Dr. Leonard Fuller retired in 1984 after 32 years in the KSU mathematics department. I talked with him in his Manhattan home, the house he built (with some help) in 1955. Fuller earned his Ph.D. in 1950 from the University of Wisconsin. After working in industry a short time he went to Kansas State College in 1952. At that time KSC had only a few thousand students, the mathematics department was located in Holtz Hall, and the standard teaching load for professors was four classes. Kansas State College of 1952 would change much in becoming Kansas State University of 1985.

In the 1950s most students at the University took their course work quite seriously. Many were, like Fuller, veterans. The attitudes of the students changed in the 1960s, which Fuller describes as the worst of times at KSU. Even though those days are long gone, Fuller says many of today's students lack studiousness and view college as merely "a continuation of high school."

Naturally, Fuller taught some courses year after year. By rewriting old lecture notes each year and changing course topics he was able to keep from being bored by the courses. According to Fuller, high school students have been taught more mathematics over the years, which has allowed college courses to become a little more advanced. Fuller wrote two successful books on matrix theory. One has been translated into 16 languages.

During the summers of 1959-1974, Fuller directed summer institutes for high school mathematics teachers. These programs, funded by the National Science Foundation, produced many master's degrees and have had a lasting impact on Kansas high schools. If there is enough interest there could be a reunion of the summer institute participants some summer in Manhattan.

Fuller is enjoying retirement. He does volunteer work at his church and tax counselling for the elderly. He walks about seven miles each day and likes to travel. He has started a scholarship fund to encourage good students to study mathematics or mathematics education.

(continued on page 2)
"Paradoxically, while mathematical applications have literally exploded over the past few decades, there has been declining attention to support of the seminal research which generates such benefits."

Contributions to the Leonard E. Fuller scholarship fund can be made through the KSU Foundation.

When they see him out walking, the thousands of former students of Dr. Fuller should not hesitate to stop and say "Hey, I had you in class." He says it's most gratifying to be remembered.

The State of Support for the Mathematical Sciences

Department of Mathematics
by R. Richard Summerhill, Chair, KSU

Several reports have been published in the last few years concerning the condition of the educational system in the United States, especially that pertaining to mathematics, but none has had greater impact than the report of the ad hoc committee on resources for the mathematical sciences. Renewing U.S. Mathematics, Critical Resource for the Future was published by National Academy Press in cooperation with the National Research Council. The committee that conducted the investigations was chaired by Edward E. David, Jr., president of Exxon Research and Engineering.

This report outlines the current state of the mathematical sciences and describes the level of financial support available for research in mathematics. A comparison with the level of support available for other fields such as biology, chemistry, and physics is also presented.

The committee came to three very important realizations early in its deliberations:

1. Mathematics is increasingly vital to science, technology, and society itself.
2. Paradoxically, while mathematical applications have literally exploded during the past few decades, there has been declining attention to support of the seminal research which generates such benefits.
3. Opportunities for achievement in mathematical research are at an all-time high, but capitalizing on these will require major new programs for support of graduate students, young investigators, and faculty research time.

These perceptions served as a guide for the committee in its deliberations concerning support for mathematics. Preliminary evidence indicated that the mathematical community was being supported at a level somewhat lower than the other sciences, but it soon became obvious that the situation was considerably more severe than originally expected. To quote from the report:

"Since the late 1960s, support for mathematical sciences research in the United States has declined substantially in constant dollars, and has come to be markedly out of balance with support for related scientific and technological efforts. Because of the growing reliance of these efforts on mathematics, strong action must be taken by the Administration, Congress, universities, and the mathematical sciences community to bring the support back into balance and provide for the future of the field."

"We estimate the loss in federal mathematical funding to have been over 33% in constant dollars in the period 1968-73 alone; it was followed by nearly a decade of zero real growth, so that by FY 1982 federal support for mathematical sciences research stood at less than two-thirds its FY 1968 level in constant dollars."

Furthermore, the committee determined that the lack of support for the mathematical sciences has had, and will continue to have, deleterious consequences:

"The absence of resources to support the research enterprises in the country's major mathematical science departments is all too apparent. In most of them, the university is picking up virtually the total tab for postdoctoral support, research associates, and secretarial and operating support; as a result, the amounts are very small. Graduate students are supported predominantly through teaching assistantships, and (like faculty) have been overloaded because of demands for undergraduate mathematics instruction, which have increased 60% in the last eight years. The number of established mathematical scientists with research support, already small in comparison with related fields, has decreased 15% in the last three years. Morale is declining. Promising young people considering careers in mathematics are being put off."

"The most serious consequence has been delayed. In a theoretical branch of science with a relatively secure base in the universities, sharp reduction in federal support does not leave large numbers of scientists totally unable to do their research, as might be the case in an experimental science. There is a considerable time lag before there is a marked slowing down of research output. The established researchers and the young people who were in the pipeline when reduction began carry the effort forward for 15 to 20 years, adjusting to increased teaching loads, to decreased income or extra summer work, and to simply doing with fewer of most things. If the number of first-rate minds in the field is large at the onset of the funding reduction, an effort of very high quality can be sustained for quite some time."

"This is what has been happening in the mathematical sciences in the United States for over a decade. The situation must be corrected."

How does the general lack of support affect our department? One obvious way is by decreasing the availability of mathematicians. Because there is little support for the study of mathematics, far fewer people enter the field. This is especially true at the graduate level, where the competition to hire teaching assistants is extremely keen. Another complicating factor is the low salary schedule at Kansas State University. In an extremely competitive market, low salaries can only have a negative effect. The University of Utah is now paying GTAs $1,000 per month compared to our $750 per month (measured in 1984-1985 dollars). A decrease in the number of teaching assistants can have a devastating effect on our current faculty. With fewer graduate teaching assistants, more pressure is brought to bear on the current faculty to teach a greater number of hours. This has been resisted in the recent past, and such resistance should continue, for the outcome could only be a decrease in the scholarly work of our entire faculty.

What can be done by Friends of Mathematics? There are two ways in which you can be of help to our department. One is by financial support for graduate students and faculty in mathematics. It is vitally important that we be able to offer scholarships to
Loggerheads

Karl Stromberg submits these two problems involving logarithms and challenges you to solve them.

1. Prove that if $a$ and $b$ are positive real numbers, then $a^b + b^a > 1$. [You will recall that $a^b = e^{b \ln a}$.]

2. There is only one line through the origin that is tangent to the graph of $y = \ln x$. What is the point of tangency?

graduate students in addition to normal GTA salaries. This should be clear from the salary examples given earlier. A second way is by noting good students in mathematics and encouraging them to continue their studies. We have a substantial number of openings for graduate teaching assistants at this time and our program has become an extremely strong one. If any of you know of good students that intend to go on to undergraduate or graduate education in mathematics, please contact the department so that we can send information to them.

It will take a concerted effort to increase the support for the mathematical sciences. Much should be done by state and federal governments, but there is a lot that can be done by individuals within the mathematical community and by those who consider themselves Friends of Mathematics. I thank you in advance for any help you can offer and I look forward to hearing from you in the future.

New Faculty

Todd Cochrane joined the faculty in August 1984 as an assistant professor. He received his B.S. in mathematics and physics from Harvey Mudd College in 1978, and graduated with a Ph.D. in 1984 from the University of Michigan. Todd's dissertation is entitled "Small Solutions of Congruences." His thesis advisor was D. J. Lewis.

Before coming to K-State, Todd worked as a teaching assistant and then as a research assistant at the University of Michigan from 1978 to 1984. His research interests lie within the field of number theory.

Alberto L. Delgado joined the department as an assistant professor in August 1984. Alberto received a B.A. in 1977 from the University of Southern California, and a Ph.D. from the University of California at Berkeley in 1981.

Alberto worked in computer software development for Softool Corporation in Goleta, California, from 1978 until 1981. During the period 1979-1981 he was also a teaching assistant at U.C. Berkeley. From June 1981 until his appointment to the faculty at K-State in 1984, Alberto was employed at the University of Bielefeld in the Federal Republic of Germany.

Alberto's research interest is the theory of finite groups. He has participated in conferences in the Federal Republic of Germany and is a joint author of two monographs published by Birkhauser Verlag.

Larry K. Forbes was appointed as an assistant professor in August 1983. He obtained his B.Sc. from the University of Adelaide in Australia in 1977, and his B.Sc. Hons. in 1978. He received his Ph.D. in applied mathematics from the University of Adelaide in 1981.

Larry worked as a postdoctoral student at the University of Adelaide during 1981 and then as a research scientist for the Australian Department of Defense in Melbourne later that same year. He was a visiting assistant professor at the Institute of Hydraulic Research at the University of Iowa from 1982 until his appointment to K-State in 1983.

His research interests are in applied mathematics and fluid mechanics, and he has published in several journals.

Linden B. Willis joined the faculty as an assistant professor in August 1984. Linden obtained his B.S. here at K-State in 1978 and an M.S. degree in mathematics in 1980 from the University of Oregon. He worked as a teaching assistant at the University of Oregon from 1980 until 1984.

Linden's research interests concern global analysis, with particular emphasis on the invariants of the heat equation of Riemannian manifolds. This research finds application in areas of differential geometry.

Friends of Mathematics

The third annual Friends of Mathematics Banquet is scheduled for April 16 in the K-State Union. Professor Peter Hilton of the State University of New York at Binghamton will be our distinguished guest. Professor Hilton is well known for his work in algebraic topology and has a reputation as a fine public speaker. He will also deliver a talk on elementary mathematics in the afternoon before the banquet.

Previous guest speakers in this series include Professors Paul Halmo and Ivan Niven.

We would be pleased if you could join us for these festivities which honor our best students. Tickets for the banquet will cost approximately $8. If you are interested, contact Dr. Louis Herman in the Department of Mathematics.

Visiting Professor

Bert Yood, a professor emeritus at Pennsylvania State University, is spending the 1984-1985 academic year with the math department at KSU. Professor Yood has held positions at Cornell University and at the University of Oregon, where some of our mathematics faculty knew him as a teacher or as a colleague. Since retiring from Penn State, he has been a Visiting Professor at Yale, U.C. Berkeley, the University of Edinburgh, and the Weizmann Institute of Science. He is well-known for his work on Banach algebras and is currently teaching a graduate course at K-State on almost-periodic functions. It is a great pleasure to have him with us this year and we hope to continue with a program of stimulating, visiting professors of his stature.
Outstanding Graduate Student

Juergen Koslowski of Hannover, West Germany, and currently studying at KSU, was the 1983-1984 recipient of the annual Hostinsky Outstanding Graduate Student Fellowship. During the same period he received an award for Best Submitted Paper. His paper, “Dual Adjunctions and the Compatibility of Structures,” has since appeared as a monograph in the Sigma Series in Pure Mathematics.

An Interview with Ivan Niven

On April 12, 1984, Professor Ivan Niven gave the second annual Friends of Mathematics Lecture. It was entitled “Surprising Results in Elementary Mathematics.” At the Friends of Mathematics Awards Banquet later that evening, he offered an after dinner talk entitled “Some Observations on Mathematics and Mathematicians.”

Earlier that same day, Professor Niven video taped an interview with Richard Greechie of the K-State Department of Mathematics. Excerpts from that interview follow.

Ivan Niven, working at the University of Oregon, is primarily a number theorist. He has written seven books and more than seventy scholarly articles. He’s a native of British Columbia, Canada, although he received his Ph.D. from the University of Chicago in 1938. In one capacity or another, he has worked at the University of Chicago, University of Pennsylvania, Illinois, University of California at Berkeley, at Stanford, Purdue, London, and the University of Oregon. He has served as an advisor to the Office of Naval Research, and to the National Science Foundation. He has been a member of the Board of Governors of the Mathematical Association of America and the Council of the American Mathematical Society. He is currently president of the Mathematical Association of America.

R.G.: Let’s start at the bottom. Who should study mathematics?

I.N.: Oh, who should study mathematics? Well, I think that lots of people should study at least a small amount of mathematics in our world today. With the technical society that we have, virtually everybody needs to know some things about the elements of mathematics—graphing, number systems, handling numbers, treating data, dealing with collections of data, and of course they must have some familiarity with the processes of computers and computer science. All these things I think are important for virtually everybody in our society if they’re really going to live fully in the modern world. Then in that large group there will be certain people, lots of people, who will want to study more mathematics.

For example, people in engineering will study mathematics, but that’s a changing situation, and now business administration, economics, all sorts of fields now require more mathematics than those basics I was talking about. So my answer to the question basically is a little mathematics for virtually everybody and quite a bit of mathematics of different kinds perhaps, depending on the direction people are going in, architecture, whatever, quite a bit of mathematics for many members of our society’s professional people.

R.G.: Does it take a special talent to survive in math courses?

I.N.: Well, we have to distinguish two things. One is the creativity situation in mathematics, so that would be the level of getting a Ph.D. in mathematics and creating some new mathematics. There, one needs a considerable amount of ingenuity. I think to comprehend the basic courses in, say, college mathematics, that’s not quite as demanding in terms of ingenuity or creativeness as the Ph.D. situation. So for lots of students, what they really need is some ability to concentrate on the subject and a certain mathematical or number sense. I have a feeling that—and this is being documented to some extent, but not really fully—that just as there are people who are tone deaf in music, so there are people who are "tone deaf" in mathematics. It doesn’t ring a bell with them, and those people really have a hard time with math and they should probably, and most of them do, sense this and move in other directions. But for the people who are comfortable with mathematics, I think it would be worthwhile to take quite a bit of math.

R.G.: So, just as there are people who think they’re tone deaf but just don’t have enough experience with music, would you say that there are many people who think that they can’t do mathematics but with an exposure could develop the same intuition that someone strong might have?

I.N.: Yes, I think so, at least they could come part way along that track. It’s certainly the case that if you don’t make an effort in mathematics you’re not going to get very far. If a student approaches the subject of mathematics feeling that somebody will tell him what to do in all circumstances, the student then will have difficulty because it’s not simply a matter of being a spectator. You cannot simply be a spectator at mathematics and watch somebody else do this problem and that problem. You have to try it for yourself. So you have to study mathematics by rolling up your sleeves, getting a pencil and paper or computer (if you’ve got a computer program that’s adequate and the right kind of software) and try it for yourself.

R.G.: How are students in America keeping up world-wide. Are the math students in America as well prepared as they are in Japan or China?

I.N.: If you take the very best students, say, the top one or two percent of students in Japan and the United States, then you have a very comparable situation. But if you take a wider sample than that and talk, for example, about all students at a certain age level or if you take all students in high school, then I think you will find that in Japan the students are more capable of, or perhaps I shouldn’t say more capable, that’s not quite the word, the word is that they are more experienced in mathematics at that age level. They have more facility with it because they’ve practiced more.

R.G.: In recent years in many countries other than the United States changes have been happening which haven’t been happening here. For example, transformation geometries have been introduced in the last few years in Canada, Australia, and Germany, but that hasn’t happened in the United States. Could you comment as to why that hasn’t happened, and do you think it should?

I.N.: It hasn’t happened in the United States to the same extent although interestingly enough a lot of the materials were developed in the United States. Some of the best books in transformation geometry have been written by American university professors of mathematics. But this has not filtered down into the lower schools as much as it has in some other countries.

But the United States has always been a little different from other countries in the way geometry and algebra are taught in the schools. In most countries of the world, a young person, say age 12, 13, 14, who starts to study mathematics—I’m not talking about arithmetic but the more abstract structures of mathematics—a young student anywhere begins by studying some algebra. He talks...
about the use of symbolism like a's and b's and x's and y's and so on for the variable quantities and the constant quantities, then moves on into geometry. But in other countries, at the point where geometry is introduced it is meshed with algebra. The standard practice is to have a course, say, five days a week for a forty minute or an hour session. Monday, Wednesday, Friday are algebra and Tuesday and Thursday concentrate on geometry. Those five classes are taught by the same teacher and the subject matter is integrated.

For some strange reason in this country in the high schools, algebra is one subject and geometry is another and the linkage is not made clear. Now, if you're going to move on to transformation geometry beyond our ordinary coordinate structures and so on, definitely transformation geometry is a linkage between algebra and geometry in its particular form, and that involves the integration of the two subjects. I hope the United States will move in that direction. There are already some pressures to do that in the schools.

R.G.: Are there programs in the United States for senior citizens?

I.N.: Not very many, actually, in mathematics. There are lots of programs nowadays for senior citizens, I'm a senior citizen myself, but they tend to be in more verbal subject areas like grammar, music, history, political science, and so on. The programs in science and engineering and mathematics for senior citizens are fewer. There are some specialized kinds of programs you can take, you can learn computer programming in special classes as a senior, but mathematics, per se, not so much. Learning mathematics is a young person's game, the same as learning music is a young person's game. Anybody could start to play the violin, say, when they were forty years of age but you will not expect them to be on the concert stage even if they work for twenty years at it. Music is in that sense a young person's game, and I think there are certain mathematical concepts that are most readily learned when you're quite young. On the other hand, if you don't know anything much about, say, history, you can start studying the history of the western world or the entire world history when you're sixty or sixty-five even though your background in knowledge is quite meager. It's a different kind of a ballgame.

R.G.: What does it take to become a good math teacher?

I.N.: Well, there are certain aspects of being a good math teacher that are no different from being a good teacher in any area. I think, first of all, you have to have a liking for the people you're teaching, whether you're in the kindergarten group or in the graduate school. To be a good teacher in any subject you have to like the people you're teaching. Secondly, you have to have an enthusiasm for the subject you're teaching. If a person drags in to the classroom and feels,}

"Oh, here I am again and I'm going to talk about the Civil War once again or I'm going to talk about some problems in calculus, and I've been through this before,' you're not going to be very effective as a teacher. So enthusiasm is necessary. I think a good teacher has to be in some sense something of an actor . . . a ham if you wish.

A teacher, a good teacher, has to present the subject, I'll take mathematics since that's the field we're talking about, and remember that when he or she was a student, the calculus was a great, novel idea to them and they were enthusiastic about it and they were delighted with the unfolding of this magnificent subject. So a teacher has to go in the remember that the students in the class are ready for that kind of an approach, and then to let the student explore some of the ideas for himself or herself. The idea of going in and simply lecturing the students on the subject—that won't work in mathematics as it won't work elsewhere. What really works best, as everybody knows, (is) if you can get student participation in the process as much as possible.

Now those are general remarks with respect to teachers in whatever field. For mathematics, there are one or two things that can be added specially. I've already said that teachers should be enthusiastic about the subject. I would say in connection with mathematics, that the teacher should feel easy with the subject. A teacher should know, of course, more than he or she is talking about that immediate day so that if the students want to explore something that's off to one side a little bit from the topic the teacher will have the background to help them with the appropriate materials in the library, so a teacher needs to know more than just what they're going to do on that particular day. They need a good background in mathematics. I think that's really true in any field, too, but it's especially true in mathematics.

If you're teaching, say, modern American history, it doesn't necessarily matter too much whether you're well-grounded, say, in Greek history or Roman history. In mathematics I think it's a little different because the parts are much more closely interlocked, as any Ph.D. in mathematics knows full well. The parts of mathematics are much more closely interlocked than the parts of history.

R.G.: Could you say something about the usefulness of the computer and how it's changing the face of mathematics?

I.N.: Well, one of the ways the computer is changing the face of mathematics is that it's a field that a person with a mathematical kind of mind can handle and manage just as readily as mathematics. There have been studies that indicate one effect of this is that a lot of people who in times past would have gone into the high school teaching of mathematics are now going into computer work; they become computer programmers and they're not teaching mathematics in high school. It's well-known that in the United States, especially in certain parts of the United States, there's a critical shortage of capable high school teachers in mathematics, and in science, too, for that matter. The factor that I'm talking about has been an important one in causing the shortage.

There's another factor, by the way, I could mention, that has nothing to do with computers. In earlier times many, many young women would head for, say, high school teaching as a career, whether it was teaching math or English or chemistry or what have you. Nowadays, of course, with the opening up of career opportunities in so many areas to women that were somewhat closed before many capable young women who used to go into teaching are not doing that. So there is a critical shortage of capable people. I believe, for the teaching profession.

R.G.: What can be done to attract those people back into mathematics?

I.N.: Ours is an open and free society and I think that the standard Adam Smith (18th century Scottish economist) theory is the basic one that will apply. It's not the only one, but it is certainly basic. As Adam Smith said, "If there's a shortage in some area the price will go up, and then there will no longer be a shortage." So that is one way that they can be handled. That's not the only way however.

I think there is another point that is very significant, and people have noticed this who've traveled in Europe. A high school teacher in many of the European countries has a higher standing in society than in the United States of America. It's not clear why this is so. Some high school coaches have very high standing in our society, but the classroom teacher, not so much. I think that one way to turn it around would be for society to give some recognition to the importance of this work, and I believe it is rather important in terms of the development of our society.

R.G.: In your long and brilliant career you must have met some very interesting people. Who stands out in your mind as being the people who framed your career or who influenced you the most?

I.N.: Well, the people that I had most immediate contact with and who influenced me strongly were the professors at the University of Chicago, especially my Ph.D. thesis director, Leonard Eugene Dickson. After those years I moved on to post-doctoral research position at the University of Pennsylvania, where I worked with a scholar who had fled Europe because Hitler had kicked him out. Actually he was not kicked out because he was Jewish. He was kicked out because he would not take the Hitler Oath in 1933. So here was a great European scholar, Hans Rademacher, of the University of Pennsylvania, and I studied with him and I learned from him, and from others. There was a coterie of people in that area. Princeton was quite nearby and Herman Weyl was there and he came down to visit at the University
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of Pennsylvania. We visited up there at Princeton and the Institute for Advanced Study. Von Neumann was there; he visited a couple of times at University of Pennsylvania while I was there.

These people from Europe had a different attitude towards mathematics and towards education, much more an elitist attitude than exists in the United States. I didn’t particularly like their total educational picture in Europe but I thought there were certain aspects, especially at the advanced level, that we could learn from. And I think we have learned from them because there were so many refugees that came over.

Einstein, of course, is well known in mathematical physics, and in mathematics itself there were some 200 of these people who fled Europe in the period from about 1935 to 1942 or 1943 and who entered our universities. Our universities made places for them, and that was a fortunate thing. Most of these refugees left Germany and Czechoslovakia and Austria and Hungary at that time to get out from under the boot of Hitler. Most of those people went to the United States, a few to Canada, a few to Great Britain. The United States was the country that really opened its doors and this had a great influence on graduate education in mathematics in this country.

Now, there were other ideas that these people brought that did not filter in and perhaps just as well. They had strong elitist ideas and those were not accepted by the United States. They had strong ideas about the administration of universities and school systems in the United States but those ideas didn’t take hold and I’m just as satisfied that they did not. I believe that the administration of universities and school systems in the United States is every bit as good as that in Europe.

R.G.: We don’t need to have one superstar at each institution.

I.N.: That’s right. We don’t need to have one superstar at each institution and we don’t have to have a limited number of professorships so that we can avoid the situation that’s so common in Europe—a middle-aged person sitting around waiting for some older person to die so they can get that job. We don’t have that situation because we can create, if necessary, new professorships. So, for example, in the United States when computer science came up on the field, I think the American universities were in a better situation to create positions in computer science than some of the European universities were.

R.G.: Could you tell us something about Reinhold Baer?

I.N.: Reinhold Baer was another of the European refugees who fled from Europe. He was on the faculty of the University of Illinois. When I joined the faculty I had an office right across the hall from him and I was strongly influenced by conversations with him. For example, many of the people in this country at that time looked upon advanced mathematics as a collection of results, theorems if you wish, but collections of results and their proofs. So you were supposed to know the fundamental theorems of calculus and you were supposed to know the Wedderburn theorems in abstract algebra and there were various other named theorems that were the building blocks of the mathematical structure in the research situation.

Reinhold Baer had a different point of view. His attitude was, “what are the basic techniques of proof that will work in mathematics?” He said that while there were many new results in mathematics every year, a genuinely new idea appeared—in his view—only once every couple of years in a worldwide situation. So what he tried to do was watch for those essentially new ideas and build his mathematical thinking on those. I think it was a very effective technique and I learned it in some measure and I believe it was useful to me.


I.N.: Yes, George Polya was very interested in proof technique and brought the whole concept of proof techniques and how to approach mathematics in order to solve problems to every man, to every woman. That was one of Polya’s great contributions in his later life. He didn’t turn to these things actually until he was about 45. He was pretty busy with his mathematical research up to that stage and then he got to thinking about the processes of learning and studying mathematics. The question has been asked from time to time about the relationship of the studying of mathematics as a technical subject versus the studying of mathematics in the same sense that you will have courses in the appreciation of music. Is it proper to have courses in the appreciation of mathematics? I think it is, but going back to Polya, Polya was not so much concerned about that. He was concerned with the technical side of mathematics and making that available in a widespread sense.

But turning away from Polya and his techniques, which were useful in their way for problem-solving, to the question of the appreciation of mathematics: there is a place for courses in the appreciation of mathematics. I believe those courses could be used for senior citizens, going back to an earlier question you asked. They have not been used so much but they could be and there are quite a few good books in the area of the appreciation of mathematics. Mathematics in those courses is studied in a more relaxed way so the students aren’t chewing the ends of their pencils while struggling with a hard problem so much as they are learning the sweep of mathematics and its relation to history, its relation to technology, its relation to science, etc.

R.G.: Professor Niven thank you very much for coming to Kansas State and enlightening us in this way. We certainly appreciate it.