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Reports on almost all of Ricci's publications were published in *Bulletin des sciences mathématiques*; although sometimes very detailed, they often appeared only after a considerable delay. For the report on "Méthodes de calcul différentiel absolu," see **35** (1911), 107–111.

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PIERRE SPEZIALI

RICCIOLI, GIAMBATTISTA (*b.* Ferrara, Italy, 1598; *d.* Bologna, Italy, 25 January 1671), *astronomy, geography*.

Riccioli entered the Society of Jesus when he was sixteen years old, and there received the comprehensive education that enabled him to teach Italian literature, philosophy, and theology, first at Parma and then at Bologna, while privately pursuing studies in astronomy and geography. He published extensively on the latter topics and these writings made him famous among his contemporaries, even though he rejected Galileo's example in using the vernacular and wrote most of his works in Latin. His commitment to church doctrine brought him into conflict with the ideas expressed by Galileo and his students and by the Florentine Accademia del Cimento. This attitude, together with the civil and religious pressures inherent in the Counter-Reformation, explains many of the apparent contradictions in Riccioli's scientific career. Following the Inquisition's condemnation of Galileo's astronomical theories, for example, Riccioli became one of the most ardent opponents of the Copernican system, which he tried to refute in every way. He nonetheless recognized the simplicity and the imaginative force of the Copernican theory, and acknowledged it as the best "mathematical hypothesis"—while striving to divorce it from any effective notion of truth.

In particular Riccioli designed a series of experiments by which he hoped to disprove Galileo's conclusions, but instead ratified them. This is especially true of his accurate and ingenious investigations of falling bodies. Although he was somewhat hampered by his reluctance to read Galileo's own works, his own skill as an experimenter served him well. With his fellow Jesuit, Francesco Maria Grimaldi, Riccioli succeeded in perfecting the pendulum as an instrument to measure time, thereby surpassing Galileo and his school and laying the groundwork for a number of important later applications.

Riccioli also made a number of significant astronomical measurements in an effort to expand and refine existing data. To this end he made measurements to determine the radius of the earth and to establish the ratio of water to land. His recourse to a mathematical treatment of these problems is noteworthy. He observed the topography of the moon and, in concert with Grimaldi, introduced some of the nomenclature that is still used to describe lunar features. Riccioli described sunspots, compiled star catalogues, and recorded his observation of a double star; he also noted the colored bands parallel to the equator of Jupiter and made observations of Saturn that, if he had had better instruments, might have led him to recognize its rings.

As a geographer, Riccioli set out to compose a single great treatise that would embrace all the geographical knowledge of his time. Although he did not complete this task, he published tables of latitude and longitude for a great number of separate localities, in which he corrected previous data and prepared the way for further developments in cartography. Despite the conservatism of the age in which he worked, Riccioli made honest and important contributions to science.

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LUIGI CAMPEDELLI

RICCÒ, ANNIBALE (*b.* Modena, Italy, 15 September 1844; *d.* Rome, Italy, 23 September 1919), *geophysics, astrophysics.*

After graduating in natural sciences from the University of Modena and in engineering from the Milan Polytechnic, Riccò became an assistant at the Modena observatory and then at the Palermo observatory. In 1885, under the sponsorship of the Accademia Gioenia, he founded the astrophysics observatory at Catania, and in 1890 he became professor of astrophysics at the university, the first chair of that subject in Italy. Riccò created an astronomic and meteorological station on Mt. Etna, and with A. Secchi and P. Tacchini he founded the Society of Italian Spectroscopists in 1872; he was editor of its memoirs until his death.

At the Palermo observatory he began a regular series of direct and spectroscopic observations of the sun, using a 25-centimeter Merz refractor and a direct-vision spectroscope. He continued this research in Catania for forty years, obtaining important results on the frequency, position, and development of sunspots and solar prominences and on their influence on terrestrial phenomena. Riccò collaborated with G. E. Hale in an unsuccessful attempt to photograph the corona in full sunlight, using a spectro-heliograph invented by Hale and taking advantage of the altitude of Mt. Etna.

In 1913, at the fifth conference of the International Union for Cooperation in Solar Research, Riccò presented the results of his observations made from 1880 to 1912 on solar prominences and their structure. He showed that the cycle of prominences lasts about as long as that of the sunspots, although there is a certain delay in the appearance of the former, in addition to other differences. Riccò noted two kinds of prominences: those associated with very active sunspots are extremely variable and are composed of hydrogen, helium, calcium, and other metals; quiescent prominences are composed almost exclusively of hydrogen and migrate toward the poles during the course of the eleven-year sunspot cycle. Riccò was one of the first to explain that the so-called filaments are merely prominences seen projected against the solar disk.

Riccò led three expeditions to study total solar eclipses, to Algeria (28 May 1900), Spain (30 August 1905), and the Crimea (August 1914). All of these expeditions achieved important results on the flash spectrum, on prominences and their relationship to the corona, and on the emission spectrum of the corona. In 1882, at Palermo, Riccò had pointed out the delayed occurrence of terrestrial magnetic storms with respect to the presence of extensive groups of sunspots. Ten years later he reported to the Académie des Sciences his discovery that magnetic storms begin on the earth forty to forty-five hours after the passage of the spots, or groups of spots, across the central meridian of the sun, and that consequently the presumed agent of the storms must travel to the earth at a speed of about 1,000 kilometers per second. This was the first observation of what was later called the solar wind.

For the international Carte du Ciel, Riccò organized and directed the study of those parts of the sky between 46° and 55° N. latitude that had been assigned to the Catania observatory. He observed the Daniel, Morehouse, and Halley comets (1908–1910) and discussed their constitution with Horn d'Arturo according to hypotheses proposed by Righi. In the fields of geodesy and geophysics he determined the gravitational anomalies and the terrestrial magnetic constants for Sicily, especially in relation to seismic activity, and carried out observations and studies on the crater of Mt. Etna during the 1910 eruption.

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A prolific writer, Riccò published mainly in the *Memorie della Società degli spettroscopisti italiani*. For a list of his papers (to 1900), see Royal Society *Catalogue of Scientific Papers*, VIII, 742; XI, 166–168; XII, 615; XVIII, 168–172. Subsequent writings are listed in Poggendorff, IV, 1241–1242; V, 1043; VI, 2165.

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