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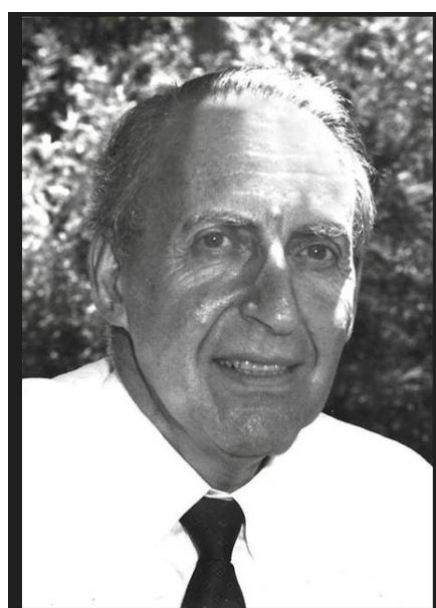


Dear ICTMA friends...

In this Newsletter we pay tribute to two significant contributors to ICTMA who have recently passed away – Henry Pollak and Richard Lesh. Given their prominence in the community, influencing so many scholars interested in mathematical modelling around the world, we thought it appropriate that their contributions be captured by those friends and colleagues who know them best. All of who tell the tale of why they will be sorely missed.

Vale Henry Pollak

Vince Geiger (President ICTMA) and Gabriele Kaiser (Immediate Past President ICTMA)



ICTMA, the International Study Group for the Teaching of Mathematical Modelling and Applications mourns the passing of Professor Henry Pollak on 8 July, 2026. Henry was a mathematician and mathematics educator of the highest repute, working as leading member of Bell Laboratories. His life's work was foundational to the goals of ICTMA, as he was one of the first to advocate for the inclusion of authentic real-world problems as a central component of mathematics education, through mathematical applications and mathematical modelling. This goal was heralded at the ICMI colloquium How to teach mathematics so as to be useful (Utrecht, The Netherlands, 1967) led by Hans Freudenthal. The proceedings of this colloquium, which were published in the inaugural issue of Educational Studies in Mathematics (1968), included Henry's landmark lecture On some of the problems of teaching applications of mathematics. Henry presented a continuation of this work at the 1st International Congress on Mathematical Education (ICME-1, Lyon, 1969), in his address How Can we Teach Applications of Mathematics?, in which he outlined his views, as an applied mathematician, on the teaching and learning of mathematical applications. In this and in his later work, Henry spoke about modelling as more than the ability to solve real-world problems within the workplace, but also as central to intelligent citizenship and personal decision-making. This included the ICME-3 (Karlsruhe, 1976), in which Henry was responsible for the section The Interaction between Mathematics and Other School Subjects, and also delivering

the influential survey lecture *The Interaction between Mathematics and Other School Subject*. In addition, Henry differentiated different meanings of applied mathematics, as content and as process, laying the ground for the further development of the discourse on mathematical modelling education.

During his ongoing contributions to the biannual International Conference on the Teaching of Mathematical Modelling and Applications (ICTMA) (ICTMA1, Exeter, 1983; ICTMA3, Kassel, 1987; ICTMA16, Blumenau, 2013), he defined the difference between word problems and the mathematical modelling of authentic situations, introduced the concept of the mathematical modelling cycle, and argued for the implementation of open-ended modelling experiences in mathematics classes – ideas central to the ongoing work of ICTMA and research and practice in modelling more broadly.

In this ICTMA Newsletter, we celebrate the many contributions of Henry Pollak to this community and as well as mathematics education itself as presented by close friends and colleagues. We hope these capture the something of the significant and innovative contributions of Henry as is a giant in our field.

What I learned from Henry Pollak

Werner Blum

The first time that I met Henry Pollak was in Haus Ohrbeck near Osnabrück where all people came together who had some role at *ICME-3 in Karlsruhe 1976*. I was the German Coordinator for Section B6 “The Interaction between Mathematics and Other School Subjects” and Henry Pollak was the Reporter who gave a plenary lecture at the congress. I was a young mathematician and a novice in mathematics education when I was asked by Hans-Georg Steiner, the Chairman of the IPC, to take on this job. From the first moment I was fascinated by Henry’s knowledge, intellectuality and aplomb. He was an expert both in mathematics and in mathematics education and occupied himself with the teaching and learning of applications and modelling starting in the 60ies (see, e.g., Pollak 1969), not as a teacher or teacher educator, but as a leading member of Bell Laboratories. In his lecture at ICME-3 (Pollak 1979), Henry addressed several fundamental questions of the topic, still absolutely fitting and relevant today, and thus I received, without him knowing it, a first-rate introduction into the topic of applications and modelling in mathematics education which was pivotal for my later work. Among many other things, I saw (his version of) the *modelling cycle* for the first time (p. 237): “... a recognition that a situation needs understanding, an attempt to formulate the situation in precise mathematical terms, mathematical work on the derived model, (frequently) numerical work to gain further insight into the results, and an evaluation of what has been learned in terms of the original external situation”, and (p. 233) “... usually involves going around the loop between the rest of the world and the mathematics many times”. And this, too, is illuminating and still crucial (p. 237): “A good model is one which is to some extent successful in explaining, or even predicting, external reality. If it fails to explain, then, no matter how satisfying the mathematics itself, the model is not good applied mathematics and must be changed”.

Henry also talked about the *goals* of teaching applications and modelling, ranging from understanding real world phenomena and preparing for future jobs over getting an adequate picture of mathematics as a science to understanding and motivating mathematical content. He advocated genuine real-world problems but also appreciated the potential role of dressed-

up problems (p. 238): *“Sometimes problems are clothed in a mantle of external vocabulary only for amusement, and the pretended application is not meant to be taken seriously. We shall call such problems whimsical problems. ... it can be quite effective to begin with an unsatisfactory oversimplification of a real situation, and to approach a genuine application ... through a series of increasingly realistic problems. Thus whimsical and unreal problems are not necessarily devoid of pedagogic value”*.

Pedagogical implications of applications and modelling for mathematics teaching were also part of his presentation (p. 240): *“... it is necessary to understand when and how and why the mathematics works in order to apply it correctly. ... the natural desire of mathematics teachers to emphasise understanding as well as technique is reinforced, not contradicted, by applications”*, and (p. 240) *“It is very valuable for the student to have open-ended modelling experience”*. This has consequences also for teacher education (p. 241): *“Teachers should become familiar with the new fields of applicable mathematics, with the process of model building, and with the associated pedagogic emphases on understanding and open-endedness”*.

Eleven years later, in his plenary lecture at *ICTMA-3 in Kassel 1987* (which Gabriele Kaiser and I organised) Henry addressed fundamental issues which are equally relevant today (Pollak 1989) and which were once again formative for me (and certainly for the whole ICTMA community). For instance, he spoke of the *goals* for teaching mathematics (p. 33/34): *“... there are four major purposes ...: (1) mathematics for practical everyday life; (2) mathematics for intelligent citizenship, and for the decisions that must be made in life – but not every day; (3) the mathematics needed for your profession, and for the preparation for that profession, (4) mathematics as part of overall human culture”*, and of curriculum content (p. 36): *“... the importance of including probability and data analysis, planning and optimisation, modern finance, discrete and algorithmic mathematics”*, and further, remarkably already 40 years ago (p. 35): *“artificial intelligence, including the problems of human interaction with machines in an intelligent way”*.

An interview with Henry on the occasion of the 14th *ICMI Study on Modelling and Applications in Mathematics Education* (Pollak 2007) contains also numerous instructive phrasings, for instance (p. 111) about what *modelling* is: *“... this whole process of beginning with the situation that you are trying to (and hope to) understand mathematically until you finally get to a picture of it, and a formulation of it that will allow you to get some answers – that whole process is what we call mathematical modelling”*. And he emphasised (p. 114) that for acquiring modelling competency *“... there are obviously two things that you have to do ... You have to take some models that have been created and have been known to be successful and students have to study those models, and understand what makes them work, Also, students have to take situations for themselves and start creating models of those situations, make decisions of what you have to keep and what you can afford to ignore, and how you are going to test whether you really succeeded”*. This interview also contains a nice self-description (p. 113): *“I had struggled for decades with the fact that I was interested both in mathematical research and in mathematics education. I wore those two hats in different official capacities and yet I had to wear those two hats on the same head. And I struggled with the consistency between these two”*, and I may add that all the time he has indeed thought and acted highly competently and consistently with both hats.

I was so lucky to meet Henry at many other opportunities, for instance when I visited him at Columbia in 2012, at a joint Michelin star dinner in Hamburg 2016 during ICME-13, or at Sol

Garfunkel's 75th birthday in Boston 2018. Each meeting was a stimulating and enriching learning environment for me. I owe him a lot, and I will always cherish his memory.

Pollak, H. O. (1969). How can we teach applications of mathematics? *Educational Studies in Mathematics*, 2(2), 393–404. <https://doi.org/10.1007/BF00303471>

Pollak, H. O. (1979). The interaction between mathematics and other school subjects. In UNESCO (Ed.), *New trends in mathematics teaching IV* (pp. 232–248). OECD.

Pollak, H. O. (1989). Recent applications of mathematics and their relevance to teaching. In W. Blum, J. S. Berry, R. Biehler, I. D. Huntley, G. Kaiser-Messmer, & L. Profke (Eds), *Applications and modelling in learning and teaching mathematics* (pp. 32–36). Ellis Horwood.

Pollak, H. O. (2007). Mathematical modelling—A conversation with Henry Pollak. In W. Blum, P. L. Galbraith, H.-W. Henn, & M. Niss (Eds), *Modelling and applications in mathematics education* (pp. 109–120). Springer US. https://doi.org/10.1007/978-0-387-29822-1_9

Memories of Henry Pollak

Mogens Niss

Henry Pollak will always be remembered as one of the first to plead for serious inclusion of mathematical applications and modelling in mathematics education (Pollak, 1969). His early view of this issue was expressed in a lecture at an ICMI colloquium “How to teach mathematics so as to be useful”, held in Utrecht (The Netherlands), 1967. Throughout his career as a prominent research mathematician and mathematics educator, Henry kept insisting that the very process of modelling – and not just extant applications and models – should be given primary emphasis in mathematics education.

My own first meeting with Henry was in 1976, at ICME-3, in Germany, where he was the reporter of the section “Interaction between mathematics and other school subjects” (Pollak, 1979) which was where mathematical applications and modelling were dealt with. Since then, we met lots of times in various settings and contexts, including at Teachers College, University of Columbia, where he invited me to give a seminar. Below are some snippets of encounters that show characteristic facets of Henry in several capacities.

At the international congress of mathematicians in Zürich in 1994, it so happened that Henry and I walked together to the congress venue. He then asked me how I would explain the value of mathematical modelling to different interlocutors, and how I would react to objections raised by skeptics, a role that Henry took it on himself to play. When we reached the congress venue Henry said: “I think we have just produced an outline of an interesting paper, don't you agree?” I did, but - alas! - it never came into being.

At ICTMA 16 in Brazil (2013), most of the participants stayed in the same hotel, which had a couple of rather slow elevators. One day, Henry and I both waited for one in the lobby. It didn't last long before Henry said: “I wonder how these elevators respond to calls. Why don't we sit down and devise a call-response model that minimises guests' waiting time?”. Later we did sit down in the lobby and identified the main objectives, variables and other features of an elevator optimisation model, without, however, constructing a full model, which time didn't permit. Henry's approach to the process was no less than impressing.

The last time I saw Henry in person was in 2018 at a symposium in Boston in honour of our common friend Sol Garfunkel. At a meal in Sol's house, Henry (then aged 90) complained about his weakening memory. Knowing that he had a long-time interest in so-called pre-

stamps (ways of paying postage for international letters before there were stamps), I asked him to explain the system to me. Pulling everything directly out of his head he explained in great detail how the system worked for a letter sent from Vienna to Amsterdam via several German states in the 1830's. Postage rates in several different currencies were included. No sign of a weak memory was shown by Henry on that occasion!

My last encounter with Henry was at ICTMA 20 in Würzburg in 2022. There, I received the Henry Pollak Award together with my great colleagues and friends Werner Blum and Peter Galbraith. Henry, who had been asked to make a speech online, impressed us all by pinpointing succinctly and clearly what he – now 94 - had learnt from each one of us.

A formidable modeller, researcher, educator, humanist and friend of the first rank has left us. Henry's mind was always alert, targeted and sharp. No bullshit involved. Yet Henry was the kindest person, treating everybody as a peer, regardless of his or her position in "the hierarchy". Hearing him talking about the way he and his family left Austria to end up in the USA in the late 1930's was telling and moving. His fluent and versatile English had a charming German accent, marked by a characteristic backthroat "r". We who knew him will never forget Henry and his legacy.

Pollak, H. O. (1969). How can we teach applications of mathematics? *Educational Studies in Mathematics*, 2(2), 393–404. <https://doi.org/10.1007/BF00303471>

Pollak, H. O. (1979). The interaction between mathematics and other school subjects. In UNESCO (Ed.), *New trends in mathematics teaching IV* (pp. 232–248). OECD.

Memories from the Brazilian Community

Joao Frederico Meyer (Joni) and Marcelo C. Borba

Here in Brazil, we had the privilege of receiving Henry Pollack during the ICTMA 16 in 2013 in Blumenau, a city in one of the southern states of Brazil.

He was, as always, himself: patient with all of us (even during his talks), ready to listen to all of us during coffee breaks, affable when hearing us out with questions, opinions, and challenges, and even attentive to small children who participated (an idea of Salett Biembengut, who organized the ICTMA meeting) by presenting their very own posters and explaining all that they had modelled and worked out mathematically.

His presence was inspiring, informative, and empathic, and he possessed a sincere personal stance that made us all look up to him. With almost no restraint in the presence of such an authority, to whom we were able to discuss ideas, regional differences, as well as historical, political, and cultural aspects that, in fact, brought up subtle (and sometimes not so subtle) differences in our modelling efforts at all levels. Pollack was theoretically important to Brazilian modelling, and he was also personally important.

His presence with us will always be felt and remembered.

Between spare ribs, the MoMath and amicable numbers in NYC, Kassel and Brazil

Rita Borrromeo Ferri

Does my headline make sense? At the very least, it might pique your curiosity, but it only hints at what has linked me to Henry since 2012. In this brief look back, you'll see how spare ribs, the MoMath and amicable numbers in NYC, Kassel and Brazil are connected, even though the list isn't exhaustive or in chronological order. I don't want to go over Henry's professional achievements here, as there is plenty to read about them. Instead, I'd like to give you a better insight, as I've come to know and appreciate him.

I first met Henry in 2012 whilst working at Teachers College (TC) at Columbia University in New York City. At that time, he was still teaching mathematical modelling courses himself, and the idea arose that he could lead the study abroad programme at the University of Kassel with a group of students. He did just that and brought 10 TC-students with him – it was wonderful to have him and his wife, Mary Margaret Shoaf, here in Kassel for two weeks, and it was also a memorable experience for my German pre-service mathematics teachers. During our time in Kassel in particular, I had the opportunity to engage in an in-depth exchange with Henry on the mathematical modelling education. At the same time, I also got to know Henry well as a person. We laughed a lot, as he can be very amusing, especially because we kept switching back and forth between German and English telling us stupid „old“ jokes. The year 2013 was interesting in many ways. Henry gave a keynote lecture at ICTMA 16 in Blumenau (Brazil) and I had the privilege of giving a response to his talk. In the preparation to the event, we exchanged many emails and I was able to learn even more about his way of thinking. Later in 2013, I was back at the TC for a few months to teach modelling courses. I did quite a few things with Henry and Mary Margaret during that time; for example, they both invited me to the National Museum of Mathematics (MoMath). We spent a lot of time there, and Henry tried out all the interactive exhibits, such as riding a bike with square tyres. Henry's wife, Mary Margaret, is from Texas, and she suggested we go for eating spare ribs in NYC. That was great fun. Above all, I loved seeing Henry and Mary Margaret together, because they were so happy. At the end of my time at the TC, a celebration was held to mark Henry's 25 years-off-service at the TC (Oktoberfest Symposium). Among the guests and speakers were Alan Schoenfeld, Werner Blum and Sol Garfunkel, and I had the honour of delivering one of the honour speeches. To this day, that still gives me great pleasure. What do you give a man like Henry Pollak to mark such an occasion? Then something occurred to me that could express our mutual exchange and connection: amicable numbers! These numbers are two different natural numbers related in such a way that the sum of the proper divisors of each is equal to the other number. I decided to use the smallest pair of amicable numbers, 220 and 284, and had them engraved on a small round metal plate and gave it to Henry after my talk. They are amicable because the proper divisors of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110, the sum of which is 284; and the proper divisors of 284 are 1, 2, 4, 71 and 142, the sum of which is 220. These numbers – or perhaps this gesture – obviously made a lasting impression on Henry.

When I visited Henry in January 2024, he said: “Rita, I haven't forgotten the amicable numbers!”



Henry and Rita (ICTMA 16, Blumenau, Brazil)

Regarding Henry - A Tribute

Peter Galbraith

I will begin with a personal story. In 1987-88 I was involved in planning and executing a 2- year modelling programme with a group of senior secondary students. My collaborating teacher, Neville Clatworthy (who taught me as much about teaching modelling as he ever learned from me), attended the (now titled ICTMA 3) conference in Kassel. He returned further inspired – by the conference as a whole, but in particular by the plenary address by Henry Pollak. The next year Henry visited Brisbane and amidst his busy schedule I drove him to the college to meet the students. There, the celebrated keynote speaker from ICME 1, ICME 3 and ICTMA 3 sat on a desk and chatted to the students about modelling as if they were the most important people in the world. Such was the man.

In his talk he raised as a major educational challenge the provision of mathematics needed for intelligent citizenship and personal decision-making. Along with preparation for changing workplace needs, we find these priorities expressed in multiple national statements today, including in my own country. He went on to suggest how mathematical modelling (properly interpreted and applied) could make a major contribution in addressing the deficits identified. But these insights were built upon a foundation already laid, as a keynote speaker on themes around modelling at two of the first three ICME Congresses in 1968 and 1976. His three addresses are provided as references at the end of this reflection.

At ICME1 he identified five families of (word) problem that in various ways purported to represent mathematical applications. Three masqueraded falsely as providing genuine examples of mathematical activity; those that used words from everyday life outside of mathematics to make the problem sound good; those that asserted links to subject disciplines, where again the reality of the application was neglected; those (whimsical problems) that used words from daily existence or other disciplines, but where it is clear that no real application is intended.

He contrasted these with actual applications to real life, or to other disciplines, which begin with a messy fuzzy situation which we are trying to understand, and where it may be more difficult to find the right problem than to solve it when found.

His major point was that it is crucial that mathematics problems which claim to be applications of mathematics from outside mathematics itself, be honest, applied mathematics – meaning that the relationship between the mathematical model and the situation in the outside world that is being mathematized must be clearly understood.

His ICME Congress paper in 1976 introduced the concept of modelling cycle as a continuous loop representing movement of problem-solving focus between what he described as "the

rest of the world" housing messy, unorganised, and ambiguous situations providing problems of interest; and the Intra-Mathematical Domain comprising the abstract world of symbols, equations, graphs et.al., that operated purely on a mathematical basis. This was later developed by the Open University (UK) into the 'famous 7-box representation' so widely used in early ICTMA presentations. This also featured as advisor an eminent professional modeller - Oliver Penrose FRS.

To truly honour a memory, we should also carry a torch. What better way than to use as a metaphor the modelling process that was Henry's signature contribution. In modelling we know that we can utilise all kinds of fancy mathematics that are dear to our heart. But unless these survive real-world testing of a resulting mathematical solution against the real problem requirements, they fail the test of validity. Similarly, we can invent all kinds of curricular activities and label them modelling – but unless they contain the essentials of beginning with a fuzzy problem to solve and moving back and forth between its real-world context and mathematics, we are not undertaking modelling in the sense that Henry advocated. The modelling cycle (initiated by Henry) is not associated with an arbitrarily defined category of activity - it defines a particular type of activity that involves using mathematics to address a problem located in the world outside mathematics. It is not one of a collection of activities each categorised as modelling, but the one against which all others are measured. It is disturbing to read, as has been recorded, that modelling in education differs from modelling undertaken by professional modellers. This is an exact parallel to the situation Henry set out to put right in his 1969 paper – except that there it was in terms of word problem content rather than something called modelling. Ever polite he recognised that pedagogical value could be attached to such activities writing of one such type that "They provide comic relief in the Shakespearean sense and probably do a lot of good - although not as applied mathematics.". In our context we can keep the first part but replace applied mathematics with mathematical modelling. We can distinguish usefully between modelling as content (Pollak) and modelling as vehicle (as introduced by Cyril Julie) where in the latter some aspects of modelling are used with the purpose of serving another curricular priority. Henry endorsed this suggested distinction in his talk at Blumenau in 2013.

In terms of recent activity, we note that for many years Henry has been an advisor to COMAP in developing and conducting the annual International Mathematical Modeling Challenge (IMMC). As indicated on its website the Challenge is established on the firm belief that students and teachers need to experience the power of mathematics to help better understand, analyse, and solve real world problems outside of mathematics itself – and to do so in realistic contexts.

This is pure Henry. Given the priority ascribed to the importance of the 'T' in ICTMA why does it apparently attract relatively peripheral interest within our community? For example, the student solutions published annually indicate that there are teachers of modelling that have much to teach the research community. In seeking to promote and continue Henry's legacy, this is one avenue to pursue.

Pollak, H. O. (1969). How can we teach applications of mathematics? *Educational Studies in Mathematics*, 2(2), 393–404. <https://doi.org/10.1007/BF00303471>

Pollak, H. O. (1979). The interaction between mathematics and other school subjects. In UNESCO (Ed.), *New trends in mathematics teaching IV* (pp. 232–248). OECD. <https://unesdoc.unesco.org/ark:/48223/pf0000124827>

Pollak, H. O. (1989). Recent applications of mathematics and their relevance to teaching. In W. Blum, J. S. Berry, R. Biehler, I. D. Huntley, G. Kaiser-Messmer, & L. Profke (Eds), *Applications and modelling in learning and teaching mathematics* (pp. 32–36). Ellis Horwood.

Meetings with Henry

Alexander Karp

I first met Henry Pollak in 1996, when I first came to the United States, at the invitation of Bruce Vogeli, Director of the Program in Mathematics at Teachers College, Columbia University. In 2000, I began working in this Program alongside Pollak, but even before then, in the summer of 1997, if I remember correctly, Bruce invited me to attend two of Henry's courses on modeling, so I can even consider myself Henry's student. The courses introduced me to much that I hadn't even heard of before – in the textbook for Russian secondary schools that I later co-wrote with Alexey Werner, Henry is justly named among those to whom the authors owe ideas that were new to them. At Teachers College, Henry taught courses on modeling, of course, but not only: he also taught courses in real and complex analysis and in dynamical systems. In addition, he was responsible for the colloquium, held four times a semester, to which he invited prominent figures in mathematics education from all over the world. Bruce rightly felt that the standard title "adjunct" in no way fit Henry's role in the Program, and he was officially called a visiting professor. And such indeed he was, a visiting professor for three decades, giving lectures and supervising doctoral students.

Henry would come to Teachers College one or two times a week several hours before his lectures, and, if he had no meetings with students, he and I would usually sit and talk in his office or mine. We discussed the most varied topics – from how he studied Latin to how someone in his family (his grandfather, I believe) had seen Brahms in person. Of course, we talked about events in mathematics education that he had observed and had actively participated in – some of his stories he later repeated while giving me an interview (see Karp, 2014), and I do not cite them now. I will recall only the leading role he played in the School Mathematics Study Group and, for example, the Lyon conference "How to Teach Mathematics so as to be Useful" in August 1967. We spoke a great deal about various mathematical problems – it was always very interesting for me to observe how he thought.

I remember how, in connection with something, he once told me about going on a trip on assignment from three different organizations at once, and then posing the problem of who should pay the travel expenses and in what proportion. Henry solved this problem. True, all three organizations agreed with him without even listening to his reasoning, which, as far as I recall, was not trivial. Solving such problems as they arise is sometimes not even very difficult, but in order to pose them one must be able to perceive what one encounters in the world as mathematizable, as translatable into the language of mathematical problems. Henry possessed this gift to perfection.

It must be said in this connection that sometimes, in order to emphasize the practical importance of mathematics, people present it as something like medicine – nasty-tasting, of course, but it helps! Henry, for all his reflections on how to show right away the practical usefulness of the mathematical object being introduced, always took pleasure in mathematics itself.

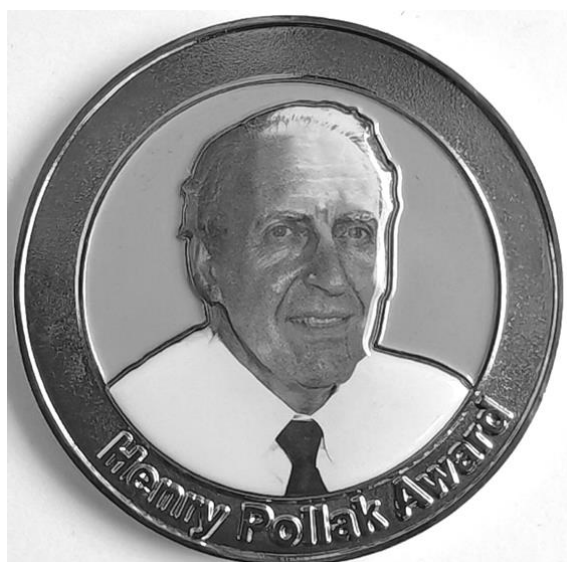
We want children to like our subject, sometimes forgetting that in order for this to happen, we must like it ourselves. Henry Pollak was very interested in what he worked on. The students felt this, of course, and valued it, as they valued the depth of what was discussed in his lectures. Henry always said that he was not a real teacher, who ideally should not speak himself, and that he talked too much, but that was precisely what was most interesting, although of course problem-solving in groups and so on was also part of his classes. Those who listened to Henry participated in his lectures, feeling the dramatic urgency of the situation

being examined, which made it necessary to seek a solution, and following the thought of the lecturer, who thought together with his students. Henry taught courses that were mathematically difficult, but he always told me that they should differ from courses taught to graduate students in mathematics: those courses look ahead – to where and how far a given theory can be advanced – whereas for mathematics educators it is more important to look back – to what a given theory grew out of, and what prepared the way for it. Henry taught not so much results as participation in a process – of observation, of analysis, of thinking. One can speak of an established Pollak's school, of the interesting dissertations defended by his students, of how they carried his ideas further into the schools and colleges where they taught. Our Program strives to preserve the spirit that Pollak created, but we miss him very much.

Karp, A. (Ed.) (2014). *Leaders in mathematics education: Experience and vision*. SensePublishers.

Henry Pollak Award

Gloria Stillman and Gabriele Kaiser



At the 13th International Congress on Mathematical Education (ICME-13), held in Hamburg, Germany in 2016, the International Community of Teachers of Mathematical Modelling and Application (ICTMA) had a large presence in Topic Study Groups and the Affiliated Study Group (ASG) Session. At the ASG session, it was proposed that the then President of ICTMA, at the time Gloria Stillman, investigate honouring Henry Pollak by setting up of an award in his name. Henry gave the keynote at the First International Conference on Teaching Mathematical Modelling, called ICTM1, the first conference of our community (later to be called ICTMA) as a recognised group in Exeter in 1983.

It was suggested that it be a career medal to celebrate the research career of a scholar who had been researching and contributing to research on mathematical modelling education for a long time and who had provided service to the ICTMA community. The idea, draft wording and an application form were presented to the ICTMA Executive Committee at its pre-conference meeting in Capetown at ICTMA 18 in July 2017 by the president. Following confirmation that such an award was appropriate for the community, Henry was contacted. Henry was honoured to have his name attached to the award for sustained contributions to furthering the role of mathematical modelling in mathematics education through ICTMA. Thus, the ICTMA Career Research Medal which is known as “The Henry Pollak Award” was

born. One member of the ICTMA Executive Committee was to oversee the Awards Portfolio with organization and oversight of awarding panels, responsibility for recommendation of awards to the executive committee and being proactive in encouraging nominations.

Selection criteria: "It is expected that the recipient of an ICTMA Career Research Medal, that is, The Henry Pollak Award, will have had a career that exhibits the following:

1. sustained and distinguished achievement in mathematical modelling education research projects;
2. research that has made a broad impact;
3. an outstanding record of quality of scholarship; and
4. research-related contributions and service to ICTMA over a period of time."

The tragic death of Helena Wessels after ICTMA 18, meant that The Henry Pollak Award was kept on hold until after ICTMA 19 in Hong Kong where it was announced to the members. The first awards were presented at ICTMA 20 in Würzburg, Germany, during the COVID epidemic. Awardees to date have been Peter Galbraith, Mogens Niss, and Werner Blum (at ICTMA 20, 2022), Gloria Stillman (ICTMA 21, 2023) and Gabriele Kaiser (ICTMA 22, 2025).



The award ceremony at ICTMA20 in 2021 in Würzburg showing the awardees Werner Blum and Mogens Niss together with Gabriele Kaiser as ICTMA president and laudator. Peter Galbraith (screen) could not be present.



The award ceremony at ICTMA21 in 2023 in Awaji Island showing the awardee Gloria Ann Stillman and the ICTMA president and laudator Gabriele Kaiser.



The award ceremony at ICTMA22 in 2025 in Linköping with Gabriele Kaiser as awardee and Vince Geiger as ICTMA president and laudator.

Vale Richard (Dick) Lesh

ICTMA has also recently lost another significant contributor to its community in Dick Lesh. Dick contributed many innovative ideas to our understanding of the processes of mathematical modelling, as well as to problem solving more generally. He is remembered fondly by friends and colleagues, not just for his scholarly contributions but also his humanity – always kind, caring, and generous. These qualities are highlighted in the tributes provided by close associates below.

Memories of Dick Lesh

Cory Brady

Our field has been shaken by the passing of Dick Lesh. His wonderful wife Jill writes that his final days and hours were peaceful and that he died surrounded by many members of the large family that survives him.

In every way, Dick was far from ordinary. So, rather than write a typical obituary, I wanted to give this community one image of the man in joyful action.

Among colleagues and friends, Dick was famous for his ability to pull out a harmonica and join in with live music acts on stage. This not only reliably enlivened the show and created a story for everyone to tell, but it also genuinely enhanced the musical performances. So, when, during COVID, he suggested he'd be interested in having weekly zoom calls to teach me and others his harmonica approach, I was enthusiastic. Over time, our group grew to include Roy Pea and Tony Petrosino; although our harmonica playing developed slowly in this virtual setting, the weekly discussions of learning, of tacit and embodied expertise, and of the blues were quite rich. Dick had been writing a book to capture his insights, and our conversations about it raised deep parallels between the challenges and breakthroughs in harmonica learning and the challenges and breakthroughs in mathematics learning. Dick didn't complete a full draft of the manuscript before he died, but we discussed the different chapters in depth over the past five years, and his working copy of the opening chapter generously credits us. The group of us that remain are committed to finishing his work in some form.

I mention this project not only because I believe it may be intrinsically interesting to many in this audience, but also because it exemplifies some distinctive ways of thinking and working that came to epitomize Dick throughout his career.

He made novel and compelling connections, both within mathematics and modeling and between these and other fields. This connection-making ability was almost a compulsion. Within mathematics education, Dick co-authored with a wide range of thinkers, bringing their perspectives into relevant connection with his Models and Modeling Perspective. And this continued well outside of mathematics education. As one example, over the past decade or so, Dick was in the hospital quite a few times, for intensive procedures like inserting stents or having bypass surgeries. He generally came home from those events not only in remarkably good spirits, but also with the kinds of insights into the medical staff's practices and procedures that would normally require a workplace study. By asking the right questions, he always managed to get the staff to share their reflective practice with him while he happened to be their patient. Similarly, Dick could engage professionals in almost any field to share their thinking with him.

He had a talent for conceptualizing projects and forums that brought people together to collaborate in new and exciting ways. From founding the PME-NA conference as a venue for novel, in-process research thinking, to convening events that would lead to such substantial and innovative edited volumes as *Beyond Constructivism* and *Foundations for the Future in Mathematics Education*, Dick was able to put junior and senior scholars together in ways that not only allowed them all to shine but also built toward a larger coherence and impact.

He worked with a style and flair that caught the eye of extremely interesting and unconventional people. As a three-season athlete in Warsaw, Indiana and a star in football and track, Dick caught the eye of Fred Olds, a legendary coach (as well as an artist and a poet). As a graduate student, Max Zorn (of Zorn's Lemma) found Dick an innovative thinker. And his long-time friendship with Jim Kaput reflected their shared ability to imagine the future of learning in compelling ways, together and independently. In turn, Dick was able to detect and elicit wonderful and interesting features in a variety of people, as though by resonating with the excellence within them.

Finally, he was generous with his time, always willing to support junior colleagues. Dick aimed to give young scholars the ideas and opportunities that they needed, adopting their perspective and matching aspects of his vast store of knowledge with what suited them. This led him to take on a wide array of students and proteges, as well as to orchestrate collaborations between young scholars whose ways of thinking he saw as compatible.

It is a common theme that humans tend to see prior generations to ours as larger than life – as figures from an age of heroes qualitatively greater than themselves. Even knowing this tendency, when I mentally survey the part of Dick's life and work that I know, I find myself recalling the poignant closing: "Such was the death of Hector, breaker of horses" and feeling that Homer's epic words strike the right chord for Dick as well: a man who lived vigorously, fighting for grateful colleagues and noble ideas.

In Memory of Dick Lesh

Şerife Sevinç

I am deeply, painfully sad that Dick is no longer with us. I still find it difficult to accept that there will not be another conversation with him, another unexpected idea, another question, another moment of thinking together.

Dick was, of course, a remarkable scholar and one of the most influential figures in mathematical modelling. The modelling community knows the intellectual legacy he leaves behind. But for me, Dick was also the person who opened a door that changed the course of my life. He was my doctoral supervisor, my mentor, and my intellectual companion. When I think of him now, I find myself remembering not only the ideas we discussed, but also many ordinary and extraordinary moments we shared.

Our paths first crossed in Ankara when he came to give a seminar, at a time when I was about to move to Florida to begin my PhD. Then Dick invited me to Indiana University to work with him. I could not have known then how profoundly that invitation would shape my academic life. The door he opened that day set me on a path far more flourishing than I could ever have imagined.

I remember research seminars that somehow ended with Dick making pizza from his sourdough. I remember him showing me his oldest sourdough with genuine pride and delight.

I remember our walks around the campus and talking about trees, particularly the ones with faces. I remember our weekends at the farmers' market in Bloomington and our trips to the countryside, where he would play his harmonica as part of a local band. I remember my first terrifying tornado experience at Jill and Dick's house, and how they comforted me through it. I remember sitting with Dick at a café on Tunalı Hilmi in Ankara, looking out at the tree-lined road, and watching him turn that view into a modelling activity. Somewhere in that conversation, one of his memorable observations came up: looking at a model is one thing; looking through a model is another. I remember visiting Dick and Jill in Park City after his retirement, hiking together, having wonderful beers, and trying some of the cowboy hats from his collection. These are only a few of the many memories I carry with me.

Beyond all these moments, I will remember Dick's wisdom, intelligence, creativity, curiosity, generosity, and, perhaps most of all, his wonderful capacity to find joy in ordinary moments.

There is one memory that says so much about what Dick valued. One day, he called me, sounding quite worried. His computer had crashed, and he was concerned that all his files, including project data and publications, might be gone. I told him that perhaps I could try to help recover them. He replied that there was only one file he really wanted to save: his latest CV. It was unlike any academic CV I had ever seen. It contained the names of his family members, including his grandchildren, followed by only a few lines about his scientific accomplishments, listed simply as xx journal articles, xx books, xx book chapters, xx conference papers, and so on. Then came page after page describing his hobbies, accompanied by small pictures: carpentry, making musical instruments and toys for his grandkids, playing the guitar, harmonica, and other instruments, cooking, skiing, making walking sticks, collecting cowboy hats and boots, and many other things.

After looking at his CV, I remember thinking to myself and saying, "This is Dick." It showed me a lot about him that went far beyond his academic achievements. It told the story of a person who was deeply curious about the world, who made things, learned things, played, explored, shared, and found joy in doing so.

I feel privileged to have shared some of those moments with him, moments that began with Dick's invitation. For that, and for everything that followed, I will always be grateful.

It is so sad to know that he is no longer here. But I also know that Dick will continue to be present in our community in countless ways: in the ideas he developed, in the questions he taught us to ask, in the modelling activities inspired by his work, and in the ways of thinking that he generously shared with his students and colleagues.

Most importantly, he will live on in the people whose lives he touched.



In memory of Richard A. Lesh

Mogens Niss

I had been working with Richard (Dick) Lesh for quite some time before we met in person. We were both appointed Chief Organisers of Theme Group 6, Applications and Modelling, for ICME-5, held in Adelaide, Australia, in 1984, and had spent several months structuring and organising the Theme Group, before we actually met in Adelaide.

Since then, we met from time to time at conferences, primarily at the ICTMAs. A very special occasion was ICTMA 13, held at the University of Indiana, Bloomington, USA, (2007) because Dick was in charge of the programme and headed the organising crew for a very successful conference. The last time I saw him was at ICTMA 16 in Blumenau, Brazil (2013). On that occasion I learnt that he had retired from his professorship in Bloomington and had moved to a charming mountain city in Utah, Park City, which I had had the chance to visit a couple of times for the Park City Mathematics Institute without knowing that Dick now lived there.

Dick was a very prolific and energetic scholar of mathematics education, dealing with a wide variety of issues and themes. As far as mathematical modelling is concerned, his most significant contribution was his work (together with Helen Doerr and others) on model-eliciting activities. In contrast to “classical” modelling studies focusing on constructing and utilising mathematical *models* to deal with extra-mathematical contexts and situations, model-eliciting activities are to do with students’ own construction of mathematical notions and *concepts* as part of coming to grips with extra-mathematical issues. Thus, model-eliciting activities serve to create (germs of) basic mathematical models as precursors to forming mathematical concepts and ideas that are new to the students.

Dick was not only a highly influential and innovative mathematics education researcher. He had other interests as well. Already when I met him in Adelaide in 1984, he told me about his designing and crafting of large unica wooden tables - almost sculptures - for his home. Later, he also engaged in other sorts of arts and crafts, making very personal objects. He also fancied playing the harmonica and the Australian didgeridoo, which those of us who attended ICTMA 13 had to privilege to experience live.

In summary, Dick Lesh didn’t like to be fenced in. He insisted on being a free bird, a man of many talents. Honoured be Dick’s memory.

Three Words for Dick Lesh

Rita Borromeo Ferri

If I were asked to describe Richard ‘Dick’ Lesh in three words, I would choose the following word(s) (pairs): deep thinker, creative mind, versatile. Dick’s work has had a significant influence on my academic career. During my research for my habilitation, in which I combined mathematical modelling education and cognitive psychology, the modelling eliciting approach – so called MEA – and, more generally, his perspective on the nature of models and modelling were fundamental. In particular, the book ‘Beyond Constructivism’, co-authored with Helen Doerr, represents a seminal work in mathematical modelling education for me. At ICTMA15 in Australia (2011), we sat together over coffee after his talk; we had actually intended to go to the next session, but ended up discussing the topic for another hour. We were both interested in whether interpretations and associations formed before the actual modelling process – after reading the problem – already constitute ‘pre-models’ or ‘models’ in our

(sub)consciousness. That was very interesting, and I still remember it to this day how deep and creative his mind worked. So, we developed a theoretical approach together and published it in the ICTMA proceedings. Dick's multifaceted talent, as we know, was not only in music – as the participants of ICTMA13 in Bloomington could experience – but also in his woodcut art. On my next trip to the USA, I had firmly resolved to visit him. He had invited me so many times. I am very sad that this is no longer possible!

In Memory of Richard A. Lesh

Helen M. Doerr and Lyn English

The scholarly contributions of Dick Lesh to the field of mathematics education reflect a breadth and depth of work on important issues that makes it difficult to know where to begin. The depth of his research can be found in his early work on children's thinking and learning about fractions, rates, ratios and proportional reasoning in the highly influential Rational Number Project. A core contribution from the breadth Dick's work can be found in his research on mathematical problem solving and modeling. In this area, Dick is probably best known as the creator of *model eliciting activities* (MEAs). These activities are designed to reveal students' thinking processes to researchers and teachers, as the students have opportunities to grapple with mathematically significant concepts that are new to them. As the students express their informal understandings and various conjectures about the problem situation, they will reveal and revise their thinking. The model-eliciting process includes multiple cycles of interpretations, descriptions, conjectures, representations and justifications that are iteratively refined as the students work together. These multiple cycles of refinement make it possible for researchers and teachers to see how students' mathematical understandings develop.

Seeing this development reveals the diversity of student thinking and the multiple pathways for the development and expression of their models. Time and again, we have found evidence in our classrooms of Dick's beliefs about all students' mathematical abilities. Students who achieve high scores on standardized tests, do not necessarily achieve highly in "real-life" problem-solving situations. We take great pleasure in seeing *all* students, irrespective of their school achievements, develop mathematically as they work on modeling eliciting activities. While creating MEAs, Dick developed a set of design principles that made it possible for a breadth of other educators (both researchers and teachers) to write MEAs that can be used for a wide variety of problem situations and in a wide range of teaching and learning situations. MEAs are designed to elicit a generalizable model that reveals the underlying mathematical structure of the problem situation so that the model is meaningful to the student in ways that can be generalized and adapted in new situations. Model eliciting activities have been used in everything from a middle school class to elicit the concept of proportional reasoning, to density over a given area, to a university level engineering class to elicit the concepts of mechanics and fluid flow.

Other researchers have designed and implemented model development sequences that begin with an MEA and are followed by model exploration activities and model adaption activities. Model exploration activities focus on the underlying mathematical structure of the model and the strengths of various representations. Model application activities engage students in applying their models to new contexts, often resulting in students adapting their model, extending representations and deepening their understanding. From an instructional point of view, MEAs shift the focus from guiding students to a particular way of thinking about a

problem situation to engaging students in revising, refining, explaining and extending their own ways of thinking about the problem situation.

Still other researchers have used model eliciting tasks that reveal students' thinking to develop assessment methods that go beyond traditional methods of assessing student learning. The breadth of this work has an important impact on school mathematics in that model eliciting activities provide a rich starting point for the students' independent development of powerful mathematical ideas.

In addition to the innovation throughout his work, Dick was a practical and collaborative person. This is quite visible in the two handbooks on research design that he co-edited with colleagues. Each of these handbooks presented the work of well-known and emerging scholars on their approaches to the practical problems of designing research in the complex situations of teaching and learning mathematics and modeling in realistic educational settings. Dick was not only a wonderful support to us as researchers, but he also cared deeply about his students, providing them with rich opportunities to learn and grow as researchers and instructors. Dick encouraged his many students to pursue their ideas and make connections among researchers to broaden and extend their works of shared interest.

Dick had many interests beyond mathematics education. For example, he was an accomplished musician, playing the harmonica with great talent. He also had much appreciation of many cultures and enjoyed their unique gifts. He was fond of Australia and took great pleasure in informing his students about life "down under," joking that it is infested with dangerous snakes and large crocodiles. Dick's students enjoyed his great sense of humor; this added to Dick's appeal to all who were fortunate enough to meet him.

The richness of Dick's research, together with his warm and generous spirit, will remain with us for many years. With each re-reading of his publications, one finds new insights that were previously overlooked or can be viewed in a new light. We are certain that we speak for many of our colleagues in stating that Dick will long remain in our hearts—along with his wisdom, his vision, and his inspiration.

In honor of Dick Lesh. He will be greatly missed.

ICTMA -

The International Community of Teachers of Mathematical Modelling and Applications

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Please send future contributions to the editor by email <greefrath@uni-muenster.de>. The next newsletter will be published in 2027. We are interested in your contributions to any of the current sections including project reports and news.
