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GÉRARD DE VAUCOULEURS
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A Biographical Memoir by

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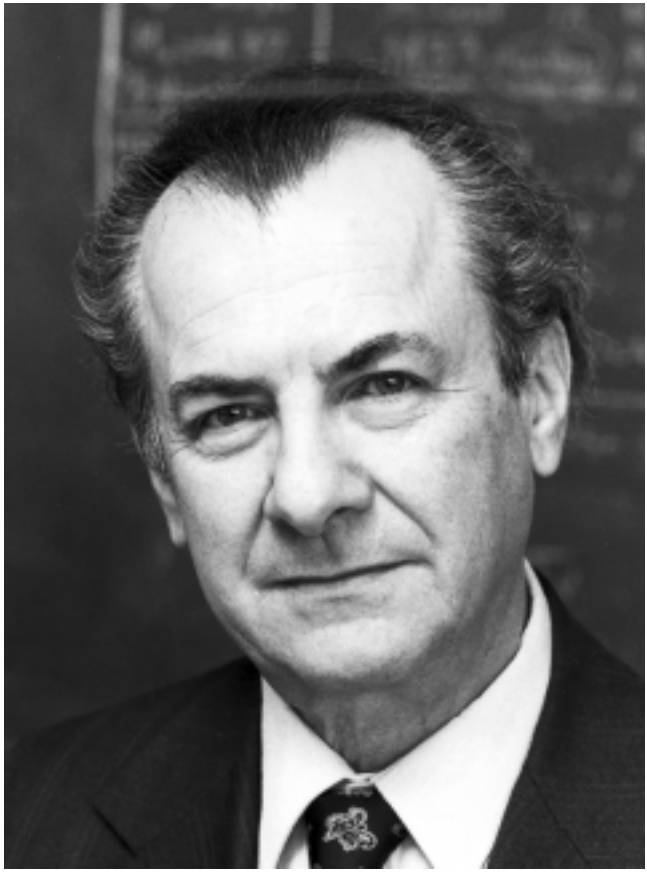

G. de Vaucouleurs

GÉRARD DE VAUCOULEURS

April 25, 1918–October 7, 1995

BY E. MARGARET BURBIDGE

GÉRARD HENRI DE VAUCOULEURS began a lifetime in astronomy as an amateur, observing planets in the solar system from early childhood; his name is especially linked with his early studies of the planet Mars. His major achievements, however, have been in his work on galaxies—the extragalactic universe—and his name will always be tied to that of his wife and coworker in these fields, Antoinette (Piétra) de Vaucouleurs. Gérard was elected to the National Academy of Sciences in 1986.

Gérard de Vaucouleurs was born in Paris on April 25, 1918; he died in Austin, Texas, on October 7, 1995. His family background and father's name have proved elusive, since early in life he took the maiden name of his mother, de Vaucouleurs. He had a sister; she died in the same year as his mother, some eight years before his death.

From an early age Gérard was interested in astronomy. As a boy of 10 he observed the Moon from the balcony of his family's apartment, using a marine telescope borrowed from a friend.[1] A few years later his mother purchased a small telescope for him. By age 15 he was an enthusiastic amateur astronomer,[2] passionately interested in solar system astronomy. At this young age he observed various stellar

occultations and planetary conjunctions, an eclipse, and with his small telescope he photographed the planet Mars in close approaches to the Moon and to the Pleiades star cluster. He presented his data to the amateur Societé Astronomique de France; these included observations of Mercury, Venus, Jupiter, and Saturn, and some good drawings of Jupiter.

A photograph taken in the summer of 1934[2] shows a group of astronomers and visitors at the Juvisy Observatory of Flammarion, including the well-known French astronomers Henri Mineur and André Couder and, second from the right-hand edge of the photo, a neatly dressed young man labeled tentatively from his short height and the widow's peak in his dark hair as G. de Vaucouleurs.

EARLY EDUCATION IN PARIS; THE PLANET MARS; JULIEN PÉRIDIER'S OBSERVATORY AT LE HOUGA, FRANCE; WORLD WAR II

Gérard began formal studies at the Sorbonne Research Laboratory, Paris, France, in 1936 and received his undergraduate degree in 1939. By this time, at age 19, he had acquired a 7.5-cm refractor and was deeply involved in solar system observations, particularly of the planet Mars. By 1939 the Commission on Mars of the International Astronomical Union had been reconstituted because of the forthcoming favorable opposition of Mars on July 23, 1939. The commission met, with G. Fournier presiding and de Vaucouleurs as secretary.[2]

In 1939 de Vaucouleurs began his long association with Julien Péridier, who had built a private observatory at Le Houga in southwest France, with an excellent 8-inch visual and photographic f/13 double refractor and a 12-inch Newtonian reflector.[3] A description of Gérard at this time[2] is of a rather short, neat young man, smiling, dedicated to his work, precise, and letting no detail escape his attention.

The association with Julien Péridier was interrupted by the start of World War II; de Vaucouleurs served in the French army (artillery) from November 1939 to May 1941.

RETURN TO PARIS AND LE HOUGA: NEW INTERESTS IN ASTRONOMY, CONTINUATION OF FORMAL EDUCATION

De Vaucouleurs returned to Le Houga in July 1941, and without abandoning his lifelong interest in Mars he turned his attention to the measurement of close double stars, variable stars, and the brightness variations of the asteroid Eros. He was in Le Houga from 1941 to 1943.

He returned to Paris in 1943 to work from 1943 to 1949 on his dissertation at the Laboratoire des Recherches Physiques of the Sorbonne and at the Institut d'Astrophysique Boulevard Arago, Paris. His thesis was on the molecular (Rayleigh) scattering of light, with accurate laboratory measurements of scattering and depolarization in various liquids and gases. This was published in full in 1950.[4] He met Antoinette Piétra, who was also studying at the Sorbonne, and they were married on October 31, 1944.

De Vaucouleurs continued his association with the Péridier Observatory in Le Houga, applying the research done for his thesis to light scattering in the Earth's atmosphere. He made observations with a visual photometer of his own design on the zenith sky brightness during evening and morning twilight at Le Houga. This experience stood him in good stead years later when he had been appointed at the University of Texas and was doing stellar and galaxy photometry at the McDonald Observatory. He made a similar study of the sky in southwest Texas then and published it in detail.[5]

INSTITUTE OF ASTROPHYSICS, PARIS

From his work at Le Houga Observatory, Gérard had taught himself to be an expert in astronomical photography

and photographic photometry. After the end of World War II, when the Institut d'Astrophysique reopened, Gérard was appointed to work with Daniel Chalonge. He had responsibility for the Chalonge microphotometer, a photographic instrument for recording the intensity of photographic spectra obtained at the telescope onto photographic paper. Subsequent to the recording the paper had to be developed in the darkroom. This apparatus was not the simplest to use (Fabry is quoted as having said "le microphotomètre Chalonge, il ne marche que quand son papa est là!"[6])

When Geoffrey and I arrived in late summer of 1949, after a month spent photographing stellar spectra at l'Observatoire de Haute Provence, with permission to stay in the Institut d'Astrophysique and run our spectra through the Chalonge instrument, Gérard de Vaucouleurs was assigned the task of showing us how to use it. We discovered that "le microphotomètre Chalonge marche assez bien sous la direction de Gérard!" That was the beginning of our friendship with Gérard.

LONDON

Gérard's fluency in spoken and written English, as well as his scientific qualifications, led to his appointment with the BBC in 1949 to run a weekly radio program on science, with guest speakers who could deal with questions in French. He and Antoinette rented a small house in northwest London, not too far from the University of London Observatory (ULO) in Mill Hill. Gérard lost no time in asking whether he could carry out some useful work at the observatory.

Following the end of World War II the lenses of the 24-inch photographic and 18-inch visual Radcliffe refractors had been retrieved from their wartime tomb at the bottom of the telescope's concrete pier, and the ULO program on parallax and proper motion had been resumed. Gérard was

delighted to join this program, both in taking the photographic plates during the night and in the daytime measuring them on the large two-coordinate measuring engine in the Wilson Building. Gérard would come to the observatory in the evening by bus, and it was my pleasure to seat him on the pillion of my small motorbike and run him back to his home after dawn. Antoinette's daytime work at ULO was in measuring spectra taken with the Wilson 24-inch reflector.

Gérard and Antoinette became good friends with C. C. L. Gregory and family, in whose home Geoffrey and I were living at the time. Clive Gregory prided himself on a special recipe for spaghetti with tomatoes and onions (Mill Hill grown!) involving careful timing and judicious use of one beaten egg (food rationing was still in force in 1949, so eggs and butter were scarce and precious). Spaghetti was easily available, and tomatoes and onions grown in the grounds of Mill Hill observatory were plentiful, so Gregory's dish was enormous and, since it comprised the whole dinner, large helpings and seconds were given. At the dinner hosting Gérard and Antoinette, they ate modest portions, expecting that something would be coming afterwards. As the plates were cleared, it became obvious that this was the end of dinner. Gérard confessed later that they left hungry and that Antoinette, who had great skill in the kitchen, would have been ashamed to serve a dinner consisting only of spaghetti.

MT. STROMLO OBSERVATORY, AUSTRALIA

The telescopes at Mill Hill and the all too frequent cloudy skies over England meant that Gérard was soon looking for better opportunities to carry on his life work. In 1951 he and Antoinette were appointed at the Mt. Stromlo Observatory, Canberra, Australia, where they worked from 1951 to

1957. During the period 1951-54 Gérard was a research fellow at the Australian National University, and all observational astronomers will recognize what he must have felt on surveying the skies of the Southern Hemisphere, including especially our nearest companion galaxies, the Magellanic Clouds.

His first important papers published shortly after settling in Australia, where he and Antoinette lived on Mt. Stromlo, was on two pieces of research for which he is famous: (1) the relation between the mass and luminosity in elliptical galaxies (that the luminosity varies as the 1/4 power of the mass from the outermost reliable luminosity measures to the inner core) and (2) "Evidence for a Local Supergalaxy" (1953) expounding his observational evidence for the organization of galaxy clusters into the larger structures, superclusters. It was not long before Gérard was deeply into Southern Hemisphere studies.

Gérard brought to Mt. Stromlo a twin Aero-Ektar camera, which he set up to investigate the structure of the Magellanic Clouds. The objective lenses had a 7-inch focal length and, stopped down to f/4, a usable field of over 20°. He used this camera to make a mosaic of long-exposure photographs covering about 40° of sky, including both the large and small clouds. His important paper (1955) reproduces his mosaic of both clouds made from the Aero-Ektar plates.

As Gérard's abstract to the 1955 paper states, his plates showed an extensive spiral pattern in the Large Magellanic Cloud, with trailing arms, and this study was followed up by studies with the radio astronomer Frank J. Kerr, using the 21-cm line from neutral hydrogen. This line had been predicted by H. van de Hulst in Leiden during World War II and was detected shortly afterwards. Therefore, it was natural that de Vaucouleurs should look at Frank Kerr's map of 21-cm velocity residuals across the Large Magellanic Cloud, and he was able to recognize the presence of a typical rota-

tion pattern for a disk galaxy. The paper by Kerr and de Vaucouleurs giving their results was published in the *Australian Journal of Physics* in 1955.

RETURN TO THE UNITED STATES: LOWELL OBSERVATORY AND HARVARD COLLEGE OBSERVATORY

I met Gérard and Antoinette again in 1957 at a meeting of the American Astronomical Society. I had with me some spectra of galaxies that Geoffrey and I had obtained at the McDonald Observatory. We were at the time working at the Yerkes Observatory, University of Chicago, and were spending much time at McDonald, observing the rotation curves of galaxies for determination of their masses and mass-to-light ratios. I recall during this society meeting Antoinette loaning me a small iron with which she always traveled (she was always so beautifully dressed!) so that I could iron creases out of my dress.

I showed Gérard and Antoinette a spectrogram we had obtained of the southern galaxy NGC 5128. We were proud of having managed, by lying on the roof of the McDonald coudé telescope room, to observe that far-south galaxy (declination –43°!) and clearly detecting the rotation of gas in the dark belt of dust across NGC 5128. Gérard was fascinated, and I think the spectrogram played a part in persuading him that it was time to leave the Southern Hemisphere and come to the United States. With Gérard's early interest in the planet Mars as a clear recommendation to the Lowell Observatory, Arizona, long famed for planetary studies, he was appointed there. He spent one year at Lowell, and then the years 1958-60 at Harvard College Observatory. Publications while he was at Lowell included a study "Magnitudes and Colors of Galaxies in the U, B, V System" (1959) (using Harold Johnson's photometric system rather than the old photographic and visual magnitudes). This

may have been the start of a friendship between Gérard and Harold Johnson, leading to Gérard's appointment at the University of Texas in 1960.

PASADENA AND THE CLASSIFICATION OF GALAXIES

Allan Rex Sandage was working at 813 Santa Barbara Street on his major work on the extension of Edwin Hubble's classification of galaxies, from ellipticals through the spiral sequence to the irregular galaxies, and production of the Hubble atlas. He spent much time with de Vaucouleurs during the time that Gérard and Antoinette were visiting Pasadena, gave Gérard access to his photographic plates, and encouraged Gérard to develop his own classification scheme. This classification scheme was described in several publications starting with a 35-page chapter in the *Handbuch der Physik* on "Classification and Morphology of External Galaxies."

THE UNIVERSITY OF TEXAS AND MCDONALD OBSERVATORY: WORK ON GALAXIES FROM 1960

The McDonald Observatory in southwest Texas was created in 1938 under the leadership of Otto Struve, at Yerkes Observatory, University of Chicago. For many years McDonald Observatory was managed by the director and colleagues at Yerkes Observatory and its instruments were designed and built there. The so-called B spectrograph, used at the prime focus of the 82-inch telescope to photograph galaxy spectra and whose spectrogram of NGC 5128 had so intrigued de Vaucouleurs, had been built by Horace Babcock and used extensively by Thornton Page for radial velocities of double galaxies, and by Geoffrey, Kevin Prendergast, and me for our work on rotation curves, masses, and mass-to-light ratios in spiral galaxies.

In 1959 the University of Texas began the development of an astronomy department and by 1969 management of

the McDonald Observatory had passed from the University of Chicago to the new University of Texas department. From his appointment in Texas to his death in 1995 Gérard was a leader in observational work, the teaching and encouragement of students, and the publication of much important work. He developed new instrumental techniques, such as the use of Fabry-Perot interferometry, to measure the velocity fields in spiral galaxies and along with Antoinette turned his attention to galaxies with activity in their nuclear regions.

An article by Jean Heidmann,[7] published in the memorial volume for Antoinette de Vaucouleurs, reported that he had been told by his friend Pascal Fouqué that Antoinette had noted in 1958 that the luminosities of the central parts of the nuclear regions of several Seyfert galaxies varied perceptibly in as short a time as a month. Seyfert galaxies, named from the original Mt. Wilson paper on a dozen of these by Carl Seyfert, have bright nuclei displaying emission lines in their spectra and are now recognized as prototype active-galactic-nuclei galaxies. Antoinette, with her careful attention to all details of the galaxies she was examining, had spotted the variability. Apparently Gérard, as he admitted later, was skeptical and told her that if anything in the Universe did not vary, it was surely the galaxies! "That was the greatest error in my life!" Gérard told Pascal Fouqué.[8]

Ten years after Antoinette's observation, details of observations of such variability appeared in 1968 in two joint publications by Gérard and Antoinette, and two short papers by Gérard and Antoinette in 1972 and 1973 described variations in the nuclear luminosity of the Seyfert galaxies NGC 3516 and 5548.

THE HUBBLE CONSTANT AND EXTRAGALACTIC DISTANCES

Distances in the extragalactic universe will always be linked with the names Hubble and Sandage. Gérard de Vaucouleurs

also became interested, particularly after spending time with Allan Sandage in Pasadena. The Hubble Constant, H_0, defines the relation between the luminosity of galaxies selected to have as similar properties as possible, as measures of their distances, and the redshifts measured in their spectra, produced by their recession velocities in the expansion of the Universe.

Sandage and Gustav Tammann, in a series of papers during the 1970s, had a value for H_0 of 57 (later 50) km/sec per megaparsec. But de Vaucouleurs favored a larger value, up to 100 km/sec per megaparsec. He worked on this between 1976 and 1987 and wrote numerous papers in various journals. He drew a figure that became famous for a few years: the Eiffel Tower in Paris with all the steps leading to determination of H_0 from the base (the Cepheid variable stars in nearby galaxies) to the far Universe. He called it "Une Construction Solide et Durable pour Atteindre H_0." Lucienne Gougenheim (at Meudon Observatory, France) and Brent Tully (University of Hawaii), commenting on the different results obtained by Sandage and Tammann and by de Vaucouleurs, expressed this disagreement as, "The Universe may be more complicated than the standard model would suppose, something that de Vaucouleurs has long suspected."

THE REFERENCE CATALOGUES

If one had to select one of his hundreds of publications that is used by astronomers worldwide and that always brings to mind Gérard de Vaucouleurs and his contributions to the study of galaxies, one might choose the *Third Reference Catalogue of Bright Galaxies*. This was the three-volume successor to the first and second catalogues, and was published in 1991, with coauthors in Texas and France and, of course, Antoinette. She was working on this when she heard the

dreadful diagnosis of cancer of the bone marrow in October 1986. Although in pain, she was able to work on the catalogue until June 1987, just ten weeks before she died. During this period I used to receive phone calls from Gérard two or three times a week to tell me of her progress or lack of it and to ask about doctors and what might be newly discovered treatments and cures. It was a sad time.

SYMPOSIUM IN THE EIFFEL TOWER

There were some happy occasions near the end of Gérard's life. A special occasion in his honor was organized by his friends in Texas, to be held in a place of his choice—where else but the Eiffel Tower Restaurant in Paris! Following this he met an old friend in Paris, and they were married—Elysabeth, who survives him. He was elected to the National Academy of Sciences in 1986. But he had not much longer to devote to his lifelong love of astronomy—he died on October 7, 1995. His legacy to astronomy is demonstrated by this necessarily brief list of selected references; only a few of his more than 400 contributions are included here.

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