Ruggiero Giuseppe Boscovich

A Dalmatian Jesuit and well-known mathematician, astronomer, and natural philosopher, b. at Ragusa, 18 May 1711; d. at Milan, 13 February, 1787. He was the youngest of six brothers and his education began at the Jesuit college of his native city. Being early impressed by the success achieved by his masters, he resolved to receive admission into their ranks, and on 31 October, 1725, at the youthful age of fourteen, he entered the novitiate of the Society of Jesus in Rome. His unusual talents manifested themselves particularly during the years devoted to literary and philosophical studies at the Collegio Romano, the most celebrated of the colleges of the Society of Jesus. Thus, for example, young Boscovich discovered for himself the proof of the theorem of Pythagoras. His professor, especially Father Horatio Borgondi, professor of mathematics, knew how to cultivate talents, and he made such progress, especially in mathematics, that he was able to take the place of his former professor at the Roman College even before the completion of his theological studies. As soon as he had completed the ordinary studies of a young Jesuit, he was appointed regular professor of mathematical science at the same college. He performed the duties of this office with much distinction for a whole generation, as is evidenced by the numerous Latin dissertations which he published nearly every year, according to the custom of the time. These show Boscovich's preference for astronomical problems. Among them may be mentioned:

•The Sunspots (1736);
•The Transit of Mercury (1737);
•The Aurora Borealis (1738);
•The Application of the Telescope in Astronomical Studies (1739);
•The Figure of the Earth (1739);
•The Motion of the heavenly Bodies in an unresisting Medium (1740);
•The Various Effects of Gravity (1741);
•The Aberration of the Fixed Stars (1742).

Problems in pure mathematics as well as philosophical speculations regarding the various theories on the constitution of matter also engaged his attention and he took an active part in all scientific discussions which agitated the learned world of his time. To these belong his The Deviation of the earth from the probable Spherical Shape; Researches on Unusual Gravitation; The Computation of a Comet's Orbit from a Few Observations, etc. His able treatment of these and similar problems attracted the attention of foreign, as well as of Italian, Academies, several of which--among them Bologna, Paris, and London--admitted him to membership. At Paris he shared with the famous mathematician Euler the honor of having submitted the correction solution to a prize problem.

Boscovich also showed much ability in dealing with practical problems. To him was due the project of the Observatory of the Collegio Romano, which afterwards became so well known. He first suggested using the massive dome-pillars of the college church of St. Ignatius as a foundation, on account of their great stability. (The church dome has not yet been completed, so the pillars still await the substructure planned by the architect.) The unfavorable circumstances of the time, and the storms brewing against the Jesuits, which ended, as is well known, in the suppression of the Society, prevented Boscovich's plan from being carried out until 1850, when Father Secchi, his worthy successor, was able to bring it to completion. There is a close parallel, it may be observed, between these two coryphaei of the Roman College, and Boscovich may, without hesitation, be considered the intellectual forerunner of Secchi. Like Secchi, too, he was the advisor of the papal Government in all important technical questions. Thus, when in the middle of the eighteenth century the great dome of St. Peter's began to show cracks and other signs of damage, causing consternation to the pope and to the Eternal City, Boscovich was consulted, and the excitement was not allayed until his plan to place large iron bands about the dome was carried out. His advice was sought when there was a question of rendering innocuous the Pontine marshes and he was also entrusted with the survey of the Papal States. Pope Benedict XIV

commissioned him and his fellow Jesuit, Le Maire, to carry out several precise meridian arc measurements, and it seems to have been due chiefly to his influence that the same pope, in 1757, abrogated the obsolete decree of the Index against the Copernican system.

Many universities outside of Italy sought to number Boscovich among their professors. He himself was full of the spirit of enterprise, as was shown when King John V of Portugal petitioned the general of the Jesuits for ten Fathers to make an elaborate survey in Brazil. He voluntarily offered his services for the arduous task, hoping thus to be able to carry out an independent survey in Ecuador, and so obtain data of value for the final solution to the problem of the figure of the earth, which was then exciting much attention in England and France. His proposal lead to the initiation of similar surveys in the Papal States, the pope taking this means of retaining him in his own domain. A detailed account of the results of the work appeared in a large quarto volume (Rome, 1755) entitled: "De litterariâ expeditione per Pontificam ditionem ad dimetiendos duos meridiani gradus et corrigendam mappam geographicam." A map of the Papal States made at the same time, which corrected many previous errors, proved to be likewise a wholesome contribution to the discussion regarding the more or less spherical form of the earth. Many of the triangulations were accomplished by no slight difficulties. The two base-lines employed in the survey--one on the Via Apia, the other in the neighborhood of Rimini--were measured with great care. The first was redetermined in 1854-55 by Father Secchi, as the mark indicating one end of the line measured by Boscovich and La Maire had been lost. (Cf. Secchi's work: Misura della Base trigonometrica esequita sull via Appia per ordine del governo pontifico, Roma, 1858.) Besides his work in mathematical astronomy, we also find Boscovich speculating, upon scientific grounds, on the essence of matter and endeavoring to establish more widely Newton's law of universal gravitation. As early as 1748 we meet essays from his pen in this field of thought, e.g. De materiae divisibilitate et du principiis corporum dissertatio (1748); De continuitatis lege et ejus consectariis pertinentibus ad prima materiae elementa eorumque vires (1754); De lege virium in natura existentium (1755); Philosophiae naturalis theoria redacta ad unicam legem virium in natura existentium (1758). Boscovich, according to the views expressed in these essays, held that bodies could not be composed of a continuous material substance, nor even of contiguous material particles, but of innumerable point-like structures whose individual components lack all extension and divisibility. A repulsion exists between them which is indeed infinitesimal but cannot vanish without compenetration taking place. This repulsion is due to certain forces with which these elements are endowed. It tends to become infinite when they are in very close proximity, whereas within certain limits it diminishes as the distance is increased and finally becomes an attractive force. This change is brought about by the diverse direction of the various forces. Boscovich divided his last-mentioned exhaustive work into three parts, first explaining and establishing his theory, and then pointing out his applications to mechanical problems, and finally showing how it may be employed in physics. His attempt to reduce the complicated laws of nature to a simple fundamental law aroused so much interest that in 1763 a third, and enlarged edition of his "Theoria philosphiae naturalis" (Venice, 1763) had become necessary. The publisher added as an appendix a catalogue of Boscovich's previous works. There are no less than sixty-six treatises dating from 1736--a proof of his literary activity. Some have already been mentioned, and to these may be added his "Elementorum matheseos tomi tres," in quarto (1752).

Boscovich attracted attention by his political writings as well as by his scientific achievements. His Latin verses in which he eulogized the Polish king, Stanislaus, Pope Benedict XIV, and various Venetian noblemen, were read before the Arcadian Academy of Rome. His "Carmen de Solis ac Lunae defectibus" (5 vols., London, 1760) was much admired. His services were also in demand in several cities and provinces. Thus, in 1757, he was sent by the city of Lucca to the Court of Vienna to urge the damming of the lakes which were threatening the city. He acquitted himself of this task which such skill that the Luccans made him an honorary citizen and rendered him generous assistance on his

scientific journeys, both in Italy, France, and England. While in England he gave the impulse to the observations of the approaching transit of Venus, on 6 June, 1761, and it is not unlikely that his proposal to employ lenses composed of liquids, to avoid chromatic aberration, may have contributed to Dolland's success in constructing achromatic telescopes. The citizens of Ragusa, his native town, besought him to settle a dispute in which they had become involved with the King of France--an affair which the pope himself deigned to adjust. Bascovich returned from England in company with the Venetian ambassador who took him by way of Poland as far as Constantinople. He availed himself of this opportunity to extend and complete his archeological studies in these countries, as may be gathered from his journal published at Bassano in 1784: "Giornale d'un viaggio da Constantinopli in Polnia con una relazione della rovine de Troja." The hardships of this journey shattered his health, yet we find him shortly after (1762) employed at Rome in various practical works, such as the draining of the Pontine marshes. In 1764 he accepted the appointment of professor of mathematics at the University of Pavia (Ticinum). At the same time, Father Le Grange, the former assistant of Father Pezenas of the Observatory of Marseilles, was invited by the Jesuits of Milan to erect an observatory at the large college of Brera. He was able to avail himself of the technical skill of Boscovich in carrying out his commission and it may be questioned to which of the two belongs the greater credit in the founding of this observatory which, even in our own time, with that of the Collegio Romano, is among the most prominent of Italy. It was Boscovich who selected the southeast corner of the college as a site for the observatory and worked out the complete plans, including the reinforcements and the necessary remodeling for the structure. Building operations were immediately begun, and in the following year, 1765, a large room for the mural quadrants and meridian instruments, another for the smaller instrument, and a broad terrace, with several revolving domes to contain the sextants and equitorials, were completed. Such was the stability of the observatory that the new 18-inch glass of Schiaparelli could be mounted in it although a cylindrical dome of 13 yards, 4 inches now takes the place of the octogonal hall of Boscovich.

The London Academy proposed to send Boscovich in charge of an expedition to California to observe the transit of Venus in 1769, but, unfortunately, the opposition manifested everywhere to the Society of Jesus and leading finally to its suppression, made this impossible. He continued, however, to give his services to the Milan Observatory for whose further development he was able to obtain no inconsiderable sums of money. In particular the adjustment of the instrument engaged his attention, a subject about which he left several papers. But as his elaborate plans received only partial support from his superiors and patrons, he thought seriously in 1772 of severing his connection with the observatory, and, in fact, in the same year, Father La Grange was placed in complete charge of the new institution. Boscovich was to become professor at the University of Pisa, but Louis XV gained his services and invited him to Paris, where a new office, Director of Optics for the Marine--d'optique au service de la Marine--with a salary of 8,000 francs, was created for him. He retained this position until 1783 when he returned to Italy to supervise the printing of his as yet unpublished works in five volumes, for it was not easy to find a suitable publisher in France for books written in Latin. In 1785 there appeared at Bassano, "Rogerii Josephi Boscovich opera pertinentia ad opticam et astronomiam. . .in quinque tomos distributa," the last important work from the pen of this active man, who, after its completion, retired for a time to the monastery of the monks of Vallombrosa. He returned to Milan with new plans, but death shortly overtook him at the age of seventy-six, delivering him from a severe malady which was accompanied by temporary mental derangement. He was buried in the church of Santa Maria Podone.

Boscovich, by his rare endowments of mind and the active use which he made of his talents, was preeminent among the scholars of his time. His merits were recognized by learned societies and universities, and by popes and princes who honored him and bestowed favors upon him. He was recognized as a gifted teacher, an accomplished leader in scientific enterprises, an inventor of important

instruments which are still employed (such as the ring-micrometer, etc.) and as a pioneer in developing new theories. All this, however, did not fail to excite envy against him, particularly in the later years of his life in France, where men like d'Alembert and Condorcet reluctantly saw the homage paid to the former Jesuit, and that, too, at a time when so many frivolous charges were being made against his lately suppressed order. This hostility was further increased by various controversies which resulted in differences of opinion, such as the contention between Boscovich and Rochon regarding priority in the invention of the rock crystal prismatic micrometer. (Cf. Delambre, Historie de l'Astronomie du XVIIIe siecle, p. 645.) The invention of the ring-micrometer, just mentioned, which Boscovich describes in his memoir "De novo telescopii usu ad objecta coelestia determinanda" (Rome, 1739), has been ascribed without reason by some to the Dutch natural philosopher Huygens. The chief advantage of the simple measuring instrument designed by Boscovich consists in its not requiring any artificial illumination of the field of the telescope. This makes it useful in observing faint objects, as its inventor expressly points out in connection with the comet of 1739. The novel views of Boscovich in the domain of natural philosophy have not, up to the present time, passed unchallenged, even on the part of Catholic scholars. Against his theory of the constitution of matter the objection has been raised that an inadmissible actio in distans is inevitable in the mutual actions of the elementary points of which material bodies are supposed to be composed. The theory therefore leads to Occasionalism. Acknowledgement must, however, must be made of the suggestiveness of Boscovich's work in our own day, and the germs of many of the conclusions of modern physics may be found in it. His illustrious successor at the Observatory of the Collegio romano, Father Angelo Secchi, in his "Unita delle forze fisiche" has in many respects followed in his footsteps, and in fact the cosmological views held by many later natural philosophers furnish unequivocal proof of the influence of the theories maintained by Boscovich.

Among his many smaller works (for a full list, cf. Sommervogel, cited below), the following deserve special attention: De annuis stellarum fixarum aberrationibus (Rome, 1742); De orbitus cometarum determinandis ope trium observationem parum a se invicem remotarum (Paris, 1774); De recentibus compertis pertinentibus ad perficiendam dioptricam (1767). His chief works, however, are:
•De litteraria expeditione per Pontificam ditionem (1755);
•Theoria philosophiae naturalis (1758);
•Opera pertinentia ad opticam at Astronomiam maxima ex parte nova et omnia hucusque inmedita (1785).
The second was published in Vienna 1758-59, in Venice, 1763, and again in Vienna in 1764. The last-named work was subjected to an exhaustive criticism by Delambre, by no means a friend of the Jesuits. He closes with these words: Boscovich in general manifests a preference for graphical methods in the use of which he gives evidence of great skill. in his whole work he shows himself a teacher who prefers to lecture rather than to lose himself in speculations."