without restriction in cost, to be furnished with instruments constructed by the ablest artists who were at the same time encouraged to new efforts, the observatory and its ample staff being, at the same time, munificently endowed with pecuniary means and all other requisite appliances, is a circumstance unique in the history of science. Nor could this magnificent plan have been successfully executed, had not the man been at hand qualified by nature and experience to organize and direct so difficult an undertaking. It is unnecessary here to describe at any length the Observatory of Pulkowa, but it would be wrong not to refer to the judicious plan of observation which Struve proposed to follow, so as best to realize the generous intentions of its imperial founder. Fully aware of the incomparable value of the Greenwich lunar and planetary observations, and of its traditions in other respects, Struve determined, from the first, to adopt a course wholly different from that followed at our National Observatory. Hence, observations of the moon and planets were to be made on exceptional occasions only, the main strength and efforts of the Observatory being directed to the astronomy and physics of the sidereal heavens. It was proposed, also, not to publish an annual volume of observations, but, after having organized systems of specific research, often of necessity extending through several years, to give the results to the world only when each project was completed, and then with the name of the particular observer attached. How well this plan has been executed the records and scientific memoirs which have proceeded from Pulkowa sufficiently attest. And, lastly, it will not be without its interest to record that, in 1844, when Struve published his elaborate description of Pulkowa, there were no less than 103 persons, including the children, domiciled within the precincts of the Observatory. This numerous family comprised seven astronomers, several *savans* connected with the geodesy of the empire, a secretary, an engineer-in-chief, a cabinet-maker, with ten artisans for the repair of the instruments and the furniture, and eight discharged non-commissioned officers for the service of the

place. Assuredly it was no ordinary man who could secure, as Struve secured, order and good-will in so considerable and multifarious an establishment. For the endowment of this noble institution the Emperor of Russia, with truly imperial generosity, assigned no. less a sum than ten thousand pounds per annum. The servant was worthy of the master.

Meanwhile, and for nearly half a century, extending almost throughout our venerated associate's directorships both at Dorpat and at Pulkowa, run continuously the gigantic operations connected with the measurement of the Russian and Scandinavian Arc of Meridian, and the Trigonometrical Survey of the enormous Russian empire. The genius of Struve presided over this vast undertaking, ever devising, co-operating, and not seldom working with his own hands and eyes, and on more than one occasion amidst ice and snow. This arc of meridian, extending through 25° 20′, from Ismail at the mouths of the Danube to Fuglenæs on the Arctic Ocean, exceeds in magnitude even our own Indian arc, from Cape Comorin to the Himalayas, the execution of which alone, and with no other work, has been sufficient to raise the fame and exhaust the labors of Lambton and Everest.

Some idea may be formed of the amount and variety of Struve's occupations at this time from the following quotation from his great work on the subject of this very arc. Speaking of that portion which runs through Livland, he says:—"Undoubtedly I could have completed this work long before, had it been the sole object of my scientific duties; but, in 1821, Reichenbach's meridian circle arrived at Dorpat, and at length, in 1824, I was put in possession of Fraunhofer's magnificent equatorial, ordered since 1820, and I thought that my first duties pointed to the immediate use of these exquisite instruments. Hence, I did not consider myself authorized to absent myself from Dorpat for more than a few weeks' work at a time in geodetical proceedings. And I think that I ought here to explain, that between 1821 and 1827 (which period embraces the field-work of the Baltic arc), I made, reduced, and published without any assistance, the meridian observations recorded in volumes III, IV, V, VI, of the Dorpat Annals; at the same time I also finished the revision of the survey of the heavens, which furnished the *Catalogus novus Stellarum duplicium*, published in 1827; and besides this I had to give an annual course of lectures on Astronomy to the University, and of Geodesy to the Imperial staff."

Such labors, great as they were, are not now referred to as being by any means without their parallel among scientific men; on the contrary, they form the rule rather than the exception; but they are mentioned here because they may well serve to remind us, that such is the cost at which our knowledge is

advanced, and for which alone the world accords imperishable fame to her sons.

Struve visited England on four different occasions. The first time was in 1830, when it so happened, that a committee was sitting for the improvement of the *Nautical Almanac;* he was invited to assist in its deliberations, and by his ability and excellent temper contributed toward bringing its labors to a successful conclusion. In 1844 he came to England for the purpose of determining the difference of longitude between the Observatories of Pulkowa and Greenwich. A step had already been taken toward the completion of that important but difficult operation, by ascertaining, in 1843, the difference of longitude between Pulkowa and Altona. In those days,—it may seem strange indeed, that we naturally fall into such expressions while speaking of but twenty years ago, but the amazing advances, which, during that short interval, have been made in the application of science to art, justify the terms—in those days, the only known method existing for the exact determination of differences of longitude between two geographical positions, was by the repeated transmission of many chronometers from one place to the other. Hence, it was necessary for Struve to organize, and personally superintend, a series of chronometric expeditions, first between Pulkowa and Altona, and then between Altona and Greenwich. In the former expedition not less than sixty-eight chronometers were sixteen times carried across the Baltic; and in the latter, forty-two chronometers passed sixteen times over the German Ocean and the Thames. In the present day, owing to the combined labors of Oersted and Wheatstone,[1] all this tedious and cumbersome operation is replaced by the mere automatic action of the clock itself, whereby a series of metallic contacts are made, conveying the precise time, to the small fraction of a second, through the electric wire to an observer waiting in quietness for the expected signals at some distant place. All honor be to Struve, and to others like him, who, toiling along rivers and seas, and without our wonderful appliances, by patient genius obtained results comparable in accuracy with our own.[2] Nor may we here omit the mention of an incident which exhibits in a characteristic manner the true greatness of Struve's mind. After he had successfully completed the very troublesome operation before alluded to, and when it had become necessary to arrange and publish the result, for geographical and other purposes, the question arose, shall the astronomical prece-

[1] Some American names are here omitted.—Eds. J. Sci.

[2] In 1844 the Astronomer Royal determined the longitude of Valentia, in the west of Ireland, to be 41m. 9s·67 W., by means of ten transits of thirty pocket chronometers to and fro. In 1862 the longitude of the same place was re-determined by galvanic signals given by the clock itself, and the final result was 41m. 9s·81 W.]—*Mem. R. Ast. Soc.*, vol. xxxii.

dence attached to the *first meridian of longitude* be assigned to Pulkowa or to Greenwich? There could be no doubt that Struve's heart was in Russia, rather than in England, and we have already seen how in external magnificence Pulkowa utterly eclipsed the unpretending buildings at Greenwich; but Struve, like a true astronomer, remembered the long line of illustrious men who had toiled at Greenwich, the old traditions of Flamsteed, and Halley, and Bradley, and to Greenwich he assigned the astronomical precedence.

Struve was in this country again in 1847. This time, the main object of his visit was to carry back with him to Russia one of the two standard bars used in the great Indian Survey, and without which it was impossible to utilize and connect the measurement of the Indian arc, with that of the still greater Russian and Scandinavian arc just completed. On this occasion, he joined the British Association, which that year fortunately assembled at Oxford, and it was thus that Struve either acquired or consolidated that strong personal regard which united him, in a peculiar degree, with the principal scientific men of England in almost every branch. Perhaps it may be allowable for the writer to record that his first acquaintance with this most amiable man was made at this period when, at the house of Sir John Herschel, and not long after the memorable discovery of *Neptune*, he, for a few days, was permitted to associate with a phalanx of scientific veterans rarely assembled in one spot,—Adams, Airy, Herschel, Leverrier, and Struve, forming the list.

Ten years later, viz. 1857, found Struve in England for the last time. He had never failed in public documents and in private communications to speak in affectionate terms of the ready aid and hospitality which he had received at the hands of the present Astronomer Royal, Mr. Airy. His headquarters were, therefore, again as of old, at Greenwich. But now, though in his sixty-fourth year, the indomitable energy and the genius of work in the man brought him thither on a project of still greater magnitude than the arc of meridian which he had just completed. In early youth, while honorably supporting himself in Livland as tutor in the family of the De Bergs, he had cast a wistful eye over the level tracts which north and south, east and west, are a characteristic feature of European Russia. Our great countryman, Dr. Arnold, used to say, with but slight exaggeration, that there was scarcely a hill between Rugby and the Ural mountains to shelter him from the east wind. Arnold observed this with the eye of a geographer; Struve knew it, and utilized it as an astronomer.[3] No sooner then was the Russian and Scandinavian

[3] Struve remarks that, along the arc between the mouths of the Danube and the Arctic Sea, there is no hill 1200 feet high. Over a great portion of it the country is so level and wooded that it was often necessary to erect lofty scaffolds in order to see the necessary signals.

arc from north to south completed, than Struve set to work to organize and arrange the measurement of an arc of parallel from east to west, of still more gigantic dimensions. He proposed to extend it throughout the entire breath of Europe; from Orsk, at the foot of the Ural Mountains, to Valentia, at the western extremity of Ireland, ranging over perhaps a twelfth part of the equatorial circumference of the earth. The operations for measuring this arc would necessarily lie in many lands; and, perhaps, this man of no jealousies was, if not the only man, at least the one best fitted to negotiate with the various governments, and men in high office, both in state and science, without whose concurrence and aid the execution of the vast project was impossible. The Emperor of the French and other state officials received Struve with especial distinction. It was to arrange for the prosecution of that portion of the arc of parallel which lies in England and Ireland, and also of that part which connects England with Belgium, that Struve now came to Greenwich. In this country he was warmly seconded by our own government, by Mr. Airy, Colonel Sir Henry James, Captain Clarke, and other *savans* connected with the geodesy of Great Britain. It is sometimes accorded by a divine providence, wiser than ourselves, that a man at the age of sixty-four may arrange and even commence so vast a plan, but it is not granted that he may complete it. So Struve labored, but it is for other men to enter into his labors. In the following year, 1858, came the first attack of a cruel malady, which might have warned him that his active labors were drawing to a close. When, however, he could no longer take the field and observe, we are informed on the best authority, that he would sit at his writing-table for fourteen or fifteen hours in the day, endeavoring to further with his pen that great undertaking which he could not assist with his hands.

Before concluding our estimate of the permanent results of Struve's labors on the advancement of astronomy, it is necessary to observe that the data for our more accurate knowledge of the constants of precession, nutation, and aberration, as now generally adopted by astronomers, were furnished by observations made by himself or under his immediate direction, in the interval between 1822 and 1841. Again, in addition to his discovery of the existence of a law in the distribution of stars in space and in the proximities of multiple stars, of which we have already spoken, for Struve may properly be claimed what Sir John Herschel happily terms "the first impression that was made"[4] on the general problem of the distances of the fixed stars from the Sun. It was humiliating to the astronomer (nay, he had almost acquiesced in the belief that for wise purposes it was designedly so) to think that an innumerable multitude of bright

[4] Address of Sir John Herschel to the Royal Astronomical Society, 1841.

objects, which he could not do otherwise than regard as worlds, were within his sight, yet beyond the reach of his geometry to measure. Our associate, however, resolved to determine, if determined it could be, whether this limit had actually been set to the bounds of human knowledge, and in the years 1819–21 he succeeded, by sagacious and diligent observations of 27 circumpolar stars, in showing, beyond a doubt, that certain indications of parallax existed sufficient to encourage further efforts with more adequate instrumental means than he at that time possessed. The history of the definite settlement of the question of stellar parallax is not a little curious, and Struve's part in it is sufficiently conspicuous. Our countryman Henderson, in 1831–2, at the Cape of Good Hope, observed α *Centauri* with the mural circle, and on his return to England shortly afterward deduced a parallax of about 1″ for that remarkable star. Struve at Dorpat, from micrometrical measurement made with Fraunhofer's instrument in the years 1835–8, obtained a parallax for α *Lyræ*, amounting to 0″·261. Nevertheless, astronomers, after their manner of most rigid and impartial scrutiny, decided that possibly the shadow of a doubt rested upon both these sets of observations, and resolved to wait for the results of fresh measurements. Meanwhile, Bessel a year after, and from observations made with the great Heliometer at Königsberg, deduced a parallax of 0″·348 for 61 *Cygni*, such as to be wholly beyond the reach of cavil. Subsequently Peters confirmed Henderson's result of the existence of a parallax in α *Centauri*, and M. O. Struve vindicated the general truth of his father's deductions. Such, then, is the share which must be assigned to our associate in the determination of this most interesting, but difficult cosmical question.

Nor must we pass over our late associate's *Description de l'Observatoire Central de Poulkova* given to the world in 1847. It would be but an obvious and inadequate remark simply to say that this is the most sumptuous and complete work ever published on the description of an observatory, its instruments and its arrangements; and a monument to the enlightened generosity of the Russian government, who defrayed the cost of its publication. A perusal of it can scarcely fail to kindle the admiration of every one who is endued with a taste for practical astronomy. What is of far more importance, almost every page indicates the perfect mastery of the author over the instruments which he thus admirably describes, and attests the scrupulous care with which he attended to the minutest circumstances which could in any way contribute to the accuracy of their construction, or of the mode of handling them. Happily this most important work has on several occasions served as a guide for building and organizing other observatories on the continent of

Europe. But while we are bound, in the interests of scientific truth, to speak thus respectfully of this truly admirable work, and of the Observatory which it describes, it is impossible for us not to turn our thoughts for a moment to our own National Observatory and to its present able Director; not indeed in the spirit of contrast or comparison, but solely in the spirit of duty. Since the establishment of Pulkowa, Greenwich also has been furnished with instruments, entirely new, wholly devised by the Astronomer Royal, and constructed entirely under his superintendence. These instruments differ greatly from those erected at Pulkowa, as might be expected from the difference of genius with which the two nations are inspired; but if the descriptions of these admirable instruments were collected from the several monographs in which they are dispersed, they would form a volume every way worthy of being a companion volume to Struve's grand description of the great Russian Observatory.

Nor are the names of our great artists, Dolland, Ramsden, Troughton, Simms, and Cooke, in any respect unworthy to be placed side by side with Fraunhofer, Ertel, Reichenbach, Repsold, Mertz, Cauchoix, Secretan, and others. In the great Alhambra of Science there are niches for them all. In gladly awarding our meed of thankful acknowledgment to the memory of Struve, and to the astronomical mechanicians who so ably assisted him, we have felt it our duty to say a word of what is due to the genius of their fellow-laborers in England. In so doing we are here claiming no preëminence nor asserting any priority; invidious comparisons, if at all and anywhere out of place, would be preëminently so in a memorial notice of a man like Struve, for it was one of the characteristic features of that great man's life that, although often provoked, he was never known to contest a scientific priority; such contests, he said, were not only destructive of the peace of a philosopher's mind but highly prejudicial to the interests of science.

Struve was, as might be suggested by his labors, a man of uncommon physical strength, greatly corroborated, as he believed, by gymnastic exercises in youth: until the first attacks of his painful malady in 1858, of which we have already spoken, and which ultimately brought him to the grave, he used to say that he had never known what illness was.[5] By the advice of his physicians he was at length induced to cease, at least temporarily, from his incessant work, and travel through Europe for the restoration of his health: that result was not to be; as in other cases, so in his, it was too late. In Struve's illness there occurred a phenomenon which, though at the time supposed to be

[5] This is not quite strictly correct. Struve used to say, with an easy pleasantry, that Fraunhofer's noble instrument was rightly named *the Great Refractor*, for he and his friend Schumacher had each broken a leg while using it.

extremely singular, is not altogether uncommon. When he began to recover from exhaustion occasioned by the first attack of his malady, his memory, for all events of recent occurrence, wholly failed him; while, at the same time, it exhibited its usual, or even increased tenacity in things long since passed away. On such occasions he would seem to be living wholly in the scenes of the past, reciting passages in Greek, Latin, or Hebrew, and speaking in some of those many dialects in which he had learned to converse in his youth. In the midst, however, of this vivid resuscitation of the past, co-existing with the temporary oblivion of all recent associations, it is a touchingly suggestive circumstance to record that he never forgot the face of a friend.

At length, reluctant to continue as the nominal head of a great establishment, which he no longer felt himself able personally to direct, in December, 1861, he requested permission to resign his post. This permission was granted, accompanied, among other special marks of honor, with the grant of an hereditary estate by his sovereign; and thus the Observatory of Pulkowa passed to the directorship of his worthy son, Mr. Otto Struve. That the mantle of the father may descend upon the son is the undoubting hope and expectation of all who are interested in the science of astronomy.

On the 19th of August, 1864, a quarter of a century having now elapsed since the inauguration of the Observatory, a great gathering of astronomers from all parts of Europe assembled at Pulkowa, to pay their respects, and, as it proved, their last respects, to the man whose character and talents had shed a lustre even on the noble science of their common pursuit. Among those present on this happy occasion was the President of our own Society; of the others many had been Struve's astronomical pupils in former days, but now they occupied high and responsible positions of their own; from the former we learn how the venerable old man, now in his 72nd year, shook off for a time the bodily feebleness to which his unceasing malady had reduced him, and assuming the animation of younger years, thanked those around him for the affection which had brought them together, and acknowledged the kindness and coöperation which, through a long life, he had met with in the prosecution of his labors. But what at Pulkowa, on this and on other occasions, struck our President the most, even among the many other remarkable features of that imperial establishment, was the oneness of purpose, mutual confidence, and friendliness of intercourse, which there seemed to have found an especial home. We could fondly believe that it was thus ordained for the old astronomer to die, like a patriarch, in the midst of his children, for within a few weeks of that memorable jubilee, on the 23rd of November, 1864, Struve was called to his rest.

Struve was twice married: his first wife was a German lady, Emilia Wall, by whom he had twelve children, of these eight survive; his second wife, now his widow, was the daughter of his old colleague, Bartels, at Dorpat; by her he had issue six children, and of these four are still living. It may be interesting here to state that, notwithstanding the multiplicity and engrossing character of Struve's occupations, he always found time personally, and with affectionate concern, to superintend the education of his children.

Such are the records of this great man's life, so far, at least, as they are suited to a memoir like the present. Whatever is mortal of Wilhelm Struve rests in the churchyard attached to the beloved institution which he so long adorned. His grave lies under the shadow of its domes, and was selected by himself: but it is not these domes alone which constitute his monument; the spirit of the man still breathes in the zeal, the labors, the unanimity, which survive the master, and reign within them. That spirit will be reproduced again and again in future ages when other men, animated by the story of his example, shall endeavor to follow his steps. C. P.