Memorial Address for J. Frank Adams

J. Peter May

Editor's note: *J. Frank Adams, the Lowndean Professor of Astronomy and Geometry at Cambridge University, was killed in a car crash on 7 January 1989. He was one of the great figures in the history of algebraic topology, and one of the most fascinating personalities in twentieth-century mathematics. The next two articles present a portrait of Frank Adams. What follows is the text of the Memorial Address for Professor Adams delivered by J. Peter May in Trinity College Chapel, Cambridge, on 29 April 1989. The Memorial Address is followed by an article, also written by J. Peter May, discussing the life and mathematics of Frank Adams.*

Frank Adams was a superb mathematician, a devoted family man, and a kind and gentle friend. He was a man of contradictions: a shy man who could and did dominate many around him; an immensely erudite man who delighted in the lowest puns and doggerel; a man of strong opinions whose view of the world's antics was tinged with a bemused and wry tolerance.

His approach to mathematics was marked by inexhaustible intensity and energy, excruciating competitiveness, insatiable curiosity, meticulous craftsmanship, vivid imagination, lively wit, deep seriousness, and marvelous eloquence of expression. But what was perhaps most remarkable about him was the way in which these qualities were wholly untempered in his approach to even the most mundane aspects of life. He was all of a piece.

It is impossible to convey any real sense of Adams's mathematical achievement to a lay audience. He was unquestionably the world's leading algebraic topologist. He dominated that field, originating many of its most fruitful directions. In particular, he took the embryonic area of stable homotopy theory and singlehandedly developed it into one of the major branches of the subject. He considered himself to be, in his own words, a "true English problem-solver," and his solutions of the "Hopf-invariant-one problem" and the "vector-fields problem" were great events in the history of topology. He was never concerned with either theory or calculation for its own sake. He regarded those as simply means to an end. Nevertheless, he left a large body of new theory of lasting importance, including such contributions as the construction of the Adams spectral sequence and the introduction of the Adams operations, while his work was marked by extraordinarily intricate and insightful algebraic calculation. He had a compulsion to learn everything there was to know about algebraic topology, and he was never happy with any new development until he understood it in complete detail. Beyond his original contributions, he left quite a few extremely valuable expository works based on the contributions of others.

J. Peter May

J. Peter May is an algebraic topologist. He obtained his Ph.D. from Princeton in 1964, taught at Yale until 1967, and then moved permanently to the University of Chicago, where he is chair of the Department of Mathematics and director of the newly established Mathematical Disciplines Center.

For some twenty-five years, Frank Adams was my mentor, my closest mathematical colleague, and my dearest personal friend. We engaged in a voluminous correspondence, interrupted only by our visits back and forth. Frank was also a good friend to my family, and his non-mathematical letters were usually addressed to my wife. Perhaps I can best give a picture of the man by quoting from his letters, letting him speak for himself.

A recurring theme in his letters was the nature of mathematical exposition. He rewrote his own papers many times over. I once asked for a copy of some work in progress, and his delightful response went as follows:

> It is perfectly true that when I last wrote to you I had drafts of sections one and three which I was willing to let people see. Today I still have the same pieces of paper, but like Mr. Brown, I discern the Capability of Improvement. The chief rogue (a definition, needless to say) has been marched off to the condemned cell, where he lodges till I determine whether his rival is likely to serve the crown more usefully; he took with him a handful of perfectly valid theorems (humming sadly "we shall not all die, but we shall all be changed").

He expected others to adhere to the same high standards he set himself, and he had little tolerance for shoddy workmanship. He stirred up hornets' nests of controversy by his public remonstrations on the subject, but his comments in private correspondence were more eloquent. Shorn of irrelevant context, one of his perorations on the subject went as follows. The matter in hand was a cryptic paper I was refereeing.

> . . . So perhaps it's best if I stick to stating a few abstract principles, and reserve the question of whether or not they have any reference to the matter in hand.
>
> (A) Mathematicians who wish for the gratitude of the mathematical public must write so that the mathematical public does not have too much difficulty in making out what they mean. And here the word "public" includes struggling graduate students, let alone people like you who have spent years thinking about the subject. I well remember one time when Henry Whitehead knew that he had Peter Hilton as a referee. His reaction was: Peter has missed the point, but Peter is an intelligent man; therefore, I must put the point more clearly.
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> (B) Mathematics in general is dependent on technical details. It may happen, though, that one likes the end without liking the means; in other words, one would wish to rely on certain technical details but finds them distasteful. I observe maybe four approaches.
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> (i) The first follows Macbeth . . . "I am so fetlock deep in gore,/Return were just as tedious as go o'er . . ." and plunges ahead with the first set of details that come to mind.
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> (ii) The second pauses to consider the technical details and examine how they can be handled so as to minimise the nuisance. This is par for the course.
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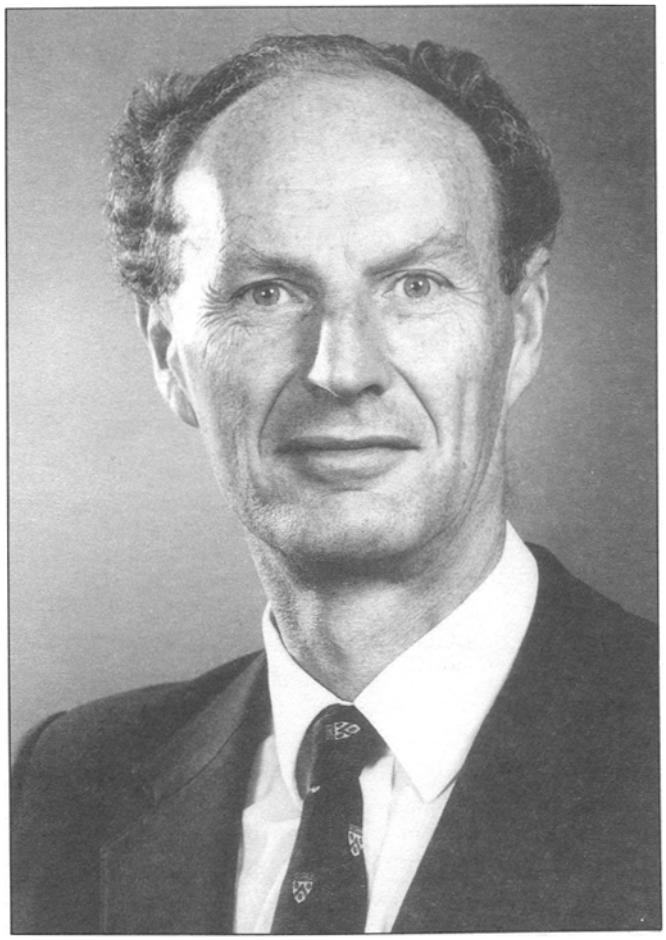
> (iii) The third pauses to consider whether a change of approach or strategy may lead to reliance on a different set of technical details which may be less distasteful. Alas, Newton's Fourth Law [the law of maximum unhappiness]. . . .



J. Frank Adams

> (iv) The fourth plan is explain the ends and leave the details out; that is, the author omits to explain what is involved.
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> As a general principle, I reject plan (iv) entirely. I did promise to reserve judgment on the applicability of these principles. The suspicion I would wish to test, though, is that the author's defence of his theorems accuses his writing of (iv).

In his very next letter, he told me about a paper he had just refereed.

> Still, let me tell you of a paper that I got to referee the other day. My thoughts went much as follows. "This has a pleasantly familiar drift; I did this in 1955/56 and never published it. Well, one can't punish the author for the fact that I never published it; if it were one-third the length it might be quite acceptable. . . . Hold on! Not only did I solve this problem in 1955/56 and never publish it, but I got a different answer. . . ."

Frank took the refereeing of papers very seriously, and his inability not to redo and improve the mathematics that he encountered occasionally led him out into the open as a coauthor of the revised versions. He was a fine collaborator. While he preferred to hold pen in hand himself, he was scrupulously careful to take the wishes of his coauthors into account. He was also very sympathetic to the needs of his students, and he

could see objectively how they might well find him difficult to work with. I vividly remember one occasion when he asked me to talk to one of his students, telling me that "every time he comes to see me he shakes."

In a similar vein, Frank was ruefully aware that he was not particularly effective in matters of politics, academic or otherwise. He engaged in acts of political protest when his feelings were strongly engaged. A recent occasion was the 1986 U.S. attack on Libya:

> Over Libya, President Reagan and Mrs. Thatcher succeeded in making Airstrip One, your unsinkable aircraft-carrier, look like a stooge to a bully. The Sunday before it happened, Grace and I were engaged in handing in petitions against it at our local U.S. base, and I was trying to explain to a heavily-armed U.S. guard that I was a friend of the U.S.A. from way back, and I just wanted to see her acting in her own best interests.

Still, such activity went a little against his grain. As he wrote in 1987, "It is one of the defects in my character that I am not as politically active as Grace thinks I ought to be." He was far from doctrinaire, but somehow he was quite capable of empathizing with the views of others, while at the same time deprecating their inability to see the obvious correctness of his own more logical position. He had a global outlook, and he was very keen on broadening contacts among mathematicians in different countries. The following quote concerns the International Congress of Mathematicians held in Warsaw in 1983:

> The International Congress was not a bad do. It was less good than it might have been because of the absence of a number of Western mathematicians, including a number of invited speakers who had accepted the invitation to speak and done nothing to inform the organisers that they weren't coming. The Poles did not like this very much; "what is the use of doing something as a protest if you don't tell people you are protesting?" A number of speakers dedicated their talks to Polish mathematicians (of course, ones who had been or were in jail); this went down much better. . . .

Later in the same letter, Frank described his indulgence in one of his favorite vices, a compulsion to climb to the top of the highest thing in sight, be it building or mountain.

> I also explored the Palace of Science and Industry, where the Congress was held. . . . The ordinary observation-platform is on floor 31 and the ordinary lifts go up to floor 33. After that there is a lift, which I presume is intended for service staff only, going from floor 33 to floor 45. As I was travelling exclusively by staircase, I was able to master the geography pretty well, and I didn't mind when the lift stopped and there was only a staircase. I found some much better and more congenial observation points higher in the tower, where the pigeons were surprised to see me. The top of the construct is a vertical tubular steel spike. As I had already disregarded all the notices in Polish which, I strongly suspect, forbade all unauthorised persons to go further, I went up it as far as there was a ladder.

Frank loved rock-climbing. He found the danger exhilarating, and he was very proud of his physical proficiency. The last trips he wrote about were in 1987; one included a "splendid climb" of Jones' Direct with his son Adrian.

Frank's family and mine figured prominently throughout our correspondence. In 1986, at its 600th anniversary celebration, the University of Heidelberg conferred an honorary doctorate on him. He wrote of Grace on that occasion:

> . . . She did enjoy being a tourist in Heidelberg: going around the castle, down the high street of the old town, walking on the *Philosophenweg* through the woods on the other side of the river, and having snacks in nice cafés or at tables outside in the square. And for the ceremony, they got her to walk beside me in the procession and gave her a bouquet.

Frank spoke in Latin at the ceremony since, as he wrote, he was unwilling to reinforce received ideas about Anglo-Saxon insularity by speaking English, and he felt that his German would embarrass all concerned. Characteristically, he obtained coaching beforehand on the proper German pronunciation of Latin. In fact, he was meticulously thorough in his preparation of all talks he gave. He usually wrote them out fully in advance, including the jokes.

Our children figured especially prominently in our correspondence. My sons viewed Frank as a friend, and he taught them and me his favorite game, GO. They once played a game, transcribed the moves, and sent the list of moves to Frank. He somehow found the time to write out 28 single-spaced pages of detailed commentary and instruction to send back to them.

He and I confided in each other about the difficulty of dealing with adolescent children. He once described some tit for tat with his daughter Alice, at age sixteen, ending by writing "Honor appears to be satisfied for the time being." It was very clear that he respected and admired her spirit. In 1983, he wrote of his pleasure at attending her graduation from the University of Edinburgh, where she was given her M.A. He also took pleasure in Adrian's rapid advancement through the ranks of his civil engineering firm, and he reported with considerable satisfaction when Adrian was granted Membership in the Institute of Civil Engineers, his final professional qualification, in 1987.

Frank had great love and empathy for younger children. He gave the following description of a day's outing with his younger daughters in the spring of 1976.

> Last time I took Lucy and Katy out to Cambridge Lucy insisted that we begin by going to the indoor swimming-pool by Parker's Piece, which turns out to be quite good. Lunch in Vigani's room, of course; they were so full when it came to the trifle that we had to take half a bowl home so as not to waste it, and return the bowl later. Then to the Fitzwilliam Museum (Katy is dead keen on the Egyptian rooms), punting on the Backs, and on to the top of the

Wren Library to admire the view. I've learnt a lot of odd corners of the College where a Fellow can take nine or ten year olds to please them. Then Lucy & Katy had tea & toast in the Parlour (which one may do if no Fellow there objects, and they seldom do).

Frank loved Trinity College not just as a great and venerable academic institution but also as a second home and a very special place to entertain those he found particularly deserving, including the administrative assistant of DPMMS, his surgeon, his most favored mathematical visitors, and most especially his children.

Lucy is coming as my guest to the Twelfth Night Dinner in Trinity. To quote from the rules "it is understood that a Fellow may bring a young member of his family," and whatever went for sons before the Statutes were amended now goes for daughters too. Lucy came in January 1978 and Katy in January 1979, so the pattern seems to be clear for a few years. Anyway, Twelfth Night is Lucy's birthday.

His letters refer to many of the feasts and other traditional occasions at Trinity. While he enjoyed them thoroughly, he also saw their humorous side, their air of quaint anachronism. This came out best in a remark about a Commemoration service held on June 8, 1985, at the College next door.

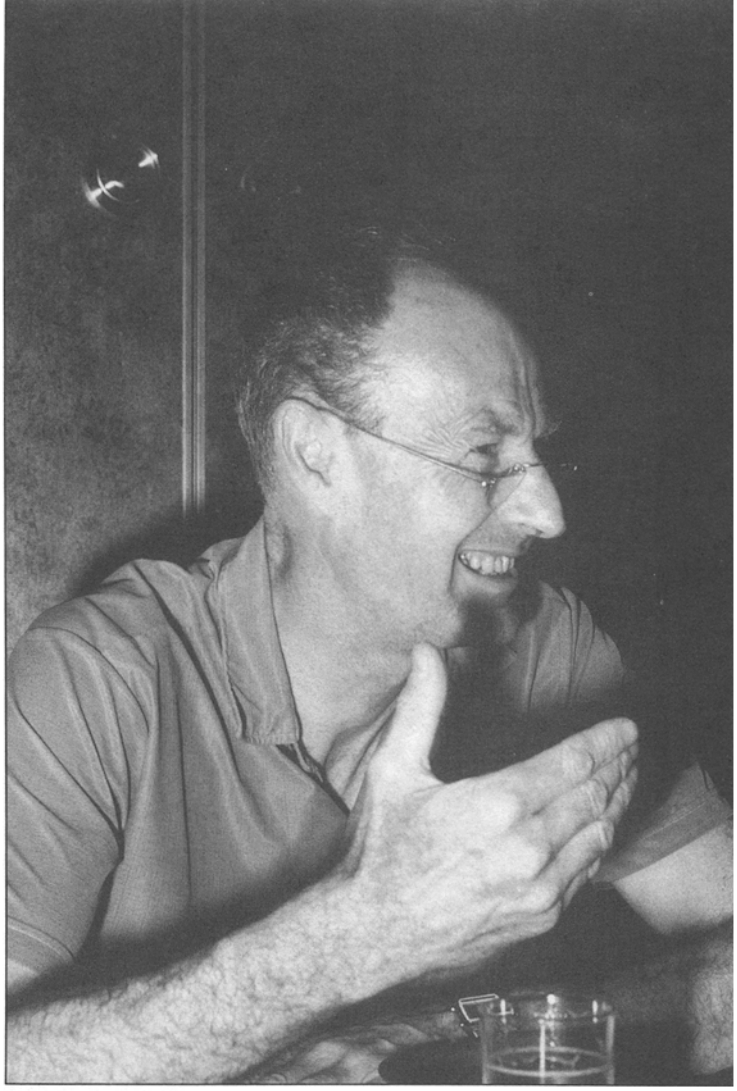
Today the fellows of St. John's have a Commemoration Service. The sort of Commemoration Service that you have once a year can of course be safely skipped by those who dislike rituals, but this is different. Four hundred and fifty years ago, to the day, their co-founder was beheaded.

In fact, Frank had a deep and yet somehow detached love of everything English. He loved the countryside, and he wrote with pleasure of his vacations with Grace in the Lake District, Norfolk, Cornwall, Wales, and Yorkshire. He very much enjoyed hiking and swimming with her. He especially loved their home in Hemingford Grey. He designed and built a lovely semicircular perennial garden behind the house. To one side of it he made a round pool for papyrus, about which he once wrote:

The other day Grace observed that there was something new in the pond which I made in our garden; a toad. Katy was overjoyed that it had chosen to honour our pond with its presence, pronounced it a splendid specimen, and took her dinner outside to eat by the pond while she continued to admire it. First things first, you understand; you get a dinner every day, but toads with copper-coloured eyes. . . .

Frank was a marvelous craftsman. He delighted in intricate carpentry and in enameling. Here are before and after quotes about a 1975 project.

In my spare time I am supposed to be making Grace a jewelry box, for her birthday. . . . It's to be in Japanese oak, replete with concealed dowelled joints, brass hinges and locks, trays in cedar, etc. Currently I am doing the carcase in duplicate so that if I make some frightful mistake with one I can carry on with the other.



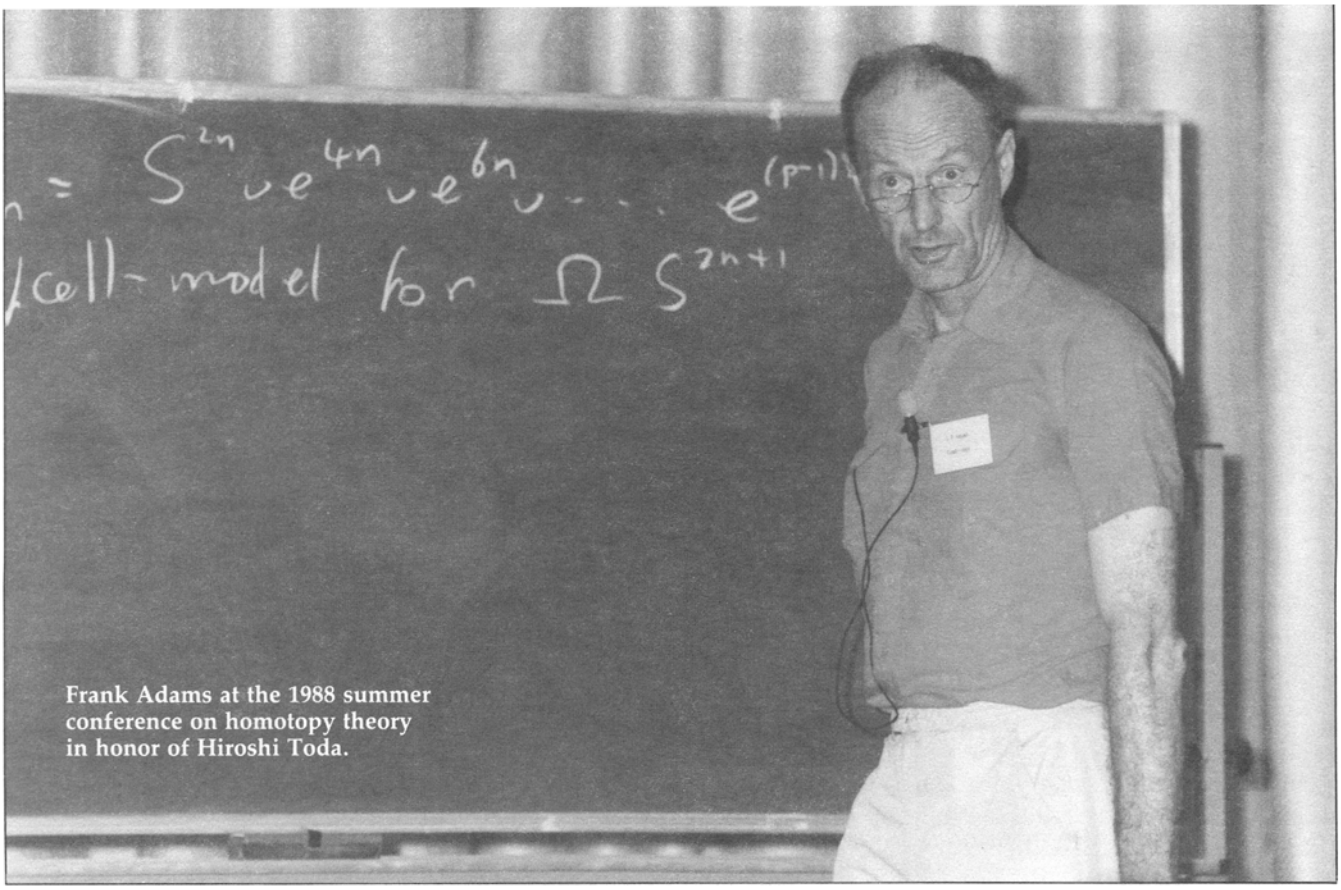
J. Frank Adams

The jewelry box for Grace turned out OK, except that when it was brought into the centrally heated house the lid decided that if nasty people were going to evaporate off its water content it would prefer to be ever so slightly concave; this entailed taking it outside again, removing the lid and planing the bit which was supposed to fit the rest of the box till it did fit the rest of the box again. The second jewelry box also turned out OK and caused great surprise when it was brought out as a Christmas present; it matches the first very handsomely.

I will give one last excerpt, from a long and chatty letter of September 1983. It describes daily life at 7 Westmeare after the vacation in Cornwall and before Lucy and Katy went off to school.

. . . As for Grace, she told our daughters what to do and proceeded to get the house the way she likes it. I think she evicted a lot of spiders. Grace believes in the conspiracy theory of spiders: she thinks that at this time of year they all go round telling each other, let's creep into 7 Westmeare, their central heating is the best. She is determined that instead a very few spiders should tell their friends how lucky they were to escape from that terrible ogre at 7 Westmeare who destroys all webs and most spiders. . . .

In the evenings I did a bit more enamelling. Apprentice enamellers should write out five times: Do Not Be Too Ambitious. My project was for small stud earrings, based on the creatures which we call ladybirds and you (more logically) call ladybugs. . . . At first my intentions were



Frank Adams at the 1988 summer conference on homotopy theory in honor of Hiroshi Toda.

Atsushi Yamaguchi

good. Since two-spot ladybugs exist in nature, my customers would have to be content with two spots per bug. Also the creatures would be a bit larger than life-size; life-size ladybugs are (a) insufficiently spectacular and (b) fiddlesome. . . .

I went out and found some ladybugs in our garden. I couldn't find any two-spot ones. The front end of a ladybug is more complicated than you might think; I had to plan on stylising it in the hope that my customers hadn't looked at a live ladybug carefully. . . . The metal work came down to a small oval base and two cloison wires making space for two red wing-covers and one black "head."

The theory is that you set the cloison wires in a layer of glass which has a higher melting-point than the red and black glasses you will use later. As usual, theory is over-simplified. To begin with, glasses don't have a melting-point; their viscosity changes gradually over a range of temperature. . . . The smaller cloison wire turned out to be particularly temperamental. Until you get enough glass on both sides, the sensitivity of such a cloison wire to gravity waves must exceed that of the conventional experimental dispositions; the only reason it is no use in that role is that it falls around for other reasons too, beginning with Brownian motion. It also responds to psychic influences and emotional vibrations; and it is deeply sensitive to the groans of spiders, lamenting the ruin of their handiwork. It is quite unmoved by the groans of human beings similarly afflicted.

The passage doesn't end there. Frank went on to describe the difficulty of making five spots per ladybug without smearing the spots. It is entirely in character that the lack of two-spotted ladybugs in his garden had left him dissatisfied with his original good intentions. Nor was he satisfied with the final result:

On considering the results, I thought, perhaps I should have left my lady-bugs unspotted. But that would not do; a no-spot ladybug is no ladybug at all. Perhaps if I had made the spots with brown glass instead of black, then the result might have looked less like coleoptera that have been cohabiting in a coal-hole.

Oh, well, . . . imperfections which distress the artificer may seem much less important to the customers. In other words, your daughters will say that your ladybugs are sweet (or in American, cute).

Frank's approach to the problem of making cloisonné earrings displays many of the same features as his approach to problems in mathematics. The intensity, curiosity, craftsmanship, attention to detail, self-critical perfectionism, imagination, and wit are all there.

Frank Adams was the most remarkable and admirable person I ever knew. I feel privileged to have been his friend and am diminished by his death. We had many marvelous times together. We climbed through a hailstorm to the top of a mountain in Scotland; we climbed on hands and knees over snow and ice to the top of a mountain in Colorado; we pushed a stalled rented car along a flooded dirt road in a torrential downpour in Mexico; we climbed a little Japanese mountain at dusk and then scrambled down in the dark of night. I shall always treasure these memories and many, many more. We also proved some theorems together, and getting to a theorem with Frank was very much the same kind of exhilarating experience as getting to the top of a mountain. There will never be another like him.

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