

Chinese Acrobatics, an Old-Time Brewery, and the “Much Needed Gap”: The Life of *Mathematical Reviews*

Since its founding in 1940, *Mathematical Reviews* has been an important part of the AMS and the mathematical sciences community. Sweeping in scope, solemn in tone, and deadly accurate, MR has led multitudes to what they were searching for in the literature of mathematics and allied areas. Mathematicians have come to rely on this stalwart guide for information on work in a particular area or by a particular author, as well as for bibliographic references. Over the years the AMS has devoted attention and resources to making MR as useful as possible. While you cannot please everybody all the time, MR has consistently provided high-quality information through a variety of media. The latest addition to the MR menu of services is MathSciNet, which provides access to the MR database through the World Wide Web. The reaction to MathSciNet has been enthusiastic.

In 1990 *Science Citation Index* did a study of the aging of references and concluded that citations of work in molecular biology had a “half-life” of months, while work in mathematics had a half-life of at least decades. There are many examples of old mathematical results spurring developments at the frontier of research. Reference works like MR therefore become crucial to progress in the field. At the other end of the spectrum, as technology makes publishing easier for groups and individuals, it becomes ever more important to have a way of organizing and preserving the literature. The AMS in the coming years will continue to invest in *Mathematical Reviews* to ensure that it remains a high-quality guide to the literature, both past and present.

This article describes *Mathematical Reviews*—its functions, its foibles, its folklore, its future—so that mathematicians who use MR will have a better understanding of this journal that has become such an important part of mathematical life.

The Early Days

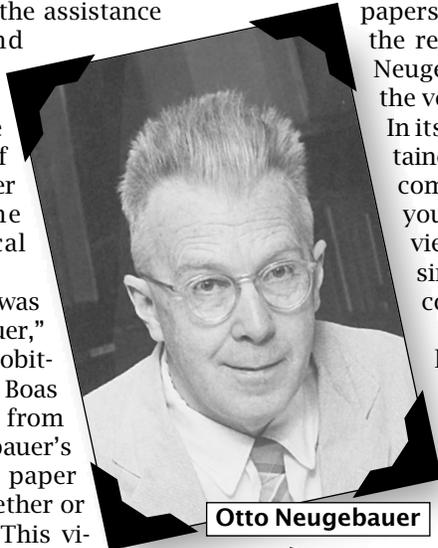
The two main mathematical reviewing journals today—*MR* and *Zentralblatt für Mathematik und ihre Grenzgebiete*—were both founded by Otto Neugebauer. He started *Zentralblatt* in the early 1930s and also launched the book series *Ergebnisse der Mathematik und ihrer Grenzgebiete* and, with W. Flugge, *Zentralblatt für Mechanik*. These ventures, valuable as they were, were by no means Neugebauer’s main accomplishments. His first love was the history of ancient and medieval mathematics and astronomy, and at Brown University he built a leading center for the history of the exact sciences. A scholar versed in the interpretation of cuneiform texts, he was responsible for much of present-day knowledge of ancient mathematical astronomy. His last scholarly work, a chronography of Ethiopic sources, was published in 1989, a year before his death at age ninety-one.

Neugebauer was a professor at the University of Göttingen when, in 1934, he refused to sign an oath of loyalty to the Nazi regime. He was forced to emigrate to Denmark, though he continued as editor of *Zentralblatt für Mathematik*. Four years later the publisher, Springer-Verlag, asked for written assurances that no Jews would act as reviewers. Neugebauer resigned, along

with most of the editorial board, and he destroyed his files. Soon thereafter Neugebauer moved to Brown. By that time there was talk of the need for a reliable reviewing journal for mathematics and the possibility of establishing one in the United States. Neugebauer was clearly perfect for the job, so in 1940 he started *Mathematical Reviews*, with the assistance of J. D. Tamarkin and W. Feller. The AMS received financial support for MR from the Carnegie Corporation of New York, the Rockefeller Foundation, and the American Philosophical Society.

“The character of MR was established by Neugebauer,” stated Ralph Boas in an obituary for Neugebauer [1]. Boas served as editor of MR from 1945 to 1950. In Neugebauer’s view any mathematics paper should be reviewed whether or not it was significant. This vision of *Mathematical Reviews* has remained largely unchanged to this day. “Neugebauer always insisted that the length of the review was not intended to be directly proportional to the importance of the paper,” wrote Boas. “Indeed, a bad paper needed to have a review sufficiently detailed so that nobody needed to look at the paper itself, whereas a really important paper needed only to be called to the world’s attention.”

In the early days of MR, the editor did everything. John V. Wehausen, who served as editor from 1950 to 1956, described his job this way: “[A]ssign papers to reviewers; translate titles not in English, French, German, or Italian (the allowable languages for reviews; in those days it was assumed that every educated mathematician could read at least these); edit the reviews, including checking cited references; prepare them for the printer; assign a field to each review; gather all the reviews together once a month, put them in some sort of order, and send them to the printer; read galleys; check page proof to verify that all corrections had been made and perhaps to make new ones; and then rejoice when the printed issue is received, while feeling like an ass because of missed errors.” [2] He could never leave Providence for more than two weeks at a time, and even then he would be sent proofs to read at odd times so as not to be buried under the workload when he returned.



Otto Neugebauer



Ralph Boas

Wehausen had a staff of three secretaries and a half-time graduate student. Today, MR executive editor R. Keith Dennis oversees about seventy copyeditors, filers, keyboarders, librarians, associate editors, and computer personnel. The increase in the size of the MR operation is not due to changes in the basic process—receive papers, send them out to reviewers, publish the reviews—for it has not changed since Neugebauer’s time. What has changed is the volume of the mathematical literature. In its first year MR ran 400 pages and contained 2,115 reviews. Today a typical year comprises about 7,000 pages (11,000 if you count indexes) and about 50,000 reviews. An enormous effort is required simply to keep up with the mass of incoming material.

A backlog could be fatal, but MR has always pulled through. Some years before he became MR executive editor, William J. LeVeque served as an associate editor in 1961. “MR was then near death,” he wrote in a reminiscence [3]. “[Walter Hayman and I] were put to work assigning journal articles to the various reviewers,

from what seemed to be an enormous backlog. As

we finished assigning the articles in each issue, we put the latter on a pile in the corner of the room—until the top of that pile rose to eight feet and we had to start a new one.”

Despite their efforts the situation remained grim. A few months later the AMS hired A. J. Lohwater as executive editor. According to LeVeque, Lohwater could work 18–20 hours a day, so “within about three years he had the journal back on schedule.”

Mathematical Literature: A Relentless River

Right now MR operates with a cap of 50,000 reviews. If this yearly output seems like a fast-flowing river, consider that it is merely a tributary of the main gusher, the material arriving at MR. Each day the mail brings 230–240 potentially reviewable books and papers as well as many others that are outside of mathematics. And MR is always on the lookout for more: one of the functions of the Acquisitions Department is to make sure MR is not missing anything. MR does not take out subscriptions; it relies primarily on

MR Folklore: Unflattering Reviews

Snide reviews form part of the folklore of *Mathematical Reviews*. The most famous one is as sublimely succinct as it is damning: “This paper fills a much needed gap in the literature.”

Though well known, this sentence never actually appeared in a review. Its origins were explained in a letter from Lee Neuwirth to Gerald Janusz, who looked into the matter when he served as executive editor from 1990 to 1992. Around 1960, when he was an instructor at Princeton, Neuwirth began a review of an article by Hale Trotter with the infamous sentence. Unaware of what he had done, Neuwirth showed the review to his colleague Ralph Fox, who “roared with laughter.” Fox rewrote the review, and it eventually appeared, without the sentence, under Fox’s name (MR 24 (1962), 683, number A3645). It appears that Fox told the story about the sentence to others, but in the telling he left out the names of Neuwirth and Trotter.

The mild wording and matter-of-fact tone of that sentence perfectly capture the kind of humor one finds in MR, where vituperation is usually excised. What follows is a collection of tidbits culled from some of the less flattering reviews.

“This paper is incorrect and most of its conclusions are false.”

“The author has published in various journals the contents of this paper.” [This statement is followed by a list of seven references for the paper in different journals.]

“The results are presented by means of a terminology and in a style of which it is impossible here to give the slightest idea; the notions introduced by the author (‘radiors’, ‘coradiors’, ‘expansors’) appear to be totally superfluous (unless it is to rescue his work from complete indiscretion) and can be cast in relatively civilized language. Nevertheless it would be premature and imprudent to attach to these comments any absolute value because of the uncertainty which weighs on the intentions of the author.” [translated from the French]

“The author tries to put Fermat’s last theorem into a physical and general dimensional analysis situation.... No proofs are given.”

“As a result of correspondence with the author, the reviewer realises that his attempt to understand the paper was unsuccessful; the criticism based on that attempt should be withdrawn. The reviewer does not understand the paper at all now.”

“[The author] leads the reader over a rough road to [a certain] inequality.... However, at one rough spot on the road the author introduces the series $0! + 1!/x + 2!/x^2 + \dots$. This series is convergent only at $x = \infty$. The proof needs fixing.”

“...The reviewer is unable to follow these proofs which hinge on unexplained dependencies among the ten variables introduced. Reviewer’s remark: The author offered to explain the ‘proof’ of the Fermat conjecture to the reviewer. The reviewer declined, considering such a meeting pointless, because—as transpires from the book—the author has difficulties with the language of mathematics.”

publishers sending material for free or in exchange for AMS publications. A number of staff are devoted to keeping records on what has come in, what has not, and where to go to find missing materials. Librarian Paula Shanks combs catalogs, journals, and other publications from all over the world for mention of books or journals that MR has not received. In certain rare cases MR will purchase materials. Shanks says there are a couple of North Korean journals that MR received for a while, along with bills asking for payment in DM. The trouble was, they did not indicate how many DM. “If they would tell me how many DM they want for the journals, I’d gladly pay,” Shanks declares. “No one else in North America gets them.”

Some journals are reviewed cover to cover, but others must be “prescanned” by the MR associate editors. These are mathematicians on the MR staff who match books and papers to reviewers; they also make judgments about whether to review items that are in applied areas but contain new mathematical results or interesting applications of known results. Once the prescanning is done, the material is placed in the green “editors’ box”. (MR usually receives two copies of each item, and the second copy is put into the library, locally known as “the cemetery”.) The box is then stationed in the “box decorating area”. This whimsical name refers to the process of inserting strips of colored paper indicating to which editor the items are to go. Each editor must examine the contents of the

green box to make final decisions about what will be covered and also to assign MR classification numbers. Consultants are called in on a regular basis to cover edges of mathematics that the associate editors’ expertise does not reach.

Once decorated, the items are placed in the red “daily box”. (The extensive use of color coding at MR is just one more indication that this place deals with a serious mass of material.) Bibliographic information is entered into the MR database in order to keep track of what will be reviewed and also for production of the journal *Current Mathematical Publications*. Lila Dann, who has worked for MR for twenty-two years and is manager of Reviewer Services, remembers well the old days when she typed CMP on an IBM Selectric typewriter. Changing fonts meant pulling a small ball out of the typewriter and snapping in a different one. Each typist had half a dozen different balls for italic, bold, Cyrillic, Greek, and roman, as well as special mathematical symbols, different type sizes, and so on. Dann could type 75 words per minute while flipping the balls in and out. She and the other typists would race to see who could do the most pages with the fewest errors. As LeVeque put it, “Like Chinese acrobatics, it had to be seen to be believed.”

Take Heart, Ye Authors of Obscurity: An MR Editor Is Reading Your Paper

In the past being an associate editor at *Mathematical Reviews* was a job that a mathematician

might hold for a few months or a couple of years. On occasion the post served well some mathematicians who had few recourses. Chandler Davis, who was not able to get a permanent job at a U.S. institution after he refused to answer questions before the House Un-American Activities Committee, worked at MR from 1958 to 1962. "When I served my prison term in spring 1960," he says, "MR gave me unpaid leave, so when my time was up, I just went back to work." Nowadays associate editors tend to spend more years at MR; three-quarters of the present group have been there a dozen years or more. Armando Armendáriz holds the record, having been at *Mathematical Reviews* since 1965. This accumulated experience, together with help from the computer, has made the associate editor staff faster, with each editor handling more material in less time.

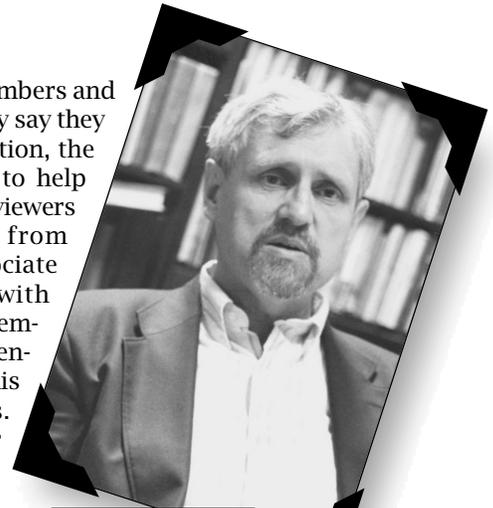
The staff of associate editors has seen its share of colorful characters. One of these is Jeffrey Joel, who after working at MR from 1973 to 1991, went to live in a yurt in Jackson Hole. A licensed rolfar and one-time member of a rock band, Joel has been known to transpose Mozart pieces to the piano while sight-reading. It is alleged that when Joel was asked by MR to fill in a form listing the languages he knew, he wrote "All"—which, according to associate editor Patrick D. F. Ion, was in some sense the best approximation. Indeed, the linguistic capability of the MR staff is impressive. Ion reports that he once overheard one of his colleagues exclaiming, "Fortunately, there is a Bulgarian summary!" The paper itself was in Tajiki.

The associate editors spend their days in a sea of mathematics. There is a continual flow of new material that needs to be examined, and examined in just the right way: carefully enough to select an appropriate reviewer, but without spending so much time as to create a bottleneck. It can be tough to strike a balance, especially when an editor comes across something he or she is very interested in reading. Selecting the right reviewer requires finesse, notes Robert Bartle, who served two terms as executive editor, 1976–78 and 1986–90. "You don't want a hatchet job or a review praising the paper to the sky because it was written by a friend of the reviewer," he says.

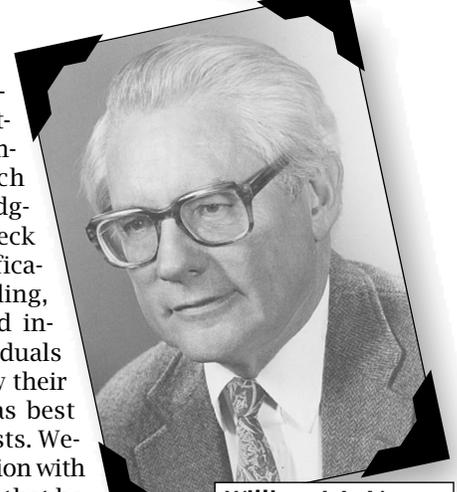
In times past the list of reviewers was kept on a hanging-card file, with colored paperclips indicating various bits of information, such as how many papers were with a reviewer. Armendáriz says he used to be able to keep in his head the names of all of the reviewers in his own area of function theory, but today there are far too many. Fortunately the MR reviewer database has taken over where brain cells give out. Using this database, the editors easily look through re-

viewers' MR classification numbers and brief descriptions of what they say they would like to review. In addition, the database gives information to help the editors avoid deadbeat reviewers and prevent reliable ones from being overloaded. The associate editors also have to deal with problematic reviews. In his reminiscences about MR, Boas mentions a review that read, "This paper contains two results. The first is due to the reviewer and the second is false." The rule of thumb, though, is that such remarks should not make it into print unless they can be substantiated. As much as is possible, the associate editors watch for claims that a paper was plagiarized and for unjustified criticisms, personal attacks, or intemperate language. In such cases the editors use their judgment to decide what to do: check back with the author for clarification, tone down harsh wording, etc. Sometimes authors send instructions that certain individuals should not be asked to review their papers, and the editors try as best they can to honor such requests. Wehausen found that his association with MR made his colleagues think that he was an expert on mathematical ethics. "Every few months I would receive a telephone call complaining that someone had stolen the caller's result," he remarked. He counseled them as best he could.

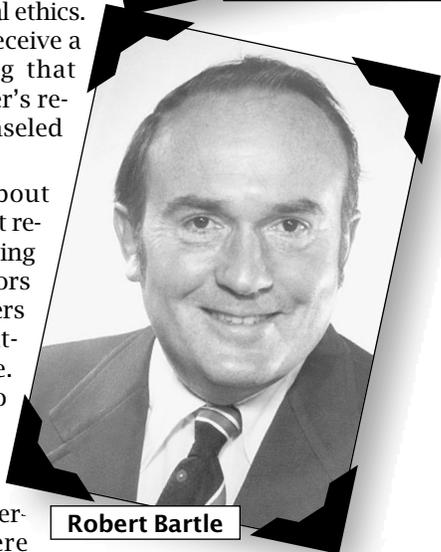
A common complaint about *Mathematical Reviews* is that it reports on too many uninteresting or trivial papers. The MR editors can decide not to review papers that are not about mathematics or are incomprehensible. But many cases are not so clear-cut; for example, a search of "Fermat" in MathSciNet turns up quite a few reviews of bogus proofs of Fermat's Last Theorem. If there were a way of deciding what was junk and what was not, then one could give the junk an automatic treatment that does not absorb much time or money and send the rest out for review. But "I don't have any idea how you do that," says John Selfridge, who served as executive



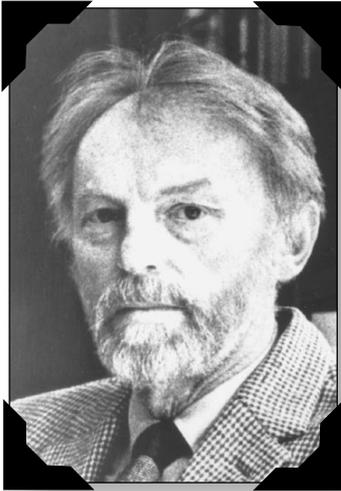
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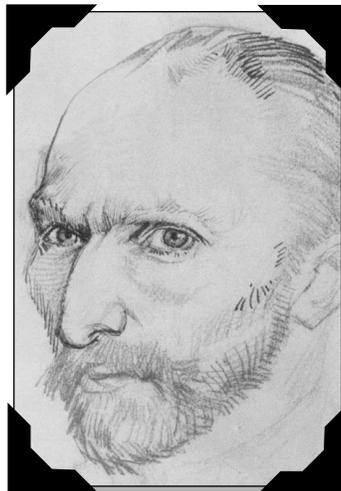
William J. LeVeque



Robert Bartle



John V. Wehausen



John V. Wehausen lookalike

—Wehausen, who is currently in the Department of Naval Architecture and Offshore Engineering at UC Berkeley, is a dead ringer for Vincent van Gogh. When he received an honorary degree from the Joseph Fourier University in Grenoble, part of the presentation included remarks about his being well known for this resemblance. (“I hope it wasn’t the basis for the degree,” says Wehausen.) One time when he was in the van Gogh Museum in Amsterdam, a Hollander came up to him and said, “I’m glad to see that the artist is here today.”

editor from 1978 to 1986. “No matter how you look at it, it’s going to take a tremendous amount of resources to make all these judgments, unless you are sloppy. And so the best thing would be to have some way where the judgments are semiautomatic and done by professional people like the associate editors.”

Nevertheless, *Mathematical Reviews* inevitably devotes more space to unimportant papers than to important ones. Several years ago MR introduced “Featured Reviews”, which highlight influential papers. The “Featured Reviews” represent something of a departure from Neugebauer’s original vision in which bad papers might have longer reviews than good ones. On the other hand, Neugebauer could not have predicted the immense increase in the mathematical literature that prompted this new kind of review, for in his day some mathematicians read MR cover to cover to find out what was going on. Today the issues are too big even for full browsing.

Checking and More Checking

In 1972 AMS President Nathan Jacobson appointed the *Mathematical Reviews* Crisis Committee to deal with a \$90,000 deficit the journal was facing. One of the main causes of the crisis was the large increase in the number of reviews. The committee conducted a survey, receiving 1,000 replies, to get an understanding of the needs of the users and subscribers of *Mathematical Reviews*. Although almost every aspect of MR was unsatisfactory to someone, they received no complaints on one point: its level of accuracy. “*Mathematical Reviews* almost never sends the reader to the wrong source, either of a paper reviewed or of one quoted in a review,” the committee noted. To this day the MR staff prides itself on meticulous precision. As the committee pointed out, this meticulousness is expensive. In the end MR survived the crisis and has maintained its legendary accuracy. (But the committee was unable to enact a

recommendation they say they received from half a dozen survey respondents: “Write fewer papers!”)

“Everything that gets done here—especially bibliographic entries—gets double-, triple-, quadruple-checked by lots of people,” says Bert TePaske-King, manager of Bibliographic Services. “We want to be sure that if we say a paper has been published somewhere, it has.” The same mania for precision extends to “author authority”. This task consists of trying to distinguish authors with the same name. The information used to be on the “salmon cards”—so named for their pale pink color—but the cards are diminishing in number as the information migrates to the computer. About 80 percent of the time the computer finds a unique individual match for any author name, and for the remaining 20 percent the staff uses other means to verify who the author is, even writing to an individual to ask if he or she has written the paper at hand. The level of detail of this work goes beyond that for comparable journals in other areas and has made possible the refinement found in the Author Identification tool on MathSciNet.

As a review wends its way through the production process, it passes through many hands. Upon receipt, reviews are copyedited, all references are verified, and MR numbers are inserted. The associate editor who solicited the review reads it with an eye toward catching any problems in the content. The review is then either keyboarded from scratch, or, if it has arrived electronically, the corrections are made in the file. After proofreading, the review is read by two associate editors. Once a month all reviews that are ready are pooled into an issue. Galleys are produced and given a final scan by copyeditors and the executive editor. In all, each MR review is read at least three times, by different people, and scanned a number of times. All aspects of the production of MR are carried out in Ann Arbor, while everything else—pricing, marketing, subscriptions—is centered at AMS headquarters in Providence.

Just how the MR staff maintain such minute attention to detail day after day is anybody’s guess. When Bartle was executive editor, a psychologist came to interview the MR staff. She classified them according to a system of personality types and found that a high percentage (80 percent, if Bartle’s memory serves him well) were found to be in the “introspective perfectionist” category. The psychologist said she had never seen in one workplace so many people in that category. “It seems that the people who stay on at MR have that kind of personality,” Bartle observes.

According to Lila Dann, the Reviewer Services Department receives 250–300 reviews on

Mondays and 100–150 on each of the other days of the week. The department uses a computerized tracking system to deal with the weekly onslaught, so that they know which reviews have been received and when to send reminder letters to laggard reviewers. Currently MR has about 13,000 reviewers and is looking for more all the time, sending out each week about one hundred invitations to review. The reviewer database makes all of these tasks much easier to manage than in the past. But because the old records can be information gold mines, one finds in Dann's office a filing cabinet containing several thousand 3-by-5 cards with data on reviewers. FBI agents confiscated the card of Theodore J. Kaczynski during their investigation of the Unabomber case—he reviewed only one paper for MR—but if you ask Dann, she will show you a copy of the card that she keeps in her desk.

Brewing a High Tech Database

Mathematical Reviews has had many homes over the years. It was located in various buildings on the Brown University campus until 1965, when the AMS trustees decided to move MR to Ann Arbor, where it has always maintained close ties to the University of Michigan. MR's present home at 416 Fourth Street is a 1904 brick building that was home to Ann Arbor's most successful brewery. Brewing up "Ann Arbor Old Tyme", "Creme Top", and "Town Club", it survived Prohibition only to close down in 1949. To the uninitiated (meaning those who have worked at MR for less than a decade) the building is a maze of ramps and hallways and staircases; to get to certain parts of the building from others, one must ascend one set of stairs and descend another.

The MR offices are modest, sporting some 1970s-vintage furnishings which, twenty years later, have earned the term quaint. These surroundings are in stark contrast to the very modern production methods. Production manager Sandra Barth started at MR thirty-one years ago

doing a wide variety of tasks without a computer in sight; today her job is much narrower and entirely computerized. The centerpiece of Barth's department is the MR database, which contains all of the bibliographic information for every item reviewed in MR going back to 1940 as well as all reviews going back to 1980. The department continually feeds new material into the database, spinning off whatever is needed for production: lists of various sorts, proof copy, and camera copy for the printed MR. The data are also transformed into various formats used by commercial distributors of the MR database and rearranged in different formats to create specialized indexes.

Early efforts at computerizing MR operations began in the early 1970s, when Jacob Burlak was executive editor, and came to fruition during the tenure of John Selfridge, who came to MR in 1978. At that time bibliographic information was typed onto dittoes, and these would be used to reproduce as many copies as needed for record keeping and other purposes. "In 1940 this was a marvelous system," Selfridge remarks, "but by 1978, it was just hopelessly out of date." MR was then typeset in hot lead by a compositor in England. Afterward, the lead was melted and all that remained was the printed publication and the paper records in Ann Arbor. This

MR Folklore: Reviews That Didn't Make It

Because of the diligence of the associate editors in ensuring that reviews stick to the facts—not to mention to conventions of grammar and spelling—what does not make it into MR is sometimes funnier than what does. Below are excerpts from unedited reviews arriving at the MR office. (Thanks to MR associate editors W. Bouwsma and P. D. F. Ion for supplying plenty of examples.)

Gastronomy

"...plays important roles in many different brunches of mathematics..." [branches]

"...seem to be dependent on the mush parameter in my opinion." [mesh]

"Authentication codes (A-codes) have been developed to provide protection against these treats." [threats]

"...the so-called Einstein effect where ordinary tea leaves floating at the bottom of a cap filled with tea..." [cup]

"...by means of the method of supper and lower solutions..." [upper]

Hoist with Own Petard

"The paper is written very bad. The language used in the paper is only a little similar to English but it is not English."

Barnyard Animals in Mathematics

"...torsion-free submodule of the free mule $F...$ " [module]

It Don't Mean a Thing If It Ain't Got That Swing

"...to the current local-differential approximations of gravitational collapse, black holes, big band and all that." [big bang]

The Places They Go!

"With the migration of Soviet mathematicians along the unstable manifold of economic and societal situations some classical results have now been translated into English."

Threatening Integrals and Mathematical Combat

"...using the theme of oscillatory integrals as a common threat." [thread]

"...which make it possible to study a really mean p -valent functions ..." [areally]

"...they are able to make sophisticated use of combatibility..." [compatibility]

"...that is, the execution of a newly arriving customer has to wait only for the termination of execution of some customers which have already arrived,..." [would not want to be a customer here!]

Greetings from a Faraway Land

"Best wishes for a Happy New Year for You and all Your Stuff." [Staff]

meant that other products, such as author indexes and reviews volumes, all required laborious retyping. By 1980 MR had set up a bibliographic database (pre-1980 material was added gradually over the succeeding ten years). About that same time MR switched from hot lead typesetting system; later on, it switched over to \TeX .

Information from the MR database has been available electronically for a number of years through commercial database vendors as well as on magnetic tape and CD-ROM. Today the database seems to have found its most comfortable home in the form of MathSciNet, the service offering access to the MR database through the World Wide Web. MathSciNet offers complete bibliographic information for MR and the text of reviews from 1980 to the present, as well as extensive links between reviews, a sophisticated author identification tool, and journal issue information.

Getting MathSciNet up and running was a collaborative effort involving a couple dozen staff members in the AMS headquarters office in Providence and the MR office in Ann Arbor. Donald G. Babbitt, who was executive editor at the time (and who is now in the Providence office as AMS publisher), got the project off the ground. MR systems developer Drew Burton and associate executive editor Jane Kister worked on the first design plan for MathSciNet in 1994, and their design is very close to what one finds on MathSciNet now. In addition to the powerful search capabilities, Burton notes, MathSciNet also “allows people to browse almost like they would in a library.” He credits the attention and care put into the MR database with making MathSciNet so flexible and powerful. In addition, the rapid spread of the World Wide Web meant that, by the time MathSciNet was introduced in January 1996, enough people were familiar with using Web browsers that MathSciNet caught on very quickly. According to Burton, the reaction to MathSciNet has been “overwhelmingly favorable.”

Another long-time MR employee, Burton was originally trained as a biblical scholar. He was on the research team for the Genesis Project, which in 1977 set out to produce one film each year for thirty years covering all of the books of the Bible. The hope was that churches around the world would put in subscriptions for the films, but the project folded after the first film for lack of subscriptions. So the following year Burton took a job as a copyeditor at MR and gradually got involved in the computerization effort, learning what he needed about programming as he went along. Working on MathSciNet is closer to Burton’s scholarly training than one might think at first: he points out that the New Testament, with its linked parallel

descriptions of the life of Jesus, was the world’s first hypertext document.

The Future of *Mathematical Reviews*

Now more than half a century old, *Mathematical Reviews* has weathered a number of crises that threatened its very existence. It survived because mathematicians saw great value in preserving this guide to the mathematical literature. Today MR is an institution, and its disappearance is difficult to imagine. However, the simple fact that information is valuable does not ensure its survival. Keith Dennis knows this only too well. When he came to MR as executive editor in 1995, he heard about a card catalog of mathematics books and papers written from the time of the invention of the printing press to about 1920 said to be in a library in Berlin. A Berlin librarian, Georg Valentin, worked on this catalog for forty years, starting in 1880. The idea of making the catalog more widely available was discussed at International Congresses of Mathematicians, but the catalog was never published. Realizing that this information would vastly increase the scope of MR, Dennis began writing to numerous mathematicians and librarians in Germany. It took two months, but he finally discovered the fate of Valentin’s catalog: it was destroyed by a bomb in February 1944.

Don’t computers make such losses less likely today? Dennis is not sure. “I think things are disappearing at a more rapid rate now than they ever have before,” Dennis notes. “They’re up on the Web, and then they’re gone.” What is needed is an organization to collect and preserve information of value so that present and future mathematicians have access to it. “I think that’s the role of the AMS and MR,” Dennis says. For example, MR is working with *Zentralblatt* on a project to convert the first mathematical reviewing journal, *Jahrbuch über die Fortschritte der Mathematik*, into electronic form. *Jahrbuch*, the precursor of both MR and Zbl, ran from 1868 to 1942 and would expand considerably the scope of MR.

Other enhancements to MR are under way. Right now one of the top priorities is to enter into the database the reviews from 1940 to 1979, which currently are available only on paper. It is expected that these reviews will be available on MathSciNet in about two years. Another improvement to MathSciNet is already here: direct links from reviews to articles appearing in AMS electronic journals. The vision is eventually to provide links from MathSciNet to any electronic journal. This is not as simple as it sounds, because there are no standards for the way information is organized in electronic journals. “If there is a different scheme for every journal, then that’s going to make it very difficult,” Dennis

says. "The more standardized things are, the more quickly—and, needless to say, more cheaply—we can do it."

In fact, many ideas that one could envision for increasing the power and reach of MR turn out to be more expensive than they seem at first glance. MR is not cheap, and, given libraries' ever-shrinking budgets, it would be perilous to pursue expensive projects to improve MR without knowing whether the improvements would pay for themselves. MR is therefore considering a number of ways to inexpensively increase its scope, such as through cooperative agreements with other organizations. For example, MR is looking into an agreement with a commercial firm that would allow MR users to connect to an existing database of Ph.D. theses. Because MR does not review Ph.D. theses, such an agreement would widen its scope. In addition, MR is discussing ways to connect to indexes of literature published by other professional societies in the mathematical sciences. This information is already accessible through some electronic products the AMS offers, so the aim now is to make it available on the World Wide Web through MathSciNet.

Another effort centers on making *Mathematical Reviews* more widely available. The main cost of MR is the preparation of the database, and this cost is the same whether three people use it or thirty thousand. "What we're looking for is an economic model which will pay the bills and make the results available to as many people as possible," Dennis explains. There are two components to the charge for MR: the Data Access Fee (DAF), which covers the cost of creating the database, and a set of subscription charges for the various delivery mechanisms (paper, tape, CD-ROM, or World Wide Web). For many institutions in poor countries, the DAF is prohibitive, and MR has a program whereby such institutions can receive discounts on the DAF and MR products. A new program now under development will make MR more affordable to about two dozen of the poorest countries, such as Ghana, Sri Lanka, and the Dominican Republic. Under this program, a country would pay a reduced-price "National DAF," and then any institution in that country would pay only the subscription fees for the MR products it needs. Croatia was the first country to sign up for a National DAF. A second new program, for consortium pricing of MR, is also under development. This program will benefit groups of institutions which include some that subscribe to MR and some that do not. The amount consortium members pay will be such that the sum is not less than the sum of the fees for the current subscribers and such that all members of the consortium pay

less than the regular subscription price for a single institution.

Guiding Progress in Mathematics

In addition to the efforts described above, MR is looking into other projects, such as improving document delivery. This service could increase in importance if libraries move to a different mode of operation in which they obtain a copy of a paper when it is requested rather than keeping journal issues sitting on a bookshelf. Most colleges and universities do not have great mathematics libraries, and those that do find their libraries' budgets shrinking. "So if you have no access to reviews, then you're dead; you cannot do much mathematics," Bartle observes. In this environment, wide access to MR can become crucial to progress in the field.

In addition, the transformation that computers are wreaking on the publishing world makes the future very difficult to predict. "There's really a boundary line between how things were done in the past and the way they're going to be done in the future," Dennis notes. "I would like to see MR become a place where you can do 'one stop shopping'. If you're interested in finding out about publications in mathematics—whatever 'publications' might turn out to mean in the future—I hope that we can set it up so that when you go to MR, you can find out what it is you want to know, and then once you've found out about it, be able to get to the original sources." The major challenge facing *Mathematical Reviews* today is to extend its reach into the past while looking forward to the future. The AMS is working hard to meet this goal.

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