P. ANGELO SECCHI, S.J., 1818-1878*

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P. Secchi was one of the great pioneers of astrophysics or "physical astronomy" as he used to call it whose work ranged over a very wide field. He made major contributions to solar physics as well as to stellar spectroscopy and he also worked with much success in geophysics and meteorology.

Angelo Secchi was born the son of a carpenter on 29th June, 1818 in Reggio in the province of Emilia some 200 miles north-west of Rome. He received his early education at the Jesuit College of his native town. At the age of 15 he left Reggio to enter the Society of Jesus at their Novitiate in Rome, and it was in Rome that he was to spend most of his life. Having completed the two years of the Novitiate he started in 1835 his humanistic and philosophical studies at the Collegio Romano, the Roman College of the Jesuits.

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* Summary of a lecture to the Irish Astronomical Science Group on 22 November, 1978 at Trinity College, Dublin, and which was first given by Professor H. A. Brück in Rome at the July IAU Colloquium which was devoted to "Spectral Classification of the Future" and which was to commemorate the 100th Anniversary of P. Angelo Secchi's death.

His Jesuit superiors came soon to the conclusion that Secchi was ultimately destined for a life of study in physics and astronomy, and believing that one gets to understand a subject best if one is forced to teach it, they sent him at the age of 23 for three years to their college at Loretto to teach physics. When he returned to Rome Secchi was ready for his theological studies which led in September 1847 to his ordination.

In the meantime the political world had become greatly disturbed in many parts of the Continent. As Karl Marx wrote at the time in London, the spectre of revolution was hanging over Europe. In February 1848 revolution actually broke out in Paris, overthrowing Louis Philippe, and then spreading to Berlin and Vienna. The revolt in Rome, the capital of the Papal States, had been from the very beginning of 1848 accompanied by an outburst of anticlericalism and by demands for the expulsion of the Jesuits. The situation became sufficiently threatening to force the Jesuit superiors to close all their houses in Rome and send the members of the Society into exile in countries like France, England and the United States. Among them was Father Secchi who went first, in March 1848, to the Jesuit house at Stonyhurst in England and half a year later to Georgetown in the U.S.A.

His exile did not last long, however. At the end of 1849 he was able to return to Rome which had been occupied by French troops following an appeal by the Pope to the Catholic Powers to restore him to his capital. In Rome Father Secchi took over the direction of the Observatory and the Chair of Astronomy at the Roman College in succession to Father de Vico who had died in exile in London. Secchi was to remain in that position until his own death 28 years later.

At the time of Secchi's appointment the Observatory was situated at the top of a high tower in the eastern part of the Roman College. It was both poorly placed and very inadequately equipped, and Secchi's main task in his first two years as Director was to improve the Observatory's instruments and find a more suitable location for his telescopes.

Secchi wanted to work in physical astronomy which meant to him, before he got involved in stellar spectroscopy in the 1860's, the visual observation of the surface features of the bodies of the solar system, the planets, comets and particularly the Sun, and also, somewhat surprisingly, the measurement of double stars and star clusters. In fact, he was so attracted by the possibility of working on double stars in conditions of good seeing that he chose as main telescope for his new observatory a visual refractor, identical in size to the then famous 9½ inch refractor which Fraunhofer in Munich had constructed thirty years earlier for F. G. W. Struve at Dorpat (Tartu) University.

As location for his new observatory Secchi chose, following an earlier suggestion, the roof of the beautiful Jesuit Church of San Ignacio which had been built in the 17th century into the northern side of the Roman College. This Church was to be originally crowned by a large dome, second in size only to the dome of St. Peter's. Because of the untimely death of the architect the dome had remained unbuilt, however, which enabled Secchi to make use of the strong pillars which originally were to support the dome, to form a base for the erection of his telescopes in conditions of perfect stability.

The telescopes which he mounted on this church roof were his new $9\frac{1}{2}$ inch Merz refractor, an earlier remounted 6-inch refractor by Cauchoix to be used for solar observations, and a transit circle by Ertel which marked the Rome meridian. All Secchi's telescopes were no more than modest instruments by present-day standards, and it is all the more remarkable, of course, what wealth of astronomical information they yielded in Secchi's hands.

His Merz refractor had hardly arrived in Rome in 1852 when Secchi started using it for a revision of Struve's great catalogue of double stars, the "Mensurae Micrometricae". In seven years of systematic work he measured more than 1300 binaries, and it speaks for his remarkable skill as a telescopic observer and for the seeing qualities of the Roman sky that Secchi was able to remeasure not only the majority of binaries in Struve's catalogue, but many more difficult ones which Struve had only been able to resolve using his large 16-inch refractor at Pulkowa.

Secchi's remarkable skill as a visual observer—and practically all his work was based on visual observation—showed itself also in his investigations of the planets, particularly those of Mars. However, his favourite object of study for many years was the Sun and he became soon recognized as a leading authority in the field of solar physics.

When Secchi started his solar work in the 1850's, solar prominences were well known to exist following their observation at the total eclipses of 1842 and 1851. Their nature, however, was very much a matter of dispute. Some astronomers believed that prominences were optical illusions, mirages produced by the terrestrial atmosphere. Others thought that they were part of an atmosphere which surrounds the Moon.

One obvious way of settling this question was to make photographic observations of the eclipsed Sun by more than one observer. Though photography was still in its infancy at the time and though his skill was in visual observation, Secchi decided to embark on the experiment at the total eclipse of 1860.

The track of the 1860 eclipse crossed Spain, and it was there that Secchi took his 6-inch Cauchoix refractor to which he had attached a specially constructed photographic camera. A well-known English observer, Warren de la Rue, arranged to photograph the same eclipse from a station 250 miles to the north-west of Secchi's.

Each of the two observers managed to obtain several good photographs with images of prominences and corona which agreed with each other in every detail. This was the first demonstration of the fact that prominences and corona are not spurious, but real phenomena and that they have a physical connection not with the Moon, but with the Sun.

If eclipse photography started in 1860, eclipse spectroscopy started at the eclipse of 1868. Secchi was unable to observe this eclipse himself much to his regret, but he followed eagerly the observations which Janssen of Paris made then, and he applied immediately to his own solar work Janssen's principal discovery, that it is possible to observe both chromosphere and prominences outside eclipses using a spectroscope.

From 1868 onwards Secchi extended his daily systematic observations of the Sun to include all transient solar phenomena, sunspots, faculae and dark filaments on the solar disc, and chromosphere and prominences at the solar limb. He made most

careful observations of the motions of prominences, the slow upward or downward drifting of quiescent prominences and the sudden accelerations in the motions of eruptive prominences. It is worth remembering that Secchi was the very first to notice the existence of the little jets in the solar chromosphere which we now call spicules.

Great as Father Secchi's work in solar physics was he is undoubtedly remembered chiefly for his contributions to stellar spectroscopy which led to the first spectroscopic survey of the heavens. Secchi tells us that he looked at the spectra of some 4,000 stars using for most of his work a simple spectroscope with a direct-vision Amici prism and two cylindrical lenses which he attached to his 9½-inch Merz refractor.

Secchi's first classification of stellar spectra of 1863 was based on observations of only 35 bright stars which he separated simply into two types, white stars like Sirius and coloured stars like Betelgeuze. Three years later he introduced a third class, that of slightly coloured stars with spectra similar to that of Arcturus, and in the same year he published his first catalogue of spectral types of some 200 stars. In 1867 appeared his famous catalogue of spectral types for some 300 stars which were separated according to their colours and line spectra into three different types. Finally, in 1868 he announced the existence of altogether four different types of spectra which are the so-called "Secchi types" of later years. They compare with our A and F, G, M, and R and N types.

The great diversity of Secchi's research in solar and stellar astronomy, in geophysics and in meteorology did not exhaust the range of his activities. Being the Pope's astronomer he was very much the Pope's scientific adviser, and the Pope of his days was not only the Head of the Church, but also the supreme ruler of the Papal States. This meant that Father Secchi was frequently consulted on semi-scientific problems which might affect the well-being of the Pope's subjects in his territories. Secchi had to advise—to give an example—on the construction and proper equipment of lighthouses along the coast at harbours like Anzio, Civitavecchia or Ancona. He was specially asked by the Pope to investigate the reliability and purity of the water supply in country areas which implied long journeys of inspection of wells, hydraulic machinery and water pipes.

At a period when popularization was looked at with disdain by many scientists, Secchi considered it to be his duty to convey some of his own enthusiasm for his work to wider audiences through semi-popular writings and public lectures. He delighted in the latter, and we hear of the great success of a memorable lecture on the Sun which he delivered to an audience of more than 300 Cardinals, Bishops and Theologians who were assembled in Rome for the first Vatican Council in 1870.

Secchi was then at the height of his fame, recognized not only in his native Italy, but throughout the scientific world as one of the great pioneers in the new field of physical astronomy.

Then a major change occurred in Father Secchi's world. Following the defeat of the French in the Franco-Prussian war of 1870 and the subsequent withdrawal of the French troops from Rome, the Italian nationalist troops under King Victor Emmanuel of Piedmont invaded the Papal States and occupied Rome itself on 20th September 1870.

What had been the Pope's city became the capital of the United Italy, thus ending the temporal power of the Papacy. Pope Pius IX, however, refused to recognize the new Italian State. For the next eight years until the end of his life he remained a voluntary prisoner in the Vatican, cautioning Catholics against taking any part in the political life of the new Italy.

Father Secchi's loyalty to the Pope never faltered in the difficult circumstances which followed. In fact, he dedicated to the Pope on his 50th episcopal jubilee one of his last major publications in which he surveys the progress of astronomical research in Rome under the pontificate of Pius IX.

The Pope's death at the age of 85 came as a great shock to Father Secchi who had been ill himself for some time. He was to follow his patron less than three weeks later, dying on 26th February 1878.

Professor Bruck's lecture was followed by a selection of slides which illustrated the work of Fr. Secchi.

Comments on Professor Bruck's Lecture

Dr. de Groot: As a spectroscopist I must admit that I had not previously been aware of the enormous extent of Fr. Secchi's contributions. I was of course aware of his spectral classifications but not of the many other aspects of his career.

Dr. Plagemann: Was Fr. Secchi his own instrument maker?

Prof. Bruck: Up to a point he was. He was his own designer. He got someone in Rome to carry out the mechanical work.

Prof. McCrea: I would also like to comment on his draughtsmanship. Did he have any help in this direction?

Prof. Bruck No.

Prof. McCrea: Then these drawings must have each taken many hours of work.

Prof. Bruck: Yes. It is incredible how much work he actually did when all of the surrounding circumstances are taken into account.

Dr. de Groot: Was Fr. Secchi the first to recognize the true nature of the dark clouds (nebulae)?

Prof. Bruck: I am not 100% certain of this but I believe it to be so.