

Chapter 36

IAMG: Recollections from the Early Years



John Cubitt and Stephen Henley

John Cubitt and Stephen Henley, with contributions from T. Victor (Vic) Loudon, EHT (Tim) Whitten, John Gower, Daniel (Dan) Merriam, Thomas (Tom) Jones, and Hannes Thiergärtner

This chapter records some of the dramatic history of the first few years of the International Association for Mathematical Geology (IAMG, much later renamed the International Association for Mathematical Geosciences), and its subsequent development told mostly through recollections (both professional and personal) of some of its early members. It complements the paper by Václav Němec in this volume who discusses his own experiences leading up to and following the foundation of the Society.

The IAMG was formed on 22nd August 1968, in a meeting at the International Geological Congress in Prague, Czechoslovakia, attended by 20 scientists from around the world. This followed preparatory work by an ad hoc committee of 14 (not all of whom were able to attend the formation meeting) which formulated statutes and by-laws and proposed names of a first set of officers.

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36.1 The Birth of Mathematical Geology and the Origins of the IAMG

36.1.1 *Vic Loudon*

The comprehensive framework for sharing geological knowledge developed over a long period, in the form of a shared network of scientific books and papers, maps, records, samples, specimens, reports, and guides—including the systematic output of regional and national geological surveys. Geological projects could contribute new information within a framework of existing knowledge and the requirements of publication. This framework, however, did not anticipate the arrival of the computer.

In the early 1960's some enthusiasts considered that computers could have an important role in creating new, widely shared mechanisms for analysing, exchanging and integrating numerical information. But to many geologists at that time, computers were a passing fad—surely the complexity of geological observation and thinking could not be reduced to mathematics, never mind its mechanical representation! Nevertheless, computer programs were shown to handle recurring statistical tasks, even if only in the detail of a geological study. They might also build on the work of others. But that requires communication, a shared objective, and in due course a shared framework.

At that early experimental stage, computer applications in geology were generally rather trivial, overlapping, uncoordinated and unpublishable. They were nevertheless essential to determine which possibilities might be fruitful, and which would be duplication. To help programmers to gain a broader view of similar work elsewhere, an informal 'Geologically Oriented Scheme for Sharing Information on Programming (GOSSIP)' was maintained at Reading University in England. Notes from various workers in geological computing were assembled and typed onto punched cards. These were sorted and revised by hand, the results printed on a typewriter connected to the keypunch, and mailed to the participants. The last of several editions was circulated in 1966 (GOSSIP 1966). It provides an insight into a fast-growing area where many individuals had been exploring possibilities independently, and beginning to develop an initial overview. Apart from one mention of information retrieval, the applications referred exclusively to numerical data.

Later, to quote Krumbein (1969): "...on the one hand we observe a growth in the complexity of programs, and on the other hand a spreading of essentially the same computer techniques through the many subfields of geology... the underlying methodology is so similar in all fields...that most speakers shifted emphasis from standard or conventional techniques to consideration of new and more analytical ways of setting up models applicable to their own fields."

36.1.2 John Cubitt and Stephen Henley

Merriam (1981) put Loudon's comments into a historical perspective by giving a helpful summary of the development of mathematical geology. This shows that the introduction of mathematical methods into the science of geology was very slow, until the advent of computer technology, despite the efforts of such notable scientists as Paolo Frisi, Charles Lyell, Paul Deshayes, Charles Babbage, and Lord Kelvin, as well as statisticians such as Karl Pearson and A.N. Kolmogorov, and others such as R. Everest, chief surveyor for India. It is well-known that the first edition of Lyell's *Principles of Geology* (1830) included statistical data that he used to justify his subdivision of the Tertiary; however, once the classification was accepted, this statistical scaffolding was not deemed important enough to be retained in subsequent editions.

The earliest consistent efforts towards routine application of quantitative methods in geology were made by A.B. Vistelius from 1941 onwards, while the use of computers was pioneered by W.C. Krumbein starting with a book in 1958 jointly written with L.L. Sloss (Krumbein and Sloss 1958). For the next ten years, there was a steadily increasing number and variety of publications on computational methods applied to geology mostly but not exclusively statistical.

36.1.3 Tim Whitten

Whitten noted that prior to 1968, different approaches to quantitative geology applied around the world. However, at the IAMG formation meeting, dissimilar approaches came together, having evolved principally in the Soviet Union, Western Europe, and U.S.A. Vistelius championed the concept that Mathematical Geology is a separate branch of science based on testing geological hypotheses mathematically, and that this should be IAMG's primary focus (Whitten 2003, 2004 pp. 384–5); for some years, he had contended it is not particularly important merely to manipulate geological data statistically. Dech and Henley (2003, p. 368) noted Vistelius (1991) considered that, if a science does not use mathematical modelling in constructing conclusions, "... it can be considered as belonging to the pre-Newtonian period, ... behind the present-day level of research by approximately 300 years."

36.2 The Role of the Kansas Geological Survey in the Origins of the IAMG

36.2.1 Tom Jones

When I got to Northwestern University in 1967, I found several faculty members were quantitative, along with a few students. Krumbein was doing work in several

areas at that time, notably geographic forms, Markov chains, and modifications of trend analyses. The Kansas Geological Survey Computer Contributions (KGSCC), spearheaded by Dan Merriam, provided an ongoing source of publications on mathematical geology and associated software.

36.2.2 *Vic Loudon*

In the late 1960s, Dan Merriam led a pioneering group of geological programmers in the Kansas Geological Survey at the University of Kansas, describing the results of their computing activities in its own publication, the KGSCC. In 1967–8, Richard Reyment spent some time at the Kansas Geological Survey, on sabbatical leave from the University of Uppsala in Sweden. He was another of the prime movers in establishing the IAMG (its first General Secretary and subsequently its President, and in 2002 the recipient of that organization’s Commendation). I was privileged to listen to one of their conversations, where they agreed that a formal body was desirable to assist and encourage documentation and communication of these developments.

36.2.3 *Tim Whitten*

The momentum driving a founding meeting in 1968 really stemmed from the Kansas Survey folk—the main activist there was Dan Merriam, who was very keen on instituting an international society and I imagine it was he who got the meeting included in the IGC programme.

36.3 Name and Establishment of the Society

36.3.1 *Vic Loudon*

Merriam (perhaps only in the wishful thinking of my biased mind), in the conversation referred to above, seemed to take the view that computer science, rather than mathematics, was the key issue. However, it seemed that the geological establishment at that time might find ‘mathematics’ more acceptable. Subsequently, Richard Reyment organised an ad hoc committee for the purpose of founding an association for the promotion of mathematical geology.

36.3.2 *John Gower*

I remember there being discussions on what name to give to the new Society and that somebody had suggested Geometrics echoing the names of the Biometrics and Psychometric Societies. It was noticed that Geometry had forestalled that suggestion so it became Mathematical Geology succeeded by Geomathematics succeeded by Mathematical Geosciences but perhaps geometrics was not so bad an idea as it seemed because originally geometry was about Measuring the Earth. Indeed, the mathematical geologists had nomenclatural problems from the start when, because of the political climate at that time, they could not appoint D.G. Krige from South Africa who would have been the obvious choice, to the Presidency. They made him a Councillor.

36.3.3 *Dan Merriam*

The 1968 IAMG foundation meeting followed considerable correspondence and fact-finding by the ad hoc committee whose Members were:

F.P. Agterberg (Canada)	D.F. Merriam (USA)
C.J. Allègre (France)	V. Némec (Czechoslovakia)
F. Chayes (USA)	R.A. Reymont (Sweden)
J.C. Griffiths (USA)	E. Schlegel (DDR)
J.W. Harbaugh (USA)	A.B. Vistelius (USSR)
W.C. Krumbein (USA)	G.S. Watson (USA)
T.V. Loudon (UK)	E.H.T. Whitten (USA)

This committee formulated a set of statutes and by-laws (largely written by R.A. Reymont in compliance with IUGS and ISI guidelines), made provision for establishing a journal, and proposed a slate of officers.

36.4 Foundation of IAMG Publications

36.4.1 *Tom Jones*

As time went on, the IAMG formed the journal *Computers & Geosciences* (C&G). The Kansas Geological Survey Computer Contributions (KGSCC) series was discontinued in 1970, probably in part due to C&G and as a result of Dan Merriam moving to Syracuse University to become Chairman of the Geology Department. The American Association of Petroleum Geologists (AAPG) formed a committee on Computer Applications, but I do not recall that it had much influence. A North American group formed MGUS (Mathematical Geologists of the United States)

around the mid 70's with the goal that MGUS would eventually become a regional group tied to IAMG. Much later (I believe 1985) AAPG sponsored a computer-oriented magazine, GEOBYTE.

36.4.2 *Vic Loudon*

To quote the IAMG website: 'The mission of the International Association for Mathematical Geosciences is to promote, worldwide, the advancement of mathematics, statistics and informatics in the geosciences'. It established a journal and a newsletter. From its inception in 1968, an important role of the IAMG has been publication—initially in its journal *Mathematical Geology* (now *Mathematical Geosciences*) which 'publishes original, high-quality, interdisciplinary papers focusing on quantitative methods and studies of the Earth, its natural resources and the environment.'

In 1975, *Computers & Geosciences* was established as a journal devoted to all aspects of computing in the geosciences. It was published by Elsevier with Merriam as its first Editor-in-Chief, and in due course became another IAMG publication. It publishes research papers on computer methods in the geosciences, such as spatial analysis, geomathematics, modelling, simulation, statistical and artificial intelligence methods, e-geoscience, geoinformatics, geomatics, geocomputation, image analysis, remote sensing and geographical information science.

These journals (including the later IAMG publication *Natural Resources Research*) filled a growing gap in the maturing area of computer applications, and became an essential part of geological computing. The earlier ad hoc sharing of results and many individually trivial, and therefore unpublishable, exploratory studies had helped to create the basis for their development and their integration. This is relevant now, as communication heads towards another looming gap, described later.

36.5 Prague

36.5.1 *Dan Merriam*

The organizational meeting of the IAMG took place at the XXIII International Geological Congress (IGC) in Prague's New Technical University, Czechoslovakia, on the 22nd of August 1968. It was attended by 20 representatives from 10 different countries:

F.P. Agterberg (Canada)	R.B. McCammon (USA)
F. Benkő (Hungary)	D.F. Merriam (USA)
D.J. Burdon (FAO of United Nations)	V. Němec (Czechoslovakia)
C.J. Dixon (UK)	R.A. Reymont (Sweden)
J.W. Harbaugh (USA)	D.A. Rodionov (USSR)
R. Hesse (FRG)	H. Thiergärtner (DDR)
R. Ivanov (Bulgaria)	A.B. Vistelius (USSR)
H. Knape (DDR)	G.S. Watson (USA)
V. Kutolin (USSR)	E.H.T. Whitten (USA)
T.V. Loudon (UK)	P. Wilkinson (UK)

36.5.2 *Tom Jones*

Several Northwestern University faculty members went to the Prague IUGS meeting, but Krumbein and Whitten were the only ones who were associated with the founding of IAMG. Of course, when word came of the Soviet army moving into Prague during the IUGS, everyone at Northwestern University was concerned about safety issues, but no news was available to us. All went well, and they had lots of stories to tell upon their return, along with photos of tanks driving down the street in front of their hotel.

36.5.3 *Tim Whitten*

I was a founding IAMG Member in Prague in 1968 and, in several papers (Whitten 2003, 2004, 2005), I've alluded to that experience and to Vistelius' participation in the founding.

In many ways, 1968 was an extraordinary year that rocked the world (cf. Kurlansky 2004). Some enthusiasts gathered to create the IAMG in exciting, but tragic, times. Soviet troops had occupied the city on August 21st; guns of encircling Soviet tanks pointed at the University, which was the centre for printing and disseminating news. Vistelius was elected IAMG President and Krumbein 'Past President' (a designation he appreciated and found amusing!); both are fathers of geological modelling methodology.

Opening of the IGC itself was fine but it was immediately followed by the invasion. The founding meeting was therefore brief, hurried, and somewhat stressful because the Americans present were anxious to get away to complete and execute their evacuation plans (being organised by the US Embassy); they soon left Prague. However, despite the fact that I was an official delegate of Northwestern University, the organisers of the US evacuation wouldn't have anything to do with me, because I was on a UK passport. With most other delegates, I continued supporting and attending IGC sessions until, after a couple more days, the Czechs

felt it necessary to terminate the Congress (at a very emotional hastily arranged closing ceremony). My friends in the Finnish contingent immediately promised I could evacuate with their party but, in the end, I learned the British Embassy was organising two coaches to drive out to Nuremberg in Bavaria—the route went through Pilsen and the passengers, being British, made the Czech drivers (against their concerns and protests) stop at the Pilsen brewery to have a last tankard apiece—thence to Nuremberg and a special BA plane via Amsterdam to Heathrow.

I had been on an excellent 14-day field trip right through Czechoslovakia before the Congress, mainly organised and led by Václav Němec—there always seemed to be an orchestra at dinner, stridently playing Dr. Zhivago, much to the consternation of the several Russian delegates.

Dr. Václav Němec from Prague deserves a word. He played a large role in the Prague IGC. In addition to his Prague home, my wife and I visited his attractive rustic cottage (in the forest someway up to the north) once whilst the country was still Russian occupied. He contributed quite a lot to one part of mathematical geology by regularly organising well-attended conferences at Příbram (not too far SW of Prague) through the 1970s—as appropriate to a mining town, there was quite a focus on mining issues and latterly on geo-ethics; these were loosely connected with IAMG. After truly awful food available during the conferences, he always organised a magnificent closing banquet (always pronounced ‘basket’)—don’t know where he wrestled up the fine food and drink!

36.5.4 Dan Merriam

Modified from an interview with the Lawrence Journal World August 21 2008 with permission of the Merriam family—

In August 1968, the Soviet Union’s Warsaw Pact allies rolled into the Eastern European country with tanks and planes to squash the movement known as the “Prague Spring,” which sought more political and social freedoms during the Cold War years. Dan Merriam, who sadly died in 2017 after retiring from the Kansas Geological Survey, escaped the country safely on a train to Austria. He recorded his notes in Prague and mailed them back to Lawrence. Merriam lived through a tense time when more than 100 people were killed and Czechoslovakia’s Communist Party leader, Alexander Dubcek, was arrested. Dubcek didn’t return to Prague until 1989. Just before the invasion, geologists from around the world, including the Soviet Union, were there in August attending a session for the IGC to form a new organization, the International Association for Mathematical Geology.

British colleagues had driven Merriam and Stanford University geologist, John Harbaugh, into Prague for the conference. They were at a hotel in the eastern part of the city when at 2 a.m. on Aug. 21, low-flying airplanes suddenly woke Merriam.

“For some reason in my mind, I thought the Russians were coming, but it didn’t occur to me that’s what was happening,” he said.

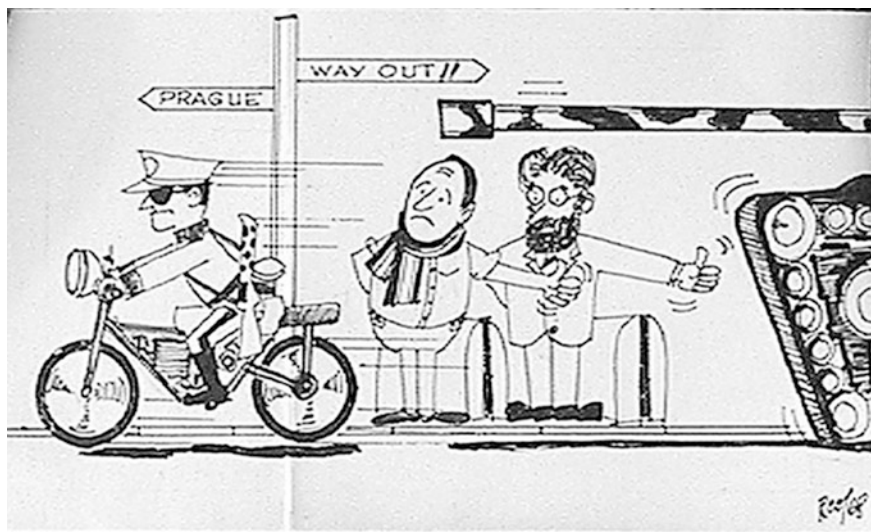


Fig. 36.1 Dan Merriam and Trevor Ford (Leicester University, UK) searching for a way out of Prague August 1968. Copied with permission of the Merriam family

The invasion also shocked the native Czechs and even the Soviet delegates who attended the geology conference. On the eastern side of the city, Merriam didn't witness much destruction. His notes from those few days mention an eerie sense of calm in the eastern part of the city, apart from airplanes sweeping in and tanks rolling around. He noted "the tears in the eyes of the waitresses and the little knots of grim" in the neighbourhood along with several protests. Much of their news came from rumours on the street because radio stations had been bombed and the spread of information was spotty.

"There wasn't anything they could do. There wasn't anything we could do, either, but just watch and hope nothing happened," Merriam said.

The US Embassy had advised Merriam and his colleagues to stay in the hotel because transport from the city was impossible. Even though several members fled the city, the geological conference continued to meet for one day after the invasion.

"The new group, the International Association for Mathematical Geology, even elected its leadership, including President Andrei B. Vistelius, a geologist from the Soviet Union, while the tanks occupied the city," Merriam said.

"It had nothing to do with it, but it was kind of an interesting coincidence anyway," he said.

During that week back in Lawrence, Annie Merriam was on edge. She frequently called Harbaugh's wife, Josephine, to see whether there was any word. But she heard nothing. Finally, Dan Merriam and John Harbaugh had a chance to leave Prague (Fig. 36.1) on a train. It left the city even with tanks nearby, he said. As it approached the Austrian border, the lights went out, and soldiers came to check passports. The train eventually stopped in Vienna, where Merriam sent the telegram

to his wife. He also mailed home his letter, which didn't arrive in Lawrence until after he returned home the next week.

It was only a few words but the short telegram Annie Merriam received at her home on Aug. 24, 1968, gave her a huge sense of relief.

“ARRIVED VIENNA OK = DAN = .”

“When that came, we were thrilled,” said Annie Merriam. When he did return to Lawrence, it ended a tense chapter for his family. “Don't you ever go anywhere again,” Annie Merriam said about her thoughts upon her husband's return. But he did continue his travels. He even returned to Prague in 1993 for the IAMG's 25th anniversary.

36.5.5 *Vic Loudon*

A few months after our marriage, my wife and I set out from Reading in southern England in our Morris Minor, heading for the inauguration of IAMG. Apart from a stone-strike on the windscreen and its replacement before we reached the English Channel, the journey seemed uneventful. But odd things happened. Travelling through the beautiful Czech countryside, we were forcibly stopped at a secluded spot by a long, shiny black Mercedes. The driver came menacingly to our window: “Exchange foreign currency now, very good price!” The distraction of a passing truck let us escape. As we approached Prague, we noticed more and more heaps of cobblestones that had been lifted from the road and neatly arranged—road-works so tidy they looked like walls. We had booked a room at the Zlata Husa, now a luxury hotel, but then more mundane. The friendly receptionist, carrying our room key, showed us into a small alcove in the reception area, pressed a button, and the entire alcove, still open to the world, moved gently upwards through the ceiling, becoming an alcove (with us still in it) in the room above. She showed us to our bedroom overlooking the beautiful Wenceslas Square. But why did our door look as though it was cased in sheets of steel?

No matter. The hotel was in the centre of town, convenient for exploring the neighbourhood, which we eagerly proceeded to do. It was a long time ago, and I forget the precise order of events, but well remember enjoying walks through alleys and shops of the Old Town; the impromptu puppet show for our benefit in the back room of a tiny shop; and the crossing of the Vltava River by the ornate Charles Bridge, where the youth of the city were chatting in cheerful groups. On the other side was St Nicolas Church, with Prague Castle beyond.

In our bedroom at the Zlata Husa, about 4 a.m. on the 21st of August, we were wakened by planes flying at rooftop level. Did this happen often? But then it was followed by gunfire outside our window, and explosions nearby. Before dawn broke, the sound of tanks moving into position came from below. The armed forces of the Soviet Union and the Warsaw Pact countries had made their point, and the

city was now under their control. A Google search for ‘images for Prague spring photography’ gives a good impression of the results.

The *Report of the 23rd Session of the International Geological Congress* records on page 20 that “On August 21st, 1968 and in the following days, the work of the Congress was interfered by the entry of foreign armies into Czechoslovakia. In result of the overall uncertainty, the blockage of bridges, tanks around the Congress Headquarters, shooting in the streets and other disturbances, a considerable part of the attending members was prevented to come to the Congress Headquarters or had to leave prematurely.” Visiting geologists housed in the suburbs lacked any means of reaching the meeting. Merriam records that the US embassy negotiated a train to the border, by which they were evacuated (Lawrence Journal World 2008).

The IGC Report records on pages 200–201: “International Association for Mathematical Geology (IAMG). This Association was officially founded at Prague on August 22nd, when it held its General Assembly. The following officers were elected: President: A.B. Vistelius (USSR). Vice President: W.C. Krumbein (USA), G.S. Watson (USA), General Secretary: R.A. Reymont (Sweden), Treasurers: V. Němec (CSSR), T.V. Loudon (UK), Ordinary members: E.H.T. Whitten (USA), D. A. Rodionov (USSR), D.G. Krige (S. Africa), G. Matheron (France), F.P. Agterberg (Canada), S.N. Sengupta (India), Editor-in-Chief: D.F. Merriam (USA). The application for affiliation to the IUGS (International Union of Geological Sciences) of this Association was unanimously approved by the Council.” And so, the IAMG was created, before a reduced but still quite substantial audience.

While I was attending the meetings, my wife took the opportunity to photograph the interesting happenings in the Old Town. A group of soldiers objected, and indicated that she should hand over her camera. They opened it to spoil the film, and returned it. A round of applause came from the on-lookers, perhaps realising that the film in the Instamatic camera would be unaffected.

A day or two later, when our business and sight-seeing were eventually complete, we felt that we should head for home and our anxious relatives. Getting out of Prague was no problem, returning on the same route as our arrival. But half-way to the border, a bridge across a river was blocked by the military, and the road closed to all. Despondently, we slowly retreated for about a mile, when an old man outside his cottage waved us down. We had no language in common, but looking about nervously he gesticulated towards a farm road a hundred yards away, making rippling movements with his hands, and repeating what sounded like the German word ‘wasser’.

Not understanding, but with little to lose, we followed his directions and came to a wide stretch of water. It was the same river, and this might be a ford. While preparing to wade in and find out, a truck came the other way, water just reaching its axles. The ford and the road led us back to our intended route, now beyond the blocked bridge. So that kind man, at considerable risk to himself, had made possible our continued journey. Our fuel was running low, and all garages had been closed. Downhill coasting and gentle use of the accelerator brought us eventually to the border at Rosvadov, with the needle firmly set on Empty. A careful passport inspection, and we were through, greeted by US soldiers—pleasant, friendly and

helpful. “There’s a gas station just up there. Or ask that guy [pointing to their encampment], he’ll fill you up, no charge.” We took the first option, and soon were in open countryside. We stopped, got out the car and for a while just stood there together—still, silent, and subdued.

36.5.6 Hannes Thiergärtner

Founding member of the IAMG -

I remember rather well the founding procedure of the IAMG. This event occurred for me as a drama in three unusual acts.

The prelude was to empower me to participate at the congress at all. Let me explain for our younger colleagues that the European world at that time was split into the western and the eastern blocks characterized by extremely different political-social systems and ways of life. I grew up, lived and worked in the former German Democratic Republic (GDR) that belonged to the “eastern world”. Here, many, not to say most, things were centralized and provided from the top. Thus, it was nearly impossible to participate individually in an international congress. Participants have been selected, nominated and merged to so-called delegations. I worked in the Central Geological Institute in Berlin, the geological survey of the country, as young graduate in the field of mathematical geology and electronic data processing without international reputation. I never had a chance to be nominated for the IGC. On the other hand, I felt the opportunity to go there because it was the first IGC after World War II held in the Eastern Bloc and restrictions to visit the congress were still distinctly lower than in later years. So, I successfully requested the Director of our institute for vacation and paid the fee and all other requirements out-of-pocket. It was a unique courageous decision, for both the Director and myself. I travelled to the congress, was integrated into the official “delegation” and found accommodation in a student’s hostel.

The main act played out in Prague. It was and is a wonderful and pulsating place. The townscape in the late 1960s was still characterized by the post war years, predominantly in greyish colours but nevertheless imposing and unique. A metro net did not yet exist at that time but the town centre was well developed by a dense tramway system. The organizers of the XXIII IGC had chosen for the opening ceremony the auditorium of the Charles University, the Carolinum, in the Prague historic centre—an amazing and venerable baroque hall with a super interior. The ceremony was impressive, indeed, and all participants hoped for a fruitful scientific exchange of ideas within the following days.

All attendees knew about the critical political situation because of the Czechoslovakian trends to reform their political system. My journey to join the congress session “Mathematical geology” passed the ministry of defence during these days. When I started to go in for the lectures on Wednesday and Tuesday (August 21–22), I had to walk in front of the Ministry between many tanks which had come from the Warsaw pact states and occupied the town. It was shocking! I do like to

take photographs but I did not in this moment—it was too serious. The situation was ghastly and the agile Prague was silent.

I reached the session rooms without personal impairment. There I met so many colleagues I never had seen before but knew from the scientific literature, such as Frederik Agterberg, John W. Harbaugh, Vyachelav Kutolin, Victor T. Loudon, Richard B. McCammon, Václav Němec, Richard Reymont, Dmitri Alekseyevich Rodionov, Andrey Borisovich Vistelius or Eric Harold Timothy Whitten. Altogether 20 persons were present. It was simply great for the young fresh geologist from Germany! Regardless of the stressful situation, we founded the International Association for Mathematical Geology. The organisation was well prepared by Richard Reymont and it proceeded to elect its leading officers. I remember that the participants from the Eastern Bloc during a break agreed to vote for Andrei B. Vistelius as first president to ensure parity within the top of the association.

On the same day, all members of the GDR delegation got orders to meet at a very small railway station in the western part of Prague to “enter” one of the now rarely running trains to the German boundary. We left the hosting country in a night and fog action.

36.6 Subsequent Events Following Prague

36.6.1 *John Cubitt*

As a second-year undergraduate at Leicester University at the time, I was almost unaware of the events of the IAMG foundation. All I can recollect is my tutor, Trevor Ford, and our Department Chairman, Professor Peter Sylvester-Bradley, returning from Prague with tall tales of the various lucky escapes. It must, however, have made some form of subconscious impression on my mind because less than a year later I mentioned to Trevor that I would like to go on to undertake postgraduate work in computer applications in geology. In that case he said, you need to meet someone and marched me out of his office and down the corridors of the Department of Geology. In a minute, we found the mystery person he wanted to introduce to me. He was striding down the corridor in cowboy boots, string tie and cowboy hat in his typical dynamic intimidating style, Dan Merriam. After brief introductions from Trevor, Dan talked about the Research Group at the Kansas Geological Survey and how I should undertake a Ph.D. at Leicester University but with the first year paid for and spent at the KGS. “That will be OK with the Department, won’t it?” Dan said to Trevor and whether it was or not, the decision had been taken. Within a few months of whirlwind arrangements, I was on my way to Kansas and my career was underway (Dan subsequently took me to Syracuse University as well so I have much to be grateful to this amazing dynamic organiser for). This frenetic activity was typical of the rapid growth in the subject of mathematical geology and the IAMG at the time.

36.6.2 Hannes Thiergärtner

The after-play led me back to the reality of those times. The founding of a new seminal association within the international geological community was ignored [in the Eastern Block] especially in the governmentally organized surveys. A policy of restriction was introduced step by step. Any contact—to say nothing of an IAMG membership—outside of the Eastern Bloc proved to be impossible and was strictly forbidden. I would however meet the majority of founding members of the IAMG again in 1984 during the XXVII IGC in Moscow where I could take an active part only on special request made by D.A. Rodionov at the GDR ministry of geology. But that is another story.

With the exception of my colleagues in Prague, Leningrad and Moscow, I was unable to renew my contacts to other founding members until after the German reunion (1990). Frits Agterberg was the first colleague I met in Potsdam (Germany). It was also 1990 and I could then renew my membership in the International Association for Mathematical Geosciences. I think we all have utilized this late time as well as possible to solve some common questions in our interesting field of science.

36.6.3 Stephen Henley

As a humble Nottingham University postgraduate student in 1968, I wasn't at the IGC or the Prague launch of IAMG. However, I was deeply involved in computer applications and statistical analysis, processing what then seemed like huge volumes of data from the X-ray fluorescence spectrometer, and then making sense of the data using esoteric methods such as factor analysis, cluster analysis, and trend surface analysis. Under the mentoring eye of Peter Harvey, I joined IAMG as soon as I heard of its existence, in 1969—and have remained a member without a break since then. It is fair to say that mathematical geology shaped my entire career. As my Ph.D. studies came to an end in 1970, an opportunity arose in Australia.

The Bureau of Mineral Resources (now Geoscience Australia) suffered a mass resignation of several dozen geologists who left to join one of the periodic mining booms—this one in Western Australia, sparked by discoveries of major nickel deposits. Among those who left was their one computing 'expert', so my meagre computing experience was sufficient to gain me a position in Canberra, where I gained a broad experience of mathematical modelling and statistics in fields that included hydrogeology, exploration geochemistry, earth tides, and global scale geochemical modelling of Archaean evolution of the Earth (this last with Andrew Glikson, based on studies of some of the world's oldest rocks). After my return to the UK, I finally accepted my type-casting as a computer geologist and in 1973 joined the Computer Unit of the Institute of Geological Sciences (now the British Geological Survey). This small specialist unit occupied two rooms on the top floor of the Geological Museum in London, and had an IBM 1130 computer—which

even then was of very limited capacity. However, we also had access to the much more powerful mainframe IBM 360/195 at the Atlas Computer Laboratory (ACL) in Oxfordshire.

The head of the Computer Unit was Dr T. Victor (Vic) Loudon who had pioneered generalised software development in his previous academic work at Reading University (the Rokdoc package) and was one of the founding members of IAMG. Rokdoc was the inspiration for a colleague Keith Jeffery to start the development of a general-purpose geological data handling system ‘G-EXEC’ which was built around the recently published ideas of IBM researcher Edgar Codd for relational database management. When I first met them, Keith and his co-worker Elizabeth Gill at ACL, were preparing an early version of G-EXEC: I walked into the office they were using to see the floor strewn with many piles of punched cards and reams of fan-folded lineprinter listings of the software. The whiteboard displayed a beautifully simple diagram of the system structure, and I was hooked.

Table 36.1 Officers and Council of IAMG

	1968–72	1972–76	1976–80
President	A.B. Vistelius (USSR)	R.A. Reymont (Sweden)	D.F. Merriam (USA)
Past president	W.C. Krumbein (USA) ^a	A.B. Vistelius (USSR)	R.A. Reymont (Sweden)
Vice president	G.S. Watson (USA)	A.T. Bharucha-Reid (USA)	G. Hill (Australia)
Treasurers Western Eastern	T.V. Loudon (UK) V. Němec (Czech.)	J.C. Davis (USA) V. Němec (Czech.)	J.C. Davis (USA) V. Němec (Czech.)
Secretary General	R.A. Reymont (Sweden)	D.F. Merriam (USA)	E.H.T. Whitten (USA)
Council members	F.P. Agterberg (Canada) D.G. Krige (S. Africa) G. Matheron (France) S.C. Robinson (Canada) D.A. Rodionov (USSR) S. Sengupta (India) E.H.T. Whitten (USA)	H.A.F. Chaves (Brazil) A.C. Cook (Australia) J.E. Klován (Canada) P. Laffite (France) G. Lea (UK) D. Marsal (W. Germany) E.H.T. Whitten (USA)	F.P. Agterberg (Canada) K.L. Burns (USA) G. de Marsily (France) D. Gill (Israel) D.M. Hawkins (S. Africa) R.J. Howarth (UK) W. Schwarzacher (UK)
Editors-in-chief Jour. Math. Geology	D.F. Merriam (USA)	D.F. Merriam (USA)	R.B. McCammon (USA)
Computers & Geosciences	—	D.F. Merriam (USA) J.C. Davis (USA)	D.F. Merriam (USA) J.C. Davis (USA)
Newsletter	G. Lea (UK)		

^aserved as Vice President

Fig. 36.2 Official logo of IAMG



Soon after that, John Cubitt joined the team, and we formed a “gang of four” providing computing services to a wide range of users within IGS as well as supplying the software to other institutes in the Natural Environment Research Council and worldwide. The IGS Computer Unit itself was a research centre in its own right: John and I both worked together on the potential use of catastrophe theory as a geoscience modelling tool, though we were ahead of the times, and it was only when catastrophe theory was superseded by chaos theory that the potential became reality, in such fields as climatology and oceanography. Working with Jeff O’Leary, then at Leicester University, I also used the relatively new field of geo-statistics in developing a 3D model of the Jwaneng diamond pipe in Botswana, but misgivings about the method, arising from that and other projects, led to development of more robust ‘nonparametric’ methods which formed the basis of a book (and led to my receiving the 1982 President’s Award of IAMG).

The underlying G-EXEC concepts (and much of the software itself) were subsequently incorporated into other products including, in my case, the ‘Datamine’ mining software system. The rest, as they say, is history.

36.6.4 Dan Merriam

(From Merriam 1978, copied by permission of the Merriam family)–

A list of Officers and Council members of the Association is given in Table 36.1.

During the first year a call for members was made. A logo was designed according to specifications of D.F. Merriam by Charles Barksdale of the Kansas Geological Survey for use in connection with official Association business (Fig. 36.2). This logo was used on a certificate received by all charter members (those who joined during the first year). negotiations were complete with Plenum Press for a new journal, Journal of Mathematical Geology (JMG), which appeared

first in 1969. It was made a quarterly in 1970 and a bimonthly in 1975. Also in 1975 the quarterly journal, *Computers & Geosciences (C&G)* was established with Pergamon Press the publisher.

The JMG focusses on geomathematics and mathematical geology, which includes geological arguments supported by numerical observations to purely mathematical models implemented with geological data. C&G is devoted to the rapid publication of computer programs of interest to earth scientists in widely used languages and their applications. A quarterly Newsletter contains general information of interest to members.

Each year the Association sponsors meetings, many in cooperation with other organisations. For example, IAMG cohosts the Geochautauqua held each year at Syracuse University and every other year a session in mathematical geology at the Pribram Mining Congress. At each IGC since Prague, we have sponsored or cosponsored several sessions of interest to our members. In addition, we have cohosted sessions at meetings of the American Association of Petroleum Geologists, and the Geological Information Society of the Geological Society of London. Proceedings for many of these meetings have been published either as special issues of the Journals or as hard-back books.

Seven national groups have been created and are functional. They are in the United States, Canada, Brazil, Great Britain, Czechoslovakia, Hungary, and Russia; others are in the formation stages. These national groups are active in disseminating information on geomathematics on a national level. Although national groups are autonomous, they are expected to coordinate their activities with the Association.

Operation of the Association is mainly through committees. The Project Committee is responsible for preparing the meetings at the next IGC which is held every four years. The Membership Committee is concerned with soliciting new members; the Finance Committee with soliciting money; and the Educational Committee with organizing material and activities to promote geomathematics. Each year a

Table 36.2 IAMG committee chairmen

		1968-72	1972-76	1976-80
Standing committees	Projects	J.E. Klován (Canada)	A.C. Cook (Australia) W.B. Hempkins (USA)	G. de Marsily (France) W.B. Hempkins (USA)
	Membership	G. Lea (UK)	M.K. Horn (USA)	J. Hefner (USA)
	Finance	H.A.F. Chaves (Brazil)	G.S. Koch (USA)	R. Till (UK)
	Education	G.F. Bonham-Carter (USA)		
Ad hoc committee	CAI			F. Mutschler (USA)



Fig. 36.3 Design for Krumbein medal

committee (chaired by the President) selects the William Christian Krumbein medallist and another special committee selects the Best Paper for an award.

A special committee has undertaken the task of compiling a list of all computer-aided instruction (CAI) programs available and of interest to geologists and it will be distributed in the near future. There are also plans for compiling a list of computer software, the list will contain information on programs and their availability and limitations. Chairmen of the various committees are given in Table 36.2.

The Association maintains close contact with other organizations which share similar interests. For example, several members of the Association serve on the IUGS-sponsored COGEOLOGICAL DATA Committee. Others are working on special projects for CODATA. The Association has a member on Scientific Committee 4 which evaluates quantitative aspects of projects for the IGCP. Liaison is maintained with the International Paleontological Association.

The William Christian Krumbein Medal is presented each year by the Association to an outstanding geomathematician. The first recipient was Professor John C. Griffiths of Pennsylvania State University, the second, Professor Walther Schwarzacher of Queen's University, Belfast, Northern Ireland, and the third, Dr. Frederik P. Agterberg of the Geological Survey of Canada, Ottawa. The recipient receives a medal with the likeness of William C. Krumbein on one side and the Association's logo on the other. The Medal was designed in 1977 by A. Pattison, sculptor of Florence, Italy and Winnetka, Illinois (Fig. 36.3).

The IAMG, in its short period of existence, has participated in and contributed to changes in the earth sciences. In the future the Association should play an even larger role in development of the science.

36.7 The Looming Gap

36.7.1 *Vic Loudon*

The methodology of geological investigation and communication was initially formalised within the constraints imposed by the traditional mechanisms of pen, paper, typewriter, printing press, bookshops and libraries. It has been extended by computer techniques, formalised in a framework set by the manufacturers and providers of computer equipment and software, but is still based on and restricted by geological traditions, conventions and precedents. Geological surveys continue to provide geological maps world-wide, with defined scales of presentation, uniform stratigraphical classifications, and separate volumes of text, with cross-references to locations on the map.

These products provide a stable underlying shared basis for subsequent geological investigations, essential for accurate communication, including a consistent and coherent structure within which new investigations can build. This is achieved by results being confined within the rigid framework and slow-moving processes of conventional publication. Geological knowledge can potentially build on a wider framework, going far beyond its current traditions, conventions, limitations and precedents.

The global information structure is being remodelled, based on new technology with unfamiliar implications. Current developments in computer translation, voice recognition and speech synthesis point to a much more flexible future.

As in the mid-1960s, a significant gap may be developing between the future of geological communication and its current implementation of published papers and maps. Experimental initiatives might be a good starting point. Their results might be inappropriate for traditional patterns of communication, but information on their development could usefully be exchanged in an open and flexible forum, for which IAMG might be a suitable host.

Appendix

A readable account in the Economist (2017) describes the power of deep learning: ‘an artificial intelligence technique in which a software system is trained using millions of examples, usually culled from the internet... Computers are, in short, getting much better at handling natural language in all its forms.’ But (p. 11): ‘Scientists do not know how the human brain draws on so many different kinds of knowledge at the same time. Programming a machine to replicate that feat is very much a work in progress.’

The conventional forms of scientific papers and the fixed scales of geological maps reflect the limitations and conventions of earlier technologies. Future development of our understanding of global geology can only be achieved through a

multitude of investigations and experimental studies. Many geological developments will be based on local knowledge and requirements. Many will be too trivial for conventional publication but valuable in their own local context. Already, the computer technology for sharing detailed studies and strategies is well established. It could help to provide the essential background for a more comprehensive framework. It could lead to deeper evaluation and integration of data, text, graphic and cartographic information at all relevant levels of detail; rapid and appropriate response to input of new information; the routine calculation, depiction and quantitative assessment of multiple geological hypotheses; and the emergence of a never-ending dialogue between human input and computer implementation, supported by a multi-media interface for input and output.

This calls for developments that go far beyond the precedents and traditions of our established conventions, into an environment for geological information where users are motivated to carry forward an accessible shared understanding. Maps, data, illustrations, simulations, text explanations and scientific papers need not be separate entities nor restricted to a single scale. Input of new information can be rapid, with continual assessment and reassessment of its validity and relevance, and examination of its consistency with previous work.

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