

The Dream of a Swedish Mathematician: The Mittag-Leffler Institute

Allyn Jackson

This year marks the thirtieth anniversary of the realization of the dream of one Swedish mathematician. In 1916, on his seventieth birthday, Gösta Mittag-Leffler promised his and his wife's considerable fortune to the goal of founding a mathematics institute. More than forty years had to pass after his death before the institute was launched in earnest in 1969 by another exceptional Swedish mathematician, Lennart Carleson. Despite the passage of time, Mittag-Leffler's dream of providing a haven for contemplating and discussing mathematics proved a durable one. The Mittag-Leffler Institute is a little gem, elegantly housed in a villa outside Stockholm and financially anchored by an endowment that has risen with the buoyant financial markets of recent years. Despite its small size, the Mittag-Leffler Institute holds its own in the increasingly crowded world of mathematics institutes as a serene and secluded place to do mathematics.

The Life of Mittag-Leffler

Born in 1846 in Stockholm, Gösta Mittag-Leffler showed an early aptitude for and interest in mathematics. He received his Ph.D. from the University of Uppsala in 1872 with a thesis on analytic function theory. The following year he traveled to Paris, where he met many of the important French mathematicians of the day. One was Charles Hermite, who spoke enthusiastically of the work of Ger-

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Mittag-Leffler Institute villa outside Stockholm.

man mathematicians, especially Karl Weierstrass. Hermite's enthusiasm was unusual in France: Germany had won the Franco-Prussian war only two years earlier, and French dislike of the Germans ran deep. After several months in Paris, Mittag-Leffler went to Berlin and met Weierstrass, who became something of an idol for the young mathematician. Although many Germans evinced a nationalistic sense of superiority after winning the war, Weierstrass was free of such attitudes. The open-mindedness of Hermite and Weierstrass made a deep impression on Mittag-Leffler. Furthermore, his mathematical horizons expanded considerably as he absorbed the new rigor Weierstrass was then introducing into analysis.

In 1875 Mittag-Leffler took a professorship in Helsinki, where he spread the ideas of Weierstrass and had a number of good students. Here Mittag-Leffler also met his bride, Signe af Lindfors, then

just seventeen years old. An only daughter, she later inherited her father's considerable fortune. At this time Sweden had two universities, one in Uppsala and one in Lund, and plans were afoot to establish a new one in Stockholm. When Stockholm University was founded in 1880, Mittag-Leffler was appointed as the first professor of mathematics. He retained this position for the rest of his life and was instrumental in building up the university, serving at one point as its rector. Mathematics in Stockholm flourished under his guidance, not so much because of his own research, which was important though not revolutionary, but because of his personal qualities and his international contacts, which allowed him to stay abreast of current research. He had a flair for inspiring enthusiasm for mathematics and attracted outstanding young Swedes as students, including Ivar Bendixson, Ivar Fredholm, Helge von Koch, and Lars Phragmén.

One of Mittag-Leffler's first feats upon going to Stockholm was to arrange a position for the brilliant Sonya Kovalevski, whom he had heard of while in Berlin. Kovalevski had been a private student of Weierstrass and had received a doctorate in Göttingen, but because she was a woman she could not hope for a permanent position in the old universities in Europe. In 1884 Kovalevski moved from St. Petersburg to Stockholm and began the five-year position Mittag-Leffler had arranged for her. Intelligent and charming, Kovalevski was a sensation in the social scene of Stockholm. She attracted many admirers, including the Arctic explorer Fritjof Nansen and the industrialist Alfred Nobel¹, whose advances she is said to have found quite ridiculous, as he was 17 years her senior. Kovalevski was close to Mittag-Leffler's sister, the writer Ann Charlotte Edgren-Leffler, and the two wrote a play together. During her time in Stockholm Kovalevski completed what is considered to be her most important work, concerning the movement of a rigid body around a point. One of her papers on this topic received the Bourdin Prize from the Académie des Sciences de Paris. After making an extended trip in 1891 she died of pneumonia. The news of her death came as a shock, as she was only forty-one years old.

Another of Mittag-Leffler's achievements was the founding in 1882 of the journal *Acta Mathematica*. Sophus Lie, who was Norwegian and had a professorship in Leipzig, suggested to Mittag-Leffler the idea of starting a new journal composed

¹Mittag-Leffler and Nobel were prominent members of Stockholm society and probably met. However, no evidence has been discovered to support rumors that antagonism between the two caused Nobel to decide against establishing a Nobel Prize in mathematics. See the article "Why is there no Nobel Prize in mathematics?" by Lars Gårding and Lars Hörmander (Math. Intelligencer 7 (1985), 73-74).

mostly of papers by Scandinavians. The idea appealed to Mittag-Leffler, but he soon decided against a Scandinavian emphasis. One reason was idealistic: influenced by Hermite and Weierstrass, Mittag-Leffler had formed a view of mathematics as a purely intellectual endeavor that transcended national boundaries. The other reason was practical: there were real concerns about whether a Scandinavian journal would attract enough subscribers. *Acta* was thus conceived of as an international journal; indeed, to this day its title page has French and German in parallel. To get the journal started, Mittag-Leffler solicited a donation from the Swedish king, Oscar II, and once that donation was made, others could not decline to contribute. Mittag-Leffler launched a marketing effort that included arranging for letters to be sent to prominent German mathematicians, expressing the wish of the king that they submit their manuscripts to *Acta*. He also persuaded the young French star Henri Poincaré to submit his ground-breaking work on Fuchsian groups to the new journal. The first few volumes of *Acta* contain Poincaré's work as well as other important papers, such as a translation into French of Georg Cantor's papers on set theory, which had originally appeared in German.

In 1885 *Acta* announced a competition for best mathematics paper, with a prize of 2,500 crowns from the king. The judges for the prize were Hermite, Mittag-Leffler, and Weierstrass. Poincaré's submission, "Sur le problème des trois corps et les équations de la dynamique," which marks the beginning of the field of dynamical systems, won the competition. However, Phragmén, who was then an assistant to Mittag-Leffler and served as proofreader for *Acta*, found a number of mistakes in the first draft of the manuscript. Poincaré was able to fix these, but further errors came to light



Portrait of Mittag-Leffler holding a copy of *Acta Mathematica*. He is wearing the Oxford gown in which he received his honorary doctorate. The painting was commissioned by his students to commemorate his fiftieth birthday. The artist is Albert Edelfelt, a Finn who made a living painting portraits in Paris and is also known for his delicate landscapes of the Finnish archipelago.

Weil on Mittag-Leffler

In 1928 André Weil spent a month at Mittag-Leffler's villa to work on a draft of a monograph on polynomial expansions that had been started by another mathematician. Weil recalls this period in the article "Mittag-Leffler as I remember him", which appeared in *Acta Mathematica* 148 (1982), 9-13. What follows is an excerpt from Weil's article, reproduced with the permission of *Acta Mathematica*.

I reached Djursholm in March 1927 and was hospitably received by Mittag-Leffler and his staff. I was given a small but comfortable room on an upper floor; meals were taken *en famille* with Mittag-Leffler's secretaries and assistant, not to mention occasional guests; these included Marcel Riesz, Einar Hille, and the economist Gustav Cassel. The old man presided. For my benefit the conversation, at first at any rate, was mostly in French, which he spoke excellently, or else in German, in which he was equally fluent; but soon I acquired a tolerable working knowledge of Swedish. Mittag-Leffler was a perfect host, and he knew it. I found the atmosphere, on the whole, quite pleasant, but a domineering strain in his make-up was unmistakable. When he was back in his study and wished for the presence of his secretary, his call "Fröken där!"* was heard all over the house. Perhaps by that time he found it an imposition to have to remember her name; apparently that position had been filled by a succession of personable young ladies, not a few of whom had ended up marrying the assistant or some other mathematician of suitable age.

Mittag-Leffler's photograph, in volume 50 of the *Acta*, gives a good idea of his appearance at the time. He looked like a bird—a bird of prey of course, such as one could see in the Skansen in Stockholm; frail but still tough, wiry, showing little sign (to my inexperienced eye at least) of his impending death, which was to occur in July. On the day after my arrival, I was called to him to discuss the monograph project. That conversation and all subsequent ones on the same subject (perhaps once or twice a week) followed one and the same pattern. He began in French, reminiscing about his earlier work on polynomial expansions, which he remembered in very general terms. Soon his mind turned to his earlier intimate contacts with great mathematicians, chiefly Weier-

*This phrase is difficult to translate into English. Literally it means "Young lady there!", but it has the brusque connotation of "Hey, you!"

—A.J.

strass; at this point he dropped into German. Invariably the next topic was Sonia Kowalewska. Then, understandably, he grew tired and lapsed into Swedish; this was puzzling to me at first, but not so after a week or two; nevertheless, he stopped himself sharply after a while with the remark: "But I was forgetting that you don't know Swedish; we will continue next time."...At night I used to sit in the incomparable library which Mittag-Leffler had spent a lifetime assembling with loving care in his villa. Perhaps its main attraction to me was the room where lay his correspondence, neatly arranged in boxes bearing the names of the great ones of the past half-century; they were all there to keep me company while everyone was asleep, opening up for me the secret recesses of their minds. Here were Hermite's letters of 1881 and 1882 about the trio of brilliant young Frenchmen, Appell, Picard, Poincaré. Vacancies had to be filled; the competition was keen. Picard was Hermite's son-in-law, and his theorem on entire functions had already made him famous; Appell, too, was related to the Hermite family by marriage; Poincaré had barely begun attacking the theory of "fonctions fuchsiennes". "We have three stars in our mathematical firmament," Hermite writes to Mittag-Leffler, but his choice is made: "I may whisper into your ear," he adds at once, "greatly fearing that Madame Hermite could overhear me, that to me Poincaré seems the brightest."

Here too was Painlevé's letter on the death of his wife, after less than one year of marriage, which he had so joyfully announced to his friend Mittag-Leffler in the spring of 1902. At the age of forty he describes himself in touching terms as a broken man, incapable henceforth of turning his mind back to mathematical work; and indeed, as a glance at his list of publications will show, this was the time of his farewell to mathematics.

I have quoted just these two letters, from many more which kept me sitting late in that room in the silence of the villa, a desk-lamp at my elbow, well into the small hours of the morning. Painlevé was almost twenty years younger than Mittag-Leffler, and a free-thinker; Hermite had been more than twenty years older than his correspondent, and a devout Catholic. Surely there must have been some rare quality of sympathy in the bonds of friendship which Mittag-Leffler had succeeded in establishing with men so diversely gifted, inducing them to confide their innermost thoughts to him with such abandon.

after the issue was printed. Mittag-Leffler wrote to all subscribers of *Acta* to recall the issue, which was then reprinted with the corrected paper. There are only a few copies extant of the flawed issue; in one of these, kept at the Mittag-Leffler Institute, there is a notation in the top corner of the first page, written in Mittag-Leffler's hand, "Hela uplagan blef makulerad. M. L." ("The whole edition was destroyed. M. L.").

In the early 1890s some prominent families of Stockholm began to move out of the city and into more salubrious surroundings. One of these "gar-

den cities" was founded on the land surrounding Djursholm castle, and it was here that Mittag-Leffler built the villa that today houses the institute. He was one of the first to buy land there and later turned a profit on the investment by selling off small plots. He was involved in other business ventures, including the construction of a railway line from Stockholm into Djursholm. He is said to have considered a particular seat on the train as his own and to have used his walking stick or umbrella to drive away anyone who attempted to sit there. Mittag-Leffler's wealth increased when his

wife received her inheritance upon her father's death in 1903. In 1907 the Mittag-Leffler villa was rebuilt by Ferdinand Boberg, designer of many public buildings and royal residences and the most important Swedish architect of the day. Mittag-Leffler and his wife never had children, and in 1916 they made public their intention to donate their entire estate to the Royal Swedish Academy of Sciences. The purpose of the donation was to create a mathematics institute.

Making the Dream a Reality

Mittag-Leffler realized part of his plans for a mathematics institute while he was still alive, as he built up his library and invited mathematicians to visit from time to time. For example, in March 1927 André Weil spent a month in Djursholm; his memories of this period were set down in a special issue of *Acta Mathematica*, published in 1982 to celebrate the journal's centenary (see sidebar). In fact, Weil's visit came just a few months before Mittag-Leffler's death in July 1927. By that time Mittag-Leffler's fortune had diminished considerably, as he had invested in German government bonds, which declined greatly in value after World War I. There was not enough money to realize his plans for a mathematics institute, but there was enough to pay part of the salary of a director and to maintain the library. Torsten Carleman, a professor at Stockholm University who was considered to be the top Swedish mathematician of the time, was appointed as the first director of the Mittag-Leffler Institute.

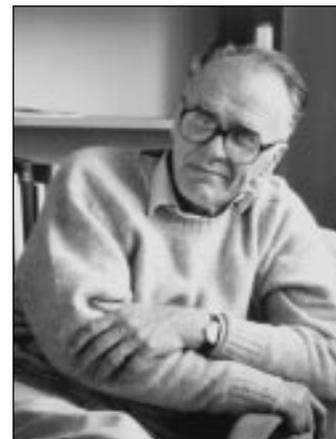
Carleman lived in the Mittag-Leffler villa and maintained the library. Occasional lectures were given, and publication of *Acta* continued. However, Carleman was not able to realize the plans for a mathematics institute, in part because of the lack of funds and in part because his personality was more suited to mathematical contemplation than to the kind of entrepreneurship needed to get an institute off the ground. After Carleman's death in 1948 the Academy searched for a new director. Two promising candidates were Fields Medalist Lars Ahlfors, a Swedish-speaking Finn who was at Harvard University, and the Swede Arne Beurling, who was then at the University of Uppsala and later moved to the Institute for Advanced Study. Both turned down the offer.

For about twenty years after Carleman's death, the institute was inactive. The library, which was used by a small group of mathematicians in the Stockholm area, was maintained by a member of the mathematics class of the Academy, first Fritz Carlson and then Otto Frostman. Frostman served as an acting director and lived on the estate in a dwelling that had been built for one of Mittag-Leffler's brothers. By the 1960s the endowment for the institute still had not grown sufficiently to finance the mathematics institute Mittag-Leffler had

dreamed of. But one dream came to the service of another: Mittag-Leffler had been so confident that *Acta Mathematica* would become an important journal that from the beginning large print runs were made, and the back issues were stored in the villa. During the 1960s when many universities around the world were expanding, several hundred complete sets of *Acta* were sold off. The sales greatly enhanced the institute's endowment.

Around this time the mathematics class of the Academy, unable for years to find a director, had formulated a plan to eliminate the Mittag-Leffler Institute. Lennart Carleson, who became chief editor of *Acta* in 1956 and was elected to the Academy in 1957, did not want to give up on Mittag-Leffler's dream, and he decided to do something to save it. He was then at the University of Uppsala, and his growing reputation had led to offers from several universities in the U.S. In an attempt to keep him in the country, the Swedish government bestowed on him a rare "personal professorship", which allowed him to choose where he wanted to work. He decided to devote his time to rebuilding the Mittag-Leffler Institute, and he moved to Djursholm in 1967. The first scientific program, on harmonic analysis, was held during 1969–70.

At that time, the world of mathematics institutes looked very different from the way it looks today. Essentially there were only two: the School of Mathematics at the Institute for Advanced Study (IAS) in Princeton and the Institut des Hautes Études Scientifiques (IHÉS) outside of Paris. Carleson did not follow the IAS-IHÉS model, in which the research is centered around a permanent faculty of mathematicians, but stuck to Mittag-Leffler's original conception of an institute for visitors. Mittag-Leffler had formulated this idea at the time of World War I, and yet when Carleson became director more than half a century later, he said, "It was like a new idea at that time." In fact, there was a good deal of skepticism among established Swedish mathematicians about whether such an institute would be successful. There were also some strong supporters, including the Finnish mathematician Rolf Nevanlinna, who not only lent his prestige to the project but also secured a donation from the Academy of Finland, which in turn led to promises of donations from the other Scandinavian countries. Carleson also got funding from Sweden's Knut and Alice Wallenberg Foundation in order to build visitor housing and to renovate the villa to create office space. Funding also came from the Swedish government and from some insurance companies.



Lennart Carleson

Photograph courtesy of Lennart Carleson.

A Dying Breed

In recent years many journal publishers have whittled away at their editorial staffs. Authors are expected to prepare their own electronic files for publication, and proofreading is held to a minimum and sometimes eliminated entirely. As a result many journal articles are riddled with typographical errors, notational inconsistencies, hard-to-read formulas, and poorly labeled graphics.



Mikael Rågstedt

The fact that such problems are largely absent from *Acta Mathematica* is primarily due to the efforts of Mikael Rågstedt, editorial assistant for *Acta*, who has worked on the journal since 1980. Initially he was a proofreader while a graduate student in mathematics at the University of Uppsala. He had a formidable predecessor: Mittag-Leffler's student Lars Phragmén was a proofreader for *Acta* when he became famous for finding the errors in the paper by Poincaré that won the 1889 prize from the King of Sweden (see main article). Nothing so dramatic has occurred during Rågstedt's tenure, but his consistent attention to *Acta* has made it arguably the most polished mathematics journal in the world.

Rågstedt's work begins after the editorial board accepts a paper for publication. He corrects spelling and grammatical errors, fixes notational inconsistencies, and works with authors to address more substantive problems in the text. He also spends a good deal of time working in *TeX*, which has been used to typeset *Acta* since 1993, in order to improve the presentation of the mathematics on the printed page. The refinement of his typesetting work is apparent in a glance through an issue of *Acta*.

The Mittag-Leffler Institute publishes *Acta* as a service to the mathematical community and keeps subscription prices low. The way the journal is produced reflects the sense of its being a historical document, recording mathematics for today and for posterity. Mathematicians now and in the future can thank Mikael Rågstedt for making *Acta Mathematica* such a beautiful journal.

—A.J.

Photograph courtesy of Mikael Rågstedt.

In the early days of the institute's restarting there was a good deal of improvisation. Carleson recalled that his graduate students even pitched in to help carry furniture. From the beginning the modus operandi of the institute was to focus for one academic year on a particular mathematical topic and to invite visitors working in that area. For approximately the first ten years, the scientific programs were related to Carleson's own research interests. An analyst and 1992 Wolf Prize recipient, Carleson has made important contributions to Fourier analysis, complex analysis, quasi-conformal mappings, and dynamical systems. The fact that ten years' worth of scientific programs could be built around his research interests testifies to their breadth. The Mittag-Leffler Institute quickly became a magnet for young Swedish mathematicians: Carleson said that when he was director, at least half of all new mathematics doctorates from Swedish universities came to the institute as post-docs.

Starting in 1978, the scientific programs at the institute were led by assistant directors Dan Laksov of KTH, Peter Jones, now at Yale University, and Per Enflo, now at Kent State University. When Carleson retired as director in 1984, Lars Hörmander of the University of Lund directed a two-year program in nonlinear differential equations. Starting in 1987, the position of director evolved into a more administrative one and was held first by Laksov and then by Arne Jensen of Aalborg University in Denmark. In 1995 the present director, Kjell-Ove Widman, formerly of the University of Linköping, was appointed.

The Institute Today

The Mittag-Leffler Institute is one of seven institutes of the Royal Swedish Academy of Sciences. These institutes span a range of disciplines, from astronomy to Arctic research to the history of science. Four of them are housed at the Academy, which is just off a highway running between Djursholm and Stockholm. The institutes are funded primarily through Academy endowments. Being part of the Academy brings a measure of prestige as well as the more tangible benefit of tax-exempt status. In fact, the Mittag-Leffler Institute could not exist without the Academy, not only because the Academy holds the endowment, but also because the institute does not have an independent legal status. Nevertheless, Academy affiliation comes at a price, sometimes paid in the form of additional bureaucracy—the institute staff's financial accounting is duplicated by the Academy administration—and sometimes in cold, hard cash: each year the Academy gives the institute a grant of about half a million Swedish crowns and then charges the institute about the same amount for administrative costs. Despite these fiscal oddities, the Mittag-Leffler Institute is run largely independently of the Academy administration.

The Mittag-Leffler endowment today stands at about 125 million Swedish crowns (\$15 million). Endowment income accounts for nearly half the institute's budget, which for the 1997–98 year was just under 11 million crowns (\$1.3 million). This figure is nearly double that of five years earlier, partly due to changes in accounting, but mostly due to increased endowment income generated by the rising stock markets of recent years. The institute also receives support from some Swedish philanthropic foundations, such as the Jacob and

Marcus Wallenberg Foundation, and from the Natural Sciences Research Council of the Swedish government (the Swedish equivalent of the U.S. National Science Foundation). There are also contributions from the other Scandinavian countries (Denmark, Finland, Iceland, and Norway), either through their scientific academies or through governmental funding agencies.

The day-to-day operations of the Mittag-Leffler Institute are run by a staff of eight, some of whom work part-time, including the director, whose position is three-quarters' time. Scientific decisions are made by the Board of Directors, consisting of the mathematics class of the Academy (which has ten active and six retired members), plus one or two representatives from each of the Scandinavian countries. Recently the Board appointed two additional advisors: William Fulton of the University of Michigan and Peter Jones of Yale University. For approximately the past ten years the institute has taken applications for its scientific programs. As director Kjell-Ove Widman explained, he and the Board do not "just sit here and hope" that applications will come in. Rather, they talk to people who might be interested in organizing a program and may even suggest the possibility of applying. The programs are set two years in advance, and Widman reports that he has discussions about possible programs five years into the future.

One of the main goals of the Mittag-Leffler Institute is to develop mathematical research. It also has another, more specific goal, which is to develop mathematics in Scandinavia. As Widman explained, anyone can apply to run a program, but "There has to be a strong Scandinavian content, which means probably that the organizing committee would have to contain at least one or two Scandinavians." He said that the programs should be in areas where Scandinavian mathematicians are active or in areas where they are less active but where there is potential for generating greater interest within Scandinavia. Can an institute with such a regional emphasis have scientific standards as high as institutes that are completely international? The answer is not clear. The Mittag-Leffler Institute has certainly run some outstanding programs; a recent example is the one held during 1996-97, which focused on enumerative geometry and the influence of new ideas coming from physics. The presence of William Fulton, who spent the entire year at the institute, was undoubtedly a key to the success of the program. Attracting top mathematicians to stay for a long period may have a larger impact on the scientific quality of the institute than does the regional emphasis. Overall, the institute has probably had a larger influence on Scandinavian mathematics than it has on mathematics internationally.

Fulton was the program's "scientific leader", a specially designated position lasting at least a full

Yearly Programs at the Mittag-Leffler Institute, 1969-2001

- 1969-70: Harmonic analysis
- 1970-71: Harmonic analysis
- 1971-72: Quasi-conformal mappings
- 1972-73: Probability theory with applications to physics
- 1973-74: Regularity problems for Dirichlet spaces
- 1974-75: Scattering theory; pseudodifferential and Fourier integral operators
- 1975-76: Partial differential operators
- 1976-77: Arne Beurling year
- 1977-78: Analytical number theory and harmonic analysis
- 1978-79: Algebraic geometry and geometry of Banach spaces
- 1979-80: Algebraic geometry; Operator theory
- 1980-81: Commutative algebra
- 1981-82: Many particle theory and scattering theory in quantum mechanics
- 1982-83: Hardy spaces
- 1983-84: Problems of iteration in classical real and complex analysis
- 1984-85: Nonlinear differential equations
- 1985-86: Nonlinear differential equations
- 1986-87: Algebraic geometry
- 1987-88: Several complex variables
- 1988-89: Operator algebras
- 1989-90: Hyperbolic geometry and quasi-conformal mappings
- 1990-91: Operator theory and complex analysis; History of mathematics
- 1991-92: Combinatorics, with emphasis on algebraic and geometric aspects
- 1992-93: Spectral problems in mathematical physics
- 1993-94: Topology and algebraic K-theory
- 1994-95: Statistical mechanics and stochastic analysis
- 1995-96: Analysis on Lie groups
- 1996-97: Enumerative geometry and its interaction with theoretical physics
- 1997-98: Computational methods for differential equations
- 1998-99: Topology and geometry of quantum fields
- 1999-00: Potential theory and nonlinear partial differential equations
- 2000-01: Mathematical logic

academic term and carrying the responsibility of organizing seminars. The scientific leader may or may not be a member of the program organizing committee. Fulton also held the Erlander Professorship while at the Mittag-Leffler Institute. This position, financed by the Natural Sciences Research Council, rotates among the various disciplines and is given to a mathematician only once every five years; the Mittag-Leffler Institute has had an Erlander Professorship twice. Because it pays a reg-



Bronze sculpture of Mittag-Leffler located in the institute library.

ular salary, this position gives the institute much more leverage in attracting top mathematicians. Apart from such a special position the institute does not pay salaries to its visitors, but only travel costs and a fixed monthly amount to cover local expenses like food and lodging. Postdocs receive 12,000 crowns (\$1,500) per month; senior visitors who stay less than three months receive around 15,000 crowns (\$1,700) per month and those who stay more than three months get a bit more. For tax reasons Scandinavian visitors are paid less but receive free lodging.

The institute accepts applications for its postdoctoral positions, which number between five and ten per year, but otherwise visiting the institute is only by invitation from the program committee.² The total number of visitors during any one program year can vary; it might be around sixty if there are many long-term visitors, or over one hundred if there are many short-term visitors. The longest possible stay is one academic year, and the shortest is one month. At any one time the institute has a maximum of twenty-eight visitors in residence. Apart from impromptu talks, seminars are held only on Tuesdays and Thursdays. Tea is served once a week, on Thursday, in conjunction with the seminar. There are no dining facilities at the institute, but every day a group heads down to an inexpensive restaurant a few minutes' walk away in the small commerce area of Djursholm. Some appreciate the quiet of the institute and the placidity of Djursholm. Those seeking the bustle of Stockholm face a trek by bus and subway that totals around forty minutes.

The institute can sometimes have a sleepy feel, perhaps due to the lack of regularly scheduled occasions for the visitors to come together. The small number of visitors and the fact that they all work

²There is one exception: the *Research in Peace (RIP)* program, whereby Scandinavian mathematicians can apply, on a space-available basis, to spend a couple of weeks at the Mittag-Leffler Institute. The institute might donate free housing, but otherwise RIP visitors are not paid. Like the *Mathematisches Forschungsinstitut in Oberwolfach, Germany*, which also has a program called RIP (*Research in Pairs*), the Mittag-Leffler Institute chose the rather ghoulish acronym as a joke.

in the same mathematical area make for easy communication and an informal, congenial atmosphere, as can be seen in the exchange of questions and answers during the seminars. Also contributing to the informality is a pronounced lack of bureaucracy. Visitors find no forms to fill out upon arrival and no reports due upon departure. There are no restrictions on telephone use, except the request that personal calls be made from the apartments. A recent visitor found upon arriving at the institute that his office had no computer and, because it was a holiday, thought the problem would be rectified only when the administrative staff returned. The groundskeeper of the institute, who normally has nothing to do with assignment of offices, found the visitor a new office, which he then kept for the duration of his stay.

The scientific programs begin in September and end in May, and these two months are usually the most active ones at the institute. Visitors often find it hard to endure the short days of the Swedish winter, when the sun rises around 9:00 in the morning and sets around 3:00 in the afternoon. The summer is the most pleasant time of year in Djursholm, but the institute is closed during June, July, and August. There does not seem to be much support for a change in the schedule. Carleson summed up one viewpoint when he said, "I don't think we should use the institute as a summer resort." Widman noted that although the institute does not at present have sufficient staff for summer activities, there have been extensive discussions about making the institute available in some way during the summer if the financial situation allows. One small schedule change is in the works: in 2000-01, the institute will close for two weeks around Christmas and stay open for two additional weeks in June.

The Mittag-Leffler Estate

Sweden's most famous export, apart from the Nobel Prizes, is probably the rock group Abba, which shot to fame in the 1970s. The group, long since disbanded, enriched its earnings by buying businesses having no relation to music, and today one can still find Abba-brand canned tuna on supermarket shelves in Sweden. The fact that a former member of Abba lives in Djursholm demonstrates just how rich this little community is. Bathed in fresh breezes off the Baltic Sea, Djursholm is dotted with distinctive homes set on ample lots. The Mittag-Leffler villa and its parklike grounds of seven acres is one of the grander estates in this village. With ducks waddling across the lawns, the occasional deer picking its way down a hillside, and lovely walks on the Baltic just



Bust of Karl Weierstrass which stands in the flower room.

a few minutes away, the Mittag-Leffler estate is nothing short of idyllic.

The Mittag-Leffler villa combines the Swedish flair for both elegance and practicality, and the result is comfortable opulence. The work of the Swedish architect Boberg, who renovated the villa around the turn of the century, can be seen everywhere, from the ornately carved bannisters, to the round “flower room” with its two-toned marble floor, to the oak-paneled second floor of the library, which has a gallery wrapping around three sides of the room and stained-glass lamps set into the vaulting. The building is filled with intriguing details, such as the dachshund-shaped fireplace gratings and the many images of owls, one of Mittag-Leffler’s favorite symbols. Among the numerous artworks are a fine bust of his sister, Ann-Charlotte, and an arresting portrait of Weierstrass. There are several likenesses of Mittag-Leffler, including a massive, larger-than-life bronze sculpture set into one corner of the library. One of the most charming things about the institute is the fact that it is still unmistakably a house, with plenty of places to sit and relax. Also contributing to the cozy atmosphere is the institute’s requirement that, in order to protect the carpets and the parquet floors and to keep the villa clean, shoes must be removed before one leaves the entry hall.

The administration, visitor offices, seminar room, and library are located in the villa. Also on the estate are two houses that date from Mittag-Leffler’s time and are used for visitor lodging. Two modern buildings, one constructed when Carleson became director and one completed in June 1999, are also used to house visitors. The houses and some of the apartments are sometimes shared by a number of visitors. Occasionally the institute has to use off-campus housing, which according to visitors can be expensive, unpleasant, and overcrowded. With the construction of the new building, the institute intends to stop using off-campus housing. This improvement might also eliminate the inconvenience some visitors have experienced of being shuffled around several different living quarters. A good bit of the institute’s increased budget of recent years has gone toward refurbishing the visitor housing and upkeep of the villa.

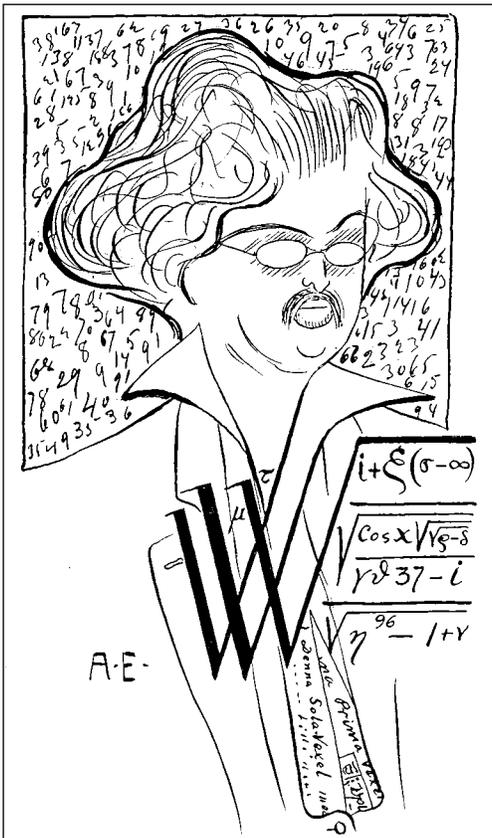
Office space at the Mittag-Leffler Institute ranges from the sublime to the reasonable. The Mahogany Room is exactly what its name implies: a room paneled entirely in mahogany, with art deco wood inlays and a magnificent view of the Baltic Sea. There are a number of other, similarly appealing offices on the eastern side of the villa. The offices on the western side are comfortable but more routine. The scientific leaders of the programs have offices to themselves, but most visitors must share with one or two others, and sometimes postdocs are four to an office. Widman noted that this situation is not ideal and that some improvements are in the



Two views of the Mittag-Leffler Institute library. Top, gallery on second floor with stained-glass lamps set into the vaulting. Below, first floor of the library.

works, but “we are limited by the four walls and the roof.”

A bigger problem is the computer system, which probably draws the most complaints of any aspect of the institute facilities. There are problems ranging from the perplexing—such as the copy of *Mathematica* that one day simply disappeared from the computer it had been on—to the pesky—such as the Swedish keyboards, found in a few offices, which lack the “@” symbol needed for e-mail addresses. (In fact, the “@” is there but requires a nonobvious combination of keys; those who want English keyboards can easily request them.) Furthermore, the Internet connection, which runs over a 64KB line, is far slower than what most mathematicians have become used to at their home institutions. The source of these problems, Widman said, is a common one for mathematics departments and institutes: the difficulty of finding com-



Pen-and-ink portrait of Mittag-Leffler.

The work is by Albert Engström, a Swedish artist, author, and general cultural personality. He edited a satirical weekly and contributed decisively to the campaign against the introduction of prohibition in Sweden.

matik, published during the Nazi era. Most of the papers are simply mathematics, but some, like the one entitled “Mathematik und Rasse” (“Mathematics and Race”) by Max Draeger [*Deutsche Mathematik* 6 (1941/42) 566–575], have a darker purpose. When it comes to newer journals, the library is impressive for a small institute, though not at the level of a top university mathematics library. It subscribes to about 250 journals; as a comparison, the mathematics library at Stockholm University subscribes to 470 journals. The number of monographs in the two libraries is about the same, though when it comes to newer books the Mittag-Leffler holdings are patchier. With its increased budget of the past few years, the institute has worked on upgrading the library. Some of its journal subscriptions come in exchange for *Acta Mathematica* and the institute’s other journal, *Arkiv för Matematik*. A few organizations have in recent years canceled these exchange agreements and instead asked the Mittag-Leffler Institute to buy regular subscriptions. This may be because *Acta* and *Arkiv*, which cost about \$225 and \$100 per year

petent computer administrators. Such people, he noted, find work at double or triple the salary the institute can offer.

For those enamored of older mathematical literature, the institute’s library is full of treasures. Mittag-Leffler was an avid mathematics book collector and bought many books, including some rare specimens, at auctions in Berlin, London, and Paris. He also subscribed to all of the important mathematics journals of his day. There are complete sets of many journals going back to their first issues, beautifully bound in leather. There are also some unusual artifacts, such as the journal *Deutsche Mathe-*

respectively, are inexpensive compared to many other journals.

Small But Significant

When Gösta Mittag-Leffler became a professor at Stockholm University, the number of mathematics professors in Sweden could be counted on one hand. When Lennart Carleson was a young professor in the 1950s, the number had grown to perhaps fifteen. Today Sweden has over one hundred mathematics professors. In addition, the kind of mathematics done in Sweden has broadened from a nearly exclusive focus on analysis—especially harmonic analysis, quasi-conformal mappings, and differential equations—to encompass other mathematical areas such as algebra, topology, algebraic geometry, combinatorics, and computational mathematics. The Mittag-Leffler Institute has played an important role in the growth of mathematics in Sweden and more generally in Scandinavia. As Carleson noted, the institute “puts Sweden on the map” in the international world of mathematics research and provides a way for young Scandinavians to “be exposed to international stars” of mathematics.

Thinking back on his time as director, Carleson observed, “It was much easier in many ways in those days.” It was easier to attract top mathematicians to come, and they brought their families and stayed longer. Nowadays mathematics institutes around the world compete to attract people and to induce them to stay for an extended period. This is a real challenge for the Mittag-Leffler Institute, with its small size and somewhat rigid schedule of yearly scientific programs. On the other hand, there is a sense of focus and serenity to the Mittag-Leffler Institute that one does not find at larger institutes that have a greater variety of activities. As Widman put it, the Mittag-Leffler Institute should not be “just a weak copy of the bigger institutes in the world... We would like to be a small but significant part of the mathematical community.”

Reference

Mathematics and Mathematicians: Mathematics in Sweden before 1950, by Lars Gårding, History of Mathematics, Volume 13, AMS/London Mathematical Society, Providence, RI, 1994.