



Guido Münch y Paniagua

1921–2020

BIOGRAPHICAL

Memoirs

*A Biographical Memoir by
Virginia Trimble*

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NATIONAL ACADEMY OF SCIENCES

GUIDO MÜNCH Y PANIAGUA

June 19, 1921–April 29, 2020

Elected to the NAS, 1967

At the time he was moving from the California Institute of Technology and the Mount Wilson – Palomar Observatories to the University of Heidelberg and Calar Alto German-Hispanic Observatory in 1977, Guido Münch stated¹ that the accomplishments of which he was proudest were (1) recognizing the importance of pressure-induced absorption (by hydrogen molecules in the atmosphere of Jupiter), (2) the study of interstellar absorption lines that traced two of the Milky Way's spiral arms and revealed clouds of gas falling down into the Galactic plane, and (3) investigations of internal motion (turbulence) in emission nebulae, especially the Orion Nebula. A later appraisal would probably have included a dozen years as director of Calar Alto that featured the commissioning of two telescopes much larger than the ones that had been in operation when he arrived.



Photograph by Virginia Trimble



By Virginia Trimble

However, an accounting by someone else would surely include (1) increased understanding of radiative transfer in the atmospheres of the sun and stars, (2) development of mathematical techniques for analyzing the brightness fluctuations in the Milky Way and for extracting the real distribution of stellar rotation speeds from the observed ones (these from his years at the University of Chicago working with Subramanyan Chandrasekhar), (3) what the first missions to Mars should expect in terms of atmospheric pressure and water concentration in time to affect the details of those missions, (4) continuing the series of synoptic images of the Crab Nebula after the death of Walter Baade, and (5) various issues concerning the core of the Andromeda galaxy and the mass-to-light ratios of spiral and elliptical galaxies. He also agreed during that interview to take some credit for guiding more than a dozen Caltech graduate students (of whom the present author was one) and was the only astronomer to contribute chapters to three of the volumes of the Kuiper compendium, *Stars and Stellar Systems*.^{2,3,4}

BIOGRAPHY

Münch was born and spent his childhood in a small town, San Cristobal de las Casas in Chiapas, Mexico, at an altitude somewhat above 7000 feet. His father, August Münch, was Mexican born, but had his schooling in Germany, where there were in late 1950's still family members who knew how Guido liked his socks folded. The senior Münch returned to Mexico in the context of the First World War and married Maria Paniagua, from an old, but not particularly distinguished partially Mayan family. Of their three children Guido was the eldest, followed in about a year by a brother Luis and in another four years by sister Elsa. A divorce and remarriage left Guido with half-brothers about the same age as his two oldest sons. The language in the Münch home was Spanish with some English. Guido later expressed the wish that his father had taught him German, which he eventually had to learn as an adult, with much greater difficulty.

The future astronomer had his primary and secondary education in the local public schools, and the family belonged to the middle class for which college was expected, typically at the Universidad Nacional Autónoma de México (UNAM). There were three professional courses available, and Münch, with some fondness for mathematics and none for law or medicine, enrolled in the preparatory program for Civil Engineering. The two years of science and mathematics went well. The following curriculum in practical engineering prompted him to move to the School of Philosophy, which had a mathematics stream.

Chance clearly played a major role in the next few years. The dedication of Tonantzintla Observatory in 1941 brought many American astronomers to Mexico City, including Otto Struve, director of Yerkes, who thought that the up-and-coming young students there in Mexico deserved more opportunities. Münch had recently assumed a computer-like position at the older Tacubaya Observatory, whose director, Joachim Gallo, thought of him when Struve wrote offering a job as an assistant observer to one of their young workers. Münch took this up, arriving in the US (after some paper work) on 1 April 1943. During a month or so at Yerkes, he met Subramanyan Chandrasekhar for the first time, and thereafter acted as something like Struve's night assistant at McDonald Observatory (in Texas, though administered from the University of Chicago). A paper on binary star θ^2 Orionis, Münch's first publication⁵ resulted from Struve handing him a bunch of plates and saying he should learn to do the job on his own.

The expiration of a visitor's visa required Münch to return to Mexico in 1944, in spite of his having registered for the US Selective Service. Though never called up, he was

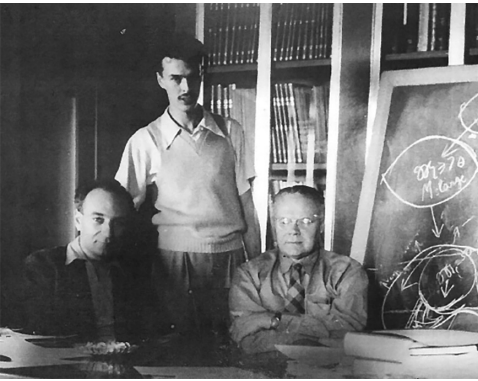


Fig. 1: First-year graduate student Guido Münch at McDonald Observatory, flanked by director Otto Struve to the right and Vladimir Kourganoff to the left. (Courtesy of Laurence M. Trafton.)

therefore eventually eligible for US citizenship. After receiving his master's degree from UNAM in 1944 and successfully applying for a Guggenheim Latin-American Fellowship, he returned to Yerkes, though there had been great temptation to go to Princeton in mathematics under Solomon Lefschetz, who had developed a great fondness for Mexico and spent his summers there. Six Chicago students received PhDs between 1944 and 1948 for work with Chandrasekhar - five women and Guido Münch, whose thesis, on the spectrum of the sun (which noted the agreement of the derived absorption coefficient with what was expected from H-), appeared in the *Astrophysical Journal*.^{6,7}

Both Münch and his Chicago/Yerkes mentors had always intended that he would return to Mexico,

and he indeed proceeded to Tacubaya, but then relocated mostly at Tonantzintla, because the older observatory had almost no equipment. A near-permanent return to the United States was occasioned by the offer of an instructorship at Yerkes, some disagreement with Manuel Sandoval Vallarta about what Münch's salary and responsibilities might be in Mexico, and his plan to marry a young lady from Williams Bay, Wisconsin, Virginia Eva Case. They had three children, Fred, Peter (later Siri Jadhva Khalso) and Amelia Gay (called Amy). As I write this, Amy the youngest, has grandchildren, so it must all have been a long time ago.

That marriage ended in divorce; youngest son, Christopher, is the child of his second, to Louise Fernandez which also ended in divorce. His third and fourth marriages, to Danish-born Eve-Marie (who accompanied him from California to Europe) and Argentina-born Maria were childless, and both pre-deceased him.

FROM CHICAGO THEORIST TO CALIFORNIA OBSERVER

It is probably safe to say that relations between a graduate student and the advisor are never entirely unfraught. It is true that Chandrasekhar appeared as first author on many papers with his students and former students (including Münch), though never on the specific papers tied to their PhDs.^{6,7} In particular Chandra's text, *Radiative Transfer*,

gives credit in the preface to Dr. G. Münch “who drew all the diagrams”, though he had also participated in writing, proof reading, and so forth, and in 1977 complained that Chandra had blamed him for two equations with the = sign missing from their multiline lay-outs (I confess I have never located these in my Dover 1960 edition of the book, which is said to be slightly revised and perhaps has the =’s inserted.).

It remains true that several of the Chandrasekhar & Münch collaborations were quite influential at the time and have accumulated sizable numbers of citations over the years. These include the derivation of an equation to relate an observed, but obviously selection-biased, distribution to the real one,⁸ and a series of six papers addressing another statistical problem, “The theory of the fluctuations in brightness of the Milky Way. I to VI.”⁹⁻¹⁴ All are Chandrasekhar and Münch, except paper IV which Guido later said he wrote when Chandra was in India and managed to sneak into the editor’s office before Chandrasekhar took over that job later in the year, in succession to Struve, for whom Münch had refereed many papers.



Yerkes Observatory staff photograph, 1946. Münch in the center of the front row, with fellow graduate student Anne Underhill on his right, director Otto Struve immediately behind, S. Chandrasekhar and Jesse Greenstein third and fifth from right in the seated row. (Courtesy of the University of Chicago Library).

It is probably the case that Chandrasekhar's name as co-author with many of his students contributed to Münch almost never appearing as his students' co-author. And alternatives to Chicago beckoned. In 1950, C.D. Shane, director of the Lick Observatory (associated then with the University of California, Berkeley) invited Münch to visit and consider an appointment there. It chimed the voice of Jesse L. Greenstein, hired by the California Institute of Technology from Chicago in 1948 to establish an astronomy program there, to go with Palomar Mountain Observatory, soon (by astronomical standards) to be the site of a 200" diameter telescope. Why not also visit Pasadena while you are on the west coast, suggested Greenstein to Münch. The visit took place; offer of a position followed; and the two former theorists became the first two Caltech astronomers, teaching a considerable range of courses with modest help from the observers at the offices of the Mt. Wilson Observatory a couple of miles away. The two observatories were jointly administered as the Hale (for George Ellery) Observatories for most of the next three decades.

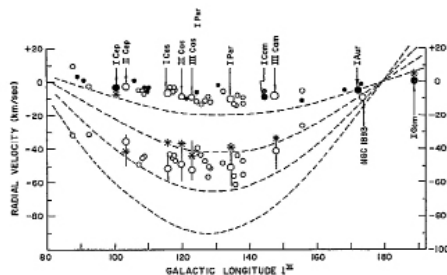
When he arrived in Pasadena, Münch had felt (so he said later) a real lack of understanding about construction of telescopes, especially spectrographs and how they might be improved. Some combination of experience and collaboration with suitable colleagues (especially Gerry Neugebauer when it came to infrared instrumentation) clearly remedied the defect, if it had ever existed. He became particularly fond of Fabry-Perot interferometers, which scan in transmitted wavelength by adjusting the spacing between two reflecting surfaces. After 15 or so years as mostly an observer and in connection with possible alternative affiliations, Münch remarked that he was a better theorist than most people realized. As a (mostly) spectroscopist, working (mostly) on sources within the Milky Way, he used (mostly, perhaps entirely) "light time," the half of each month with the most moonlight, slipping in occasional extra galactic objects at the beginnings or endings of nights, when the moon had not yet risen or had already set. The "dark" time, that is the other half of each month with little moonlight, on both the 100" (Mt. Wilson) and 200" (Palomar Mountain) telescopes was primarily assigned to astronomers working on other galaxies and later quasars, trying to determine cosmological parameters and the large-scale distribution of mass, or at least light, in the cosmos. Münch was occasionally known to forget that Mt. Wilson kept "mountain time", that is standard time throughout the summer months.

On at least two occasions, before actually doing so, Münch considered leaving Caltech and the Hale Observatories. The first was during a 1958 sabbatical in Germany with Reimar Lüst (then at the Max Planck Institute in Munich) who tried to persuade him to

These include a rather wide range of topics and so are more clearly seen grouped that way than if traced chronologically.

ACHIEVEMENTS DURING THE CALIFORNIA YEARS

Down here in the middle, where perhaps no one will notice it, is maybe the right place to suggest that Guido was possibly a bit unfair to his brother during his oral history interview. True presumably that Luis Münch had no formal training in science and functioned more or less as a night assistant, but he has about 24 sole-author papers (mostly in Spanish) in the Astrophysics Data System, plus at least one with his brother¹⁹ and a fairly



Münch's observations of radial velocities of interstellar absorption lines in the spectra of relatively distant stars trace out two spiral arms of our Milky Way galaxy.

highly cited paper (including some recent citations) with William Morgan.²⁰

Returning to the main topic, Münch noted in the oral history that a much better job of spiral structure from interstellar absorption lines could have been done with the right equipment – that is, either a Coudé focus on the Mt. Wilson 60" or the 100" able to access the right part of the sky. Indeed, he thought that, with one or the other of those, Walter S. Adams could have discovered gaseous spiral arms around 1949.

Gas infalling to the plane of the Milky Way. The dominant paper was Münch and Harold Zirin²¹ (the latter newly-arrived at Caltech and the observatories). The issue then (and to a certain extent still now) was whether this was fresh gas coming from far outside the Milky Way or part of a circulation pattern, with gas blown up and out by supernovae and falling back. As is often the case in such dilemmas, the answer is probably “both, please.” Münch said in 1977 that he would like to revisit the issue with radio data, and that he had talked with the radio astronomers at Bonn concerning the use of the 300' Effelsberg telescope. If this ever happened, he was not among the authors.

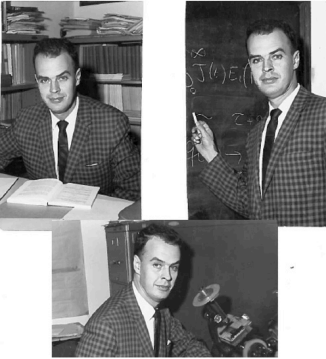
Ventures into extragalactic astronomy. Somehow these all turned out rather unhappily. There was a sort of rotation curve for M82;²² an attempt at mass to luminosity ratios for a number of galaxies²³ reporting numbers around 30 for both spiral and elliptical galaxies and citing Martin Schwarzschild for $M/L = 800$ in the Coma cluster; no mention of Zwicky, and somehow sufficiently obscure that I didn't catch it when reviewing evidence for dark matter back in 1987.²⁴

In the wake of the discovery of a 21 cm expanding gas arm about 3 kpc from the center of the Milky Way, Münch examined gas around the center of M31.²⁵ The length scale was, however, closer to 300 pc than 3 kpc. Münch affirmed the reality of the expansion at IAU Symposium 15 the next year, in response to a question from Lodewijk Woltjer.²⁶

And then there were Quasi-Stellar Radio Sources (QSRS, quasars). Münch's name appears on a couple of multi-author reports, presumably because he contributed one or more spectra (of 3C 273 for instance), but he took no further interest in them.

Turbulence in the interstellar medium and elsewhere. Turbulence is inherently dissipative, with energy tending to migrate down to smaller and smaller scales until it is lost as heat. The question therefore arises, what puts energy back into turbulent motions of the galactic gas on both large and small scales, the latter appearing as turbulence within individual emission nebulae like Orion. The input seemed and seems to go the opposite direction – from stellar winds stirring HII regions to HII regions and supernova

remnants stirring gas on larger scales. Münch addressed those issues many times, starting as early as 1952²⁷ and continuing into his years at Calar Alto²⁸ an application of a Fabry-Perot scanner on the Calar Alto 1.2 meter telescope.



What astronomers did in around 1966: reading and writing of books; lecturing at chalk boards; measuring stellar spectra at a spectral comparator. (Courtesy of Virginia Trimble.)

Still worth reading, if you can find them, are Münch in 1965 on “Galactic structure and interstellar absorption lines”²⁹ which ends with the thought that bringing remnants of Type II supernovae into the picture “will require extensive additional work, mostly of an observational nature;” and a sort of meditation on Selected Topics on the physics of the interstellar medium,³⁰ dealing with composition as well kinematics and dynamics. The two volumes are based on lectures given at the 1968 Second Summer Institute for Astronomy and Astrophysics, held at the State University of New York Stony Brook. Incidentally, Woltjer in Volume 2³¹ concludes that any one of supernovae, HII regions, or cosmic rays contain enough energy to keep the turbulence alive.

The paper that I think Guido would most have liked to see cited here is the one on Internal Motions in the Orion Nebula.³² The paper appears in the proceedings of a symposium, part of a series called *Cosmical Gas Dynamics*, and of the 80 or so participants, four were from the Soviet Union, which was a lot for those times of restricted US-USSR cooperation!

Most intriguing is the paper “Space-time correlations in stationary isotropic turbulence.”³² It was undertaken in connection with a study of electromagnetic wave scattering in earth’s atmosphere; random fading of radio signals; scintillation of radio stars; and microwave propagation beyond the horizon. That this was “defense related” becomes clearer if you winkle out that co-author Wheelon (1929 – 2013), who was a long term member of the Caltech Board of Trustees, was then at Ramo-Wooldrige (from 1952 to 1962), went on to the CIA (1962-66), and ended his career at Hughes Aircraft. On the paper, Münch gave the Ramo-Wooldrige address, but was only consulting there and listed Caltech as his permanent address. He also put in some consulting time at Jet Propulsion Laboratory (JPL), saying this was mostly for extra money (though he seems also to have made use of infrared detector expertise there).

How do I know that what later became T (for Thompson) RW was heavily involved in classified work? There still hangs on my wall a poster from my father's year working there with the caption "Know their identity before discussing classified information" The picture is an old fashioned drawing of Little Red Riding Hood in bed with the wolf.

Stellar atmospheric compositions. Yes, he occasionally had a spectroscopic look at these, or guided students who did, but his mid-career view was that no composition anomaly of less than a factor two should be taken seriously.

Onward to longer wavelengths and shorter distances. Several of Münch's most highly cited papers are collaborations reporting results from the Mariner (to Mars) and Pioneer (to Jupiter and beyond) Missions.^{34,35} The collaboration with Gerry Neugebauer, who came to Caltech from JPL, bringing considerable infrared expertise with him, was clearly of great importance. But it had started on the ground, with Hyron Spinrad, Münch, and Lewis D. Kaplan³⁶ saying that the sporadically reported lots of water in the Martian atmosphere had turned out to be contamination from terrestrial water vapor. A prime consideration for the location of modern large optical telescopes is to be above as much as possible of the terrestrial water vapor ("precipitable water"). Probably the most important of these ground-based infrared papers was another collaboration with Kaplan and Spinrad, which rightly concluded that the atmospheric pressure at the surface of Mars was very much less than the previous consensus value.³⁷ Luckily the data became available in time to affect the design of the first US Martian lander. Münch continued to appear as a co-author on some Pioneer papers for several years after moving to Europe.³⁵

LEAVING CALIFORNIA

By the time of the 1977 oral history interview Münch had already been living in Europe for about a year, and had informed the Hale Observatories and the California Institute of Technology of his official resignation effective 1 January 1978. This would result in greatly reduced access to telescopic collecting area, whether for infrared or visible light (and a few papers with residual 200" etc. data slid out for a few years). But the drivers were both professional and personal. His third wife, Eve-Marie, was a very elegant European woman (though they met while she was in Southern California), and when he retired, they chose to live in Spain, not the USA.

The professional issue was for what Münch perceived as a fatally deteriorating situation at the Hale Observatories (in contrast to apparently secure financial situations in Germany and Spain). Horace W. Babcock (1912-2003) was due to retire as observatory director

upon turning 67, and a new director would be wanted. Münch suspected he was in line for the job and did not want it for several reasons. He thought Babcock had made an enormous, financially disastrous error in deciding to develop the Las Campanas site with a 100" telescope, when the available money would have been much better spent upgrading the 200". And Münch thought that the Carnegie Institution – Caltech collaboration that had permitted joint staff operation, etc. for the Mt. Wilson and Palomar Mountain Observatories was about to fall apart, probably when Phillip Abelson stepped down as head of Carnegie (this in fact eventually happened, after Maarten Schmidt had briefly taken on the joint directorship).

Münch also felt that the balance between Hale Observatories and the national ones was badly prejudiced in favor of NOAO and such in terms of evaluation of proposals, allotment of funds, and so forth.

THE EUROPEAN YEARS

Münch's expectations about financial support, at least early in his time as Professor at Heidelberg and Director of the Calar Alto Observatory (1978-1989), were apparently justified, based on his first annual report, co-authored by Hans Elsasser,³⁸ submitted from the Max Planck Institute. The 1.2 meter was in regular use, the 2.2 meter almost complete, with the 3.5 meter to come. The staff included 22 scientists, 3 associates (including A. Behr of Heckmann-Schücking-Behr cosmologies, of Hamburg, so cosmology wasn't entirely the enemy!), 10 foreign guests (including Bambang Hidayat of Indonesia and Peter Wehinger from the USA, so no major grudges against the previous host country!), 5 doctoral students, and 55 technical personnel (probably outnumbering the support staff at Hale). Two or three further annual reports appear under Münch's name, and there are later ones by Elsasser. They had more or less divided the administrative tasks as Elsasser = business director, Münch = scientific director. Elsasser carried on alone for the next few years after 1989.

And by the time of Münch's retirement, his colleagues in Spain were still sufficiently fond of him to organize "Guido's Jubilee", IAU Colloquium 120, "Structure and Dynamics of the Interstellar Medium" at the Instituto de Astrofísica de Andalucía. This was organized along a fine combination of German and Spanish principles, with, for instance, the last speaker in a session being told to keep strictly to time, though finally getting to start a couple of minutes after the nominal end time. Not the sort of thing normally to be remembered, but I was that speaker. The conference banquet went on for many hours, with Guido singing and playing guitar (Maria Bonita, yes, but refusing Adios Mariquita

Linda), and expressing surprise when your present author took over the guitar (which she had not learned to play until after leaving Caltech) for a run-through of “Juanita” in Spanish, which Anneila Sargent quickly joined in English, because it had been her mother’s party song.

Münch’s astronomical publications from the Max Planck – Calar Alto years appeared mostly in *Astronomy and Astrophysics*, the all-European journal of which both countries are/were sponsors. His most frequent co-author was Hans Hippelein (who remarked that Guido often rewrote what he, Hans, had written, but whether for scientific or linguistic reasons is not quite clear), and the data came from, first, the Calar Alto 1.2 meter telescope. The most cited of these papers deals with a HII region.³⁹ One more student completed her PhD with Münch nearly a decade after his official retirement through the La Laguna University in San Cristobal de La Laguna on Tenerife in the Canary Islands, where Guido and Eva-Marie were then living, and he had some sort of academic affiliation. He and Eva-Marie had continued to live in Almeria for a while after 1989 but moved to Tenerife feeling that the climate would be better for her respiratory problems. She died in Spain of cancer in about 1992-93. By the epoch of the January, 1999 membership directory of the International Astronomical Union, he reported an address at a retirement home (Casa de Mañana) in La Jolla, California, and he said that one of the reasons for returning to the US was that such institutions were more attractive and available here than in Europe. Proximity to some of his children was also relevant. He returned to California with his fourth wife, Maria, who also developed assorted medical issues and pre-deceased him.

Münch’s last published paper had initially been advertised as an after-dinner talk, but appears in the proceedings as if the first, introductory presentation.⁴⁰

The 2021 AAS directory still locates CAHA and Calar Alto Observatory in Almeria and part at least of the Instituto de Astrofisica de Canarias at La Laguna, Tenerife. It is clear from the CAHA annual reports that Münch was, at least occasionally, assigned telescope time, and he appeared as author or co-author of *Astrophysics Data System* papers on

- highly excited molecular hydrogen in M42 and other nebulae, including Orion
- H-alpha emission in directions toward high velocity 21 cm clouds
- post-perihelion photometry of comet Halley
- C₂ in comet Halley

- something about planetary nebulae
- GIOTTO flight dynamics
- vibration band of water in Orion (nebula)
- molecular carbon in distant supergiants
- dust in HII regions
- internal reddening of HII regions and Herbig-Haro objects, e.g. W3, NGC896
- molecular hydrogen emission at $1.084\ \mu$ in Orion
- effect on spectra of emission nebulae due to scattering by internal dust
- development of a Fabry-Perot for the 3.5m Cassegrain double star spectrograph
- HII region driven by WR star (HD 56925 & NGC 2359)
- forbidden [OI] in Orion A & B (M42 & NGC 2024)
- redetermination of the rotation period of Uranus (really its rotation velocity)

The implication of all these is that, while Münch gave up access to the largest telescope operating in the world by moving to Europe, he made extraordinarily good use of what was available there.

HONORS AND RECOGNITION

Guido Münch was elected to the IAU from Chicago, and by the time he was established at Hale Observatories was a member of commissions 29 (Stellar Spectra) and 34 (Interstellar Matter and Planetary Nebulae). Later Commission memberships included 33 (Structure and Dynamics of the Galactic System), 36 (Theory of Stellar Atmospheres), at various times also 36 as Spectrophotometry, the organizing committee of 33 (1961-64), and various Divisions.

He also joined the American Astronomical Society from Chicago, was a member of its Council for the term 1961-64 (nearly the last member to have only



Subject and author in Mexico City in August 1965. (Courtesy of Virginia Trimble.)

a first initial in the AAS directory listing of past leaders), let that membership go soon after moving to Heidelberg, but he reappears in the 1998 Membership Directory as an emeritus member with an address in La Jolla (and remained so until his death, though the 1999 directory gives an affiliation as University of Helsinki Observatory). He joined the Astronomische Gesellschaft in 1978, according to one of their publications.

Recognition came from both sides of the Atlantic. Münch was elected to the American Academy of Arts and Sciences in 1962 and the US National Academy of Sciences in 1967. He received a NASA medal of Exceptional Scientific Achievement (for the Mars-related work) in 1974. From Spain came the Premio Principe de Asturias de Investigacion Cientificos y Technico Prize for Civil Investigation in 1989 and the Order Alfonso X el Sabio in 1998. He received an honorary degree from the Mexican university INAOE and was elected to the Third World Academy of Science in 1984. In addition to the three Guggenheim Fellowships, Münch also held a Fulbright in 1958 for his first venture into European astronomy (INAOE = Instituto Nacional de Astrofisica, Optica, y Electronica).

GUIDO MÜNCH Y PANIAGUA IN SONG AND STORY

When first asked to prepare this memoir, I did two things: first type up everything I remembered first hand or having been told by Guido 1965-68 and a bit thereafter; second was to hunt out email addresses for all of his former students then living and ask for anecdotes, memories, and so forth. Eventual responses came from 15, all of which pertain to the Caltech years and thereafter. A few colleagues from the Calar Alto years also responded to requests for information and anecdotage.

Two items from the earlier years (in the category “Guido told me”.) First, at some time during his childhood in San Cristobal, they were visited by B. Traven, the semi-legendary author of *The Treasure of Sierra Madre* (and other novels), whom his father had known when they were both in Germany before World War I. Second, some of his expertise in mariachi-style guitar playing and singing came from his student days in Mexico City, when (in addition to the more respectable employment mentioned in his oral history and above), he earned some pocket money by playing with friends in the streets.

Indeed, when asked in 1977 about non-scientific avocations, he mentioned playing the guitar first, and also reading, especially history, and working around the house. The tinkering abilities of an instrument designer and sometimes builder were surely wasted during the apartment-based years between Münch’s second and third marriages.

His guitar-playing and singing (a light baritone) were both in evidence during the Caltech years, and after a glass or two of wine, the singing improved, the playing perhaps deteriorated a bit. Carlos Eiroa (now at UAM in Spain) noted that, when he arrived at the Max Planck Institute for Astronomy in October, 1976, he and Münch were both in lodging for a time, Münch used to go outdoors to play guitar, and Eiroa mistook him for another new scholarship student, though the hair by then was already very thin on top, a point about which Münch had long been sensitive. He once contemplated a “peruke” of color-matched human hair. He also contemplated circumcision, but didn’t do that either. The most expensive present he ever asked for was a complete set of recordings of the Beethoven piano sonatas. He got it, though my food budget took a 20% hit for months. And he generally called Johannes Brahms “Prunes.”

The students, colleagues, and other friends of Guido’s who contributed items to both this section and some of the earlier ones included (not in any very rational order)

Richard Bondo Larson, Christopher Marlowe Anderson, Sven Eric Persson, Jeffrey Drexel Scargle, Carlos Eiroa, Hans Hippelein, Monica Rodriguez, Hans Zinnecker, Roland Gredel, Kurt Anderson, Anneila Sargent, Laurence Trafton, Jay Albert Frogel, Eric Becklin, and Bruce Peterson (responding for Vicki).

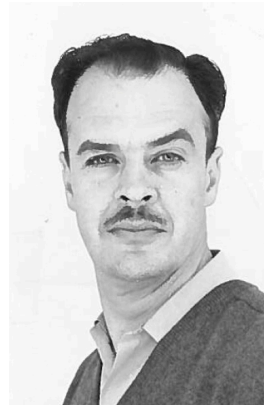
Most of the reminiscences belong to one of three categories (1) Münch and wine (etc.), (2) Münch and women, and (3) Münch interacting with his students.

Let’s take the third category first. Several reported having been initially frightened by his clearly high expectations for them, especially when something had gone wrong, but later definitely kind and supportive when someone needed some time off from work. Larson reported that his initial goal was to study formation of whole galaxies, but Münch persuaded him to try to understand first the formation of a single star. This was a career-forming, successful choice. Chris Anderson remembered being tasked with taking an image of Venus at inferior conjunction to learn about its upper atmosphere, getting photos that were nowhere near good enough to address the issues, but then being guided through a thesis on properties of interstellar gas clouds and being then recommended to the University of Wisconsin for an entry-level position. He spent the rest of his astronomical life there. Chris also remembered being in a dark room with Münch, who lit a cigarette while a plate was still in the developer. Chris must have let out a gasp, because Münch said “Eet’s OK, Crees, they are just IIaO’s” (that is, plates with no red sensitivity).

Jeff Scargle recalled fond memories of Guido's warmth and intelligence and being given the Palomar continuum plates of the Crab Nebula, because Guido knew of Jeff's interest in plasma physics (another career-transforming interaction). On the other hand when Jeff had returned to Caltech from an early postdoc at UC Berkeley to give his "degree talk," Münch, in introducing him, went on and on with a lot of generous comments and details, such that Jeff began, "Well, I guess that pretty much covers it. Are there any questions?" Scargle appeared a second author of "The spectra of two extremely red objects,"⁴¹ but feels he had done very little, and that Guido was being very generous.

At one stage, the Caltech astronomy graduate students produced a chart of the lecturing capabilities of the faculty (reports Anneila Sargent) which extended from bad down to "beyond belief", and Münch was second to the bottom. She, however, found that if one took verbatim notes and studied them thereafter, that there had actually been a great lecture presented. This was almost my experience, although the lecture notes sometimes seemed to be ones he had taken in a Chandrasekhar class on stellar atmospheres. He also taught planetary atmospheres at least occasionally.

Larry Trafton was aware as he was carrying out the computations for his thesis that Münch thought the idea was important (pressure-broadening of molecular hydrogen features as an important greenhouse contributor for Jupiter), though the details were not verified until Pioneer 10 and 11 flew by some years later. Münch also thought that Trafton should have some observing experience, which resulted in their sharing a midnight lunch at which Guido bit off more than he could chew, in the form of a very hot red pepper, which turned his face as red as the pepper. The most dangerous moment during that run was, however, probably when Münch demonstrated to Trafton how the rolling chair on the Newtonian focus platform of the 100" at Mt. Wilson provided a warning that the observer was about to make a rapid descent to the dome floor in the form of a $\frac{3}{4}$ " wood strip that the chair's wheels would hit at the edge. Larry concluded that Guido judged when to stop from the horrified look on Larry's face. Trafton also had brief custody of some photos of Münch taken with other more senior astronomers around 1941-44 that are probably now lost from the McDonald Observatory archives. One of them appears at the beginning of this article.



"Guido Bandido." The mustache, like the umlaut, came and went. The monotonically receding hairline puts the date about 1967. (Courtesy of Virginia Trimble)

Earlier pages mentioned that Münch's interactions with Chandrasekhar were not always un-acrimonious, and Eric Persson mentions that Guido complained to him about the extent to which Chandra could be a slave driver, expecting results on Sunday morning of calculations that had been suggested only on Saturday afternoon. On the other hand a 1945 paper, ends by saying Münch is "deeply indebted to Dr. S. Chandrasekhar for his constant encouragement and advice," and Chandra's 1950 book, *Radiative Transfer* (page 316 in the Dover edition) thanks Dr. Münch, for "revising his calculations for the purposes of this book."

Two former students (who would perhaps prefer to remain nameless) reported that their mothers, meeting him for the first time, remarked upon his "bedroom eyes" and/or expressed a wish of being a decade or so younger, to fall within his category of interesting women. This provides a natural transition to anecdotes about Guido and women.

Four wives is by no means unique, shared indeed with the charismatic Russian astrophysicist Yakov B. Zel'dovich, and they shared also the loss in death of the deeply loved third. He must have left a mark on the first two, since neither ever remarried, though fairly young at the time of the divorces. Louise, the second, said she particularly missed him when she wanted to dance La Bamba.

Not that he was always precisely gracious to or about all women, least of all his colleagues. He said of Nancy Grace Roman (for whom the former WFIRST space telescope is now named) that she had all the grace of a baby elephant. And about Cecilia H. Payne Gaposchkin that a suitable present for her on some occasion would be "a shaving machine." And it is perhaps just a strange coincidence that, long before he won the Prince of Asturias award, he referred to the woman who had been Princess of Asturias in the early 16th century as "Juana la Loca." His behavior between the second and third marriages could perhaps best be described as "flamboyant." Unkindness is probably inherent in flamboyance. At least one of the women in his mid-1960's entourage was his own age within three or four years, Mildred Gloria Lloyd Guasti, the daughter of Harold Lloyd, silent motion picture comedian, (whose own online life is fairly complicated). Of her, he said, "she is old, ugly, stupid, and I love her." That last true at least to the extent of a fairly expensive emerald ring, of which he said "I hardly gave her anything."

Here is one curious tale that concerns none of "wine, women, and song." Skirmishes with Fritz Zwicky were a constant theme in Caltech and Hale Observatory astronomy at least from 1948 (when Greenstein arrived) to 1974, when Zwicky died. Librarian Eleanore Ellison, custodian of the books and journals held in Robinson, the astronomy building,

recalled one such squabble, about the color of some particular star. “You’re all color-blind!” hollered Fritz, and ordered a set of the Ishihara color perception testing plates, to which he subjected his colleagues. It turned out that Guido really was colorblind, more completely than just the fairly common red-green confusion.

This brings us to wine. Guido claimed that you can always get 12 more drops out of a bottle that had been declared empty by others. His tastes were quite broad, but did not extend to retsina (an awkward discovery on an occasion when I had prepared dinner for him, radio astronomer Peter A.G. Scheuer, and his then-best-gal, Mary). The Greek food was also not a great success. At one time Münch had developed an ulcer, and, with that in mind, asked for a whiskey and milk at some student party.

Reminiscences from another student included the occasion where someone found Münch apparently asleep in the host’s bathtub. And then there was the PhD-celebration for another of his students. Münch arrived late, probably already not entirely sober, and parked his car in an unfamiliar place. Festivities over, after additional consumption of student-budget drinks, he apparently wandered in the wrong direction, and encountered the late-night arm of the law. Uncertain orientation, insobriety, and a noticeable Mexican accent in mostly-still-stuffy Pasadena were not a good combination, and he spent the rest of the night in the local lock-up, to be bailed out the next morning by the woman who had spent the rest of the night in his apartment, in time for Münch to catch a plane to the east coast for some meeting of a government advisory committee.

At the time of his 1989 retirement colloquium, Guido Münch still had happy relationships with all of wine (as the conference lunch lengthened into a conference dinner), women (his much-loved third wife), and song (both his own guitar playing and singing, and that by others, though I shall always wonder why he refused to play or sing *Adios Mariquita Linda*). By the time of the 1997 IAU General Assembly in 1997, after the death of Eve-Marie, these had all faded. He had seen her through a fairly lengthy illness and death from metastatic cancer, and (most unfairly one cannot help but feel), in 2003 his fourth wife, Maria, then 84, required a hip prosthesis that never quite worked, Guido become once again a more or less full-time caregiver and no longer spent time with the astronomers at the nearby University of California, San Diego in La Jolla, as was his retirement home.

But if I were allowed only one memory, it would probably be Mother’s Day, 1965, when Guido came with me to a Farmer-Trimble family meal hosted by Uncle Roy and Aunt Esther Farmer, brought his guitar, played (*En el Alhambra*) and sang for us.

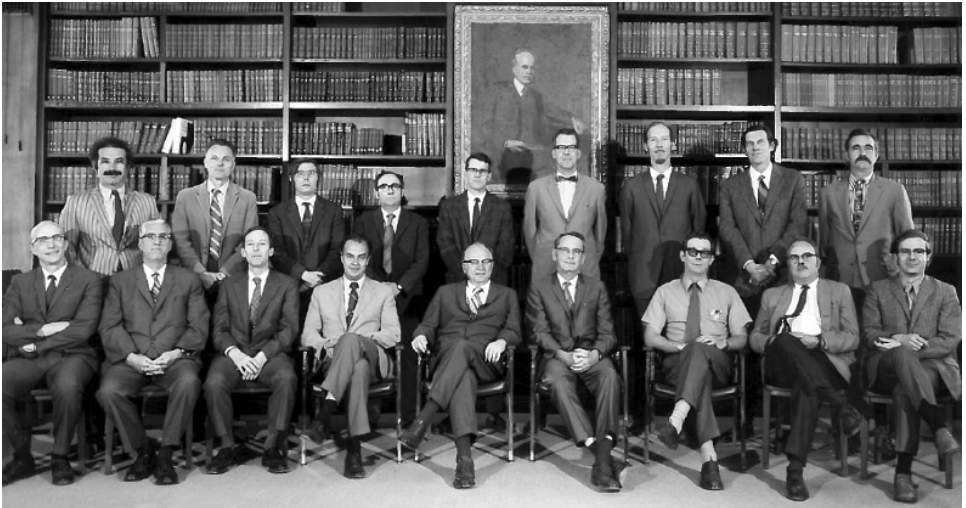


Fig. 7: Staff of Hale Observatories in 1971. Münch seated, fourth from left, Caltech astronomy chair Jesse L. Greenstein fifth from left, and former Münch student, James E. Gunn, who by then had returned from a postdoctoral position at Princeton where he eventually spent most of his career) on the right end of the seated row. Co-author Zirin is at the left end of the standing row and Co-author Neugebauer fifth from left (or right) in the standing row, flanked by Leonard Searle and Maarten Schmidt. Observatory director Horace W. Babcock (1912-2003), whose decision to establish Las Campanas Observatory contributed to Münch's leaving for Calar Alto is fourth from right in the front row. (Courtesy of The Carnegie Institution for Science).

Appendix: The Thesis Students

The Mathematics Genealogy Project credits Chandrasekhar with 17 students from 1946 to 1975, all but one from the University of Chicago, and 337 descendants, the largest number via Jeremiah P. Ostriker, followed by Russell Kulsrud and Guido Muench-Panigagua. Astrogen has 45 Chandra students (incomplete overlap with MGP), and Donald Osterbrock⁴² found 46 distributed across astronomy, physics, and chemistry, including five women who completed degrees between 1940 and 1973. One more, named only as Siciy, died before she could complete her degree.⁴³

“In Spring Siciy died. I had her and Backus (George F. Backus, 1956 Chandra PhD) for dinner on a Thursday evening. She went into surgery on Friday, and Tuesday she died. I was to go to Baltimore and Washington on Thursday; and on that morning I had to be

one of her pallbearers. I liked Siciy; and it was great pity she had to die.” One would, of course, like to know more, including whether the name, transcribed from a hand-written original, is correct.

G. Srinivasan⁴⁴ thought the total number of Chicago Chandra PhDs probably exceeded 50. As every honest theoretical astrophysics paper ends, “More work is needed.”

The Mathematical Genealogy Project credits Muench-Paniagua with 15 students, all but the last at the California Institute of Technology, including four women, and 32 descendants in later generations, all via James E. Gunn. Astrogen reports 18 Münch students, 1955-1988, including the last three in Europe, and four women.

Chandrasekhar said on one occasion that he preferred woman students, because they worked hard. Münch’s view on this topic has not come down to us. The list of 18 is probably incomplete, like Chandra’s, because of a few co-supervisions in departments other than astronomy. The topics of the Chandra-student theses generally track rather closely his chaptered career of tackling a new subject, wrestling it to what he felt was a satisfactory conclusion, writing a book, and then moving on to something else.

The table following here contains the titles of the Münch-student theses, and these track his own interests somewhat less closely. Trafton’s topic was actually the pressure broadening of H_2 absorption features in the atmosphere of Jupiter that Münch regarded as the most important of his own insights. Gunn carried out rather mathematical work on one of those large-scale, extra-galactic topics that his advisor had very little interest in. And Guido never really worked on the Crab Nebula after saying in 1958 that the long axis was probably aligned parallel to the Galactic plane and therefore parallel to the Galactic magnetic field, putting it 2 kpc away, not 1-1.5.⁴⁵ He also took over regular, large telescope imaging of both the filaments and the nebular continuum emission from the Crab after Baade left the task, but stopped after handing over the plates to students Scargle and Trimble.

One Caltech astronomy student, Waldemar T. Lungershausen, died while Münch was on the faculty, but was not specifically his student. Because his parents asked that his books be given to other students, I have the name, W.T. Lungershausen carefully printed on a couple of fly leaves. He was generally called Butch and was a World War I, Red Baron, fan. Although he did not complete a degree, the Astrophysics Data system records one paper of which he was a co-author: by Leonard Searle (at Mt. Stromlo), W. T. Lungershausen (at Caltech), and W.L.W. Sargent (at U California San Diego).⁴⁶ A footnote

states “We regret to report the tragic death of Mr. Lungershausen, a graduate student in the department of astronomy of the California Institute of Technology.” The acknowledgements explain that the work was begun at Mt. Wilson and Palomar Observatories and the California Institute of Technology (with thanks to J.L. Greenstein for the opportunity of working in his department) and continued at Mt. Stromlo, with thanks to Bart Bok from WLWS for hospitality there.

Appendix – Page 3 – Table

Year	Name	Thesis Title (Astrogen: Caltech alumni director)
1955	John Charles Stewart	A quantitative analysis of the atmospheres of three peculiar low luminosity B stars
1963	Robert Allan Ridley Parker	The physical conditions pertaining to some possible supernova remnants
1964	Manuel E. Mendez	The spectrophotometry of the Orion Nebula
1964	Robert Henry Norton	He ⁺ in stellar atmospheres
1965	Laurence Munro Trafton	A study of the energy balance in the atmospheres of the major planets
1966	James Edward Gunn	A mathematical framework for discussing the statistical distribution of galaxies in space and its cosmological implications
1968	Christopher Marlowe Anderson	The interstellar extinction of stars in HII regions
1968	Richard Bondo Larson	Dynamics of collapsing protostars
1968	Virginia Louise Trimble	Motions and Structure of the filamentary envelope of the Crab Nebula
1969	Jeffrey Drexel Scargle	Activity in the Crab Nebula
1970	Arsine Victoria Peterson	A Spectroscopic investigation of four O-type subdwarfs
1971	Judith Gamora Cohen	The Lithium isotope ratio in F and G stars

1972	Sven Eric Persson	Interpretation of the neutral helium triplet spectrum in planetary nebulae
1977	Jorge Melnick	The structure of giant extragalactic HII regions
1981	Pedro Gomez Garriso	Estudio espectroscopico en W4 (U. Madrid)
1987	Roland Gredel	Flourescent and collisional excitation in diatomic molecules (U. Heidelberg)
1998	Monica Rodriguez	The iron abundance in galactic HII regions (La abundancia de hierro en regions HII galacticas (U. La Laguna)
1969	Robert Terry Brinkmann	The photodissociation of water vapor, evolution of oxygen, and escape of hydrogen in the earth's atmosphere (Planetary Science and Astronomy, co-advisor)

NOTES

1. Guido Münch, interviewed by David DeVorkin at Palomar Observatory, July 7, 1977, Niels Bohr Library & Archives, American Institute of Physics, College Park, Maryland; <https://www.aip.org/history-programs/niels-bohr-library/oral-histories/4789>.
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