

Mathematics in Uganda

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This column is a forum for discussion of mathematical communities throughout the world, and through all time. Our definition of "mathematical community" is the broadest. We include "schools" of mathematics, circles of correspondence, mathematical societies, student organizations, and informal communities of cardinality greater than one. What we say about the communities is just as unrestricted. We welcome contributions from mathematicians of all kinds and in all places, and also from scientists, historians, anthropologists, and others.

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Elephant tusks mark the spot where Uganda's main road crosses the equator. A lush country, bordered by Kenya, Tanzania, Rwanda, Zaire, and Sudan, Uganda contains the ice-capped "Mountains of the Moon," some of the few mountain gorillas remaining in the world, and the elusive source of the Nile sought by such 19th-century western explorers as Speke, Grant, and Stanley. Makerere University, located in the capital Kampala, was founded in 1922. This article concerns how the Department of Mathematics at Makerere has coped with historical and financial constraints that make recent difficulties at western universities seem trivial.

Visitors to Makerere University usually live in the campus Guest House, where the staff is friendly, there is an ample portion of potatoes at each meal, and it is easy to get accustomed to the stray dogs that bark late into the night. During our (Vince family) three-week residence there, while waiting for a university flat, we met a number of academics who had visited Uganda during the 1960s and early 1970s. They had at least two recollections in common: game in Uganda as abundant as in the Serengeti in Tanzania, and the Eden that was Makerere University.

Winston Churchill called Uganda the pearl of Africa; Makerere was the Cambridge of Africa. The grounds were like a garden; the scholars were the most respected in East Africa, many renowned much further. Mulago was a prestigious teaching and research hospital.

But two decades of political chaos and financial neglect have taken their toll. At the time of our visit in 1993–94, the library had almost no books published after the early 1970s; textbooks and computers were scarce; buildings were run down; overcrowded dormitories resembled tenements; very little research was being done. A defect in the water storage tank in our university flat resulted in a small Murcheson Falls flooding the place; our faculty neighbors kindly helped sweep the water into the street. We were embarrassed to learn later that our neighbors had no storage tanks at all, so water was available only two hours each day. The annual repair budget for the 1000 or so Makerere University housing units was about \$7000. There was a two-week period during our stay when no one had water because the university had amassed too many arrears on its water bill.



Main hall on the Makerere campus.

Erasers accidentally left at a chalkboard would be stolen (as would toilet paper left in a restroom). Fire extinguisher cases were either empty or burglar-proofed (rendering the extinguishers inaccessible). Because surgical lighting is costly to replace, it was not unusual for a procedure in the operating theater to pause for a few moments while clouds passed overhead.

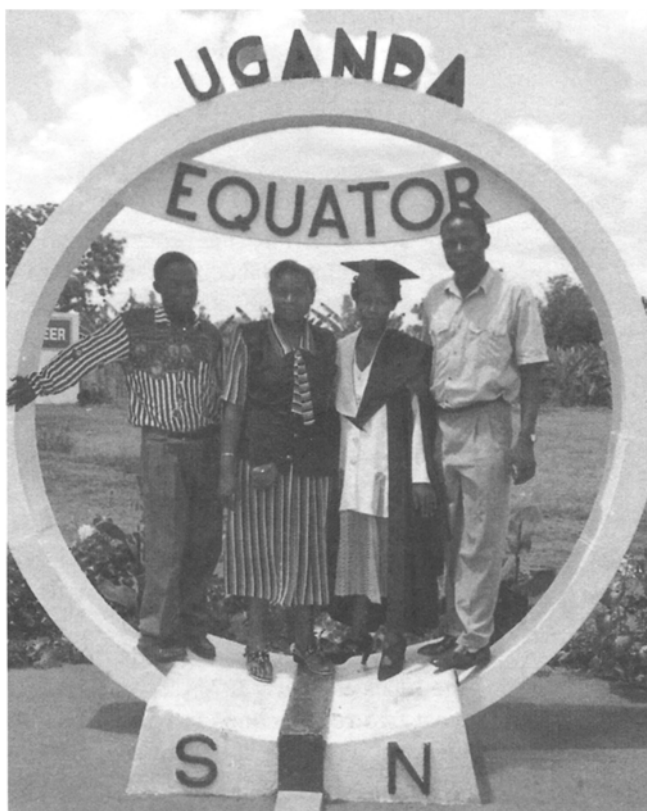
Faculty salaries were so low (between \$125 and \$350/month) that most faculty had two or more jobs, and the faculty job was usually not the primary one. Second jobs among the mathematics department faculty included a computer consultancy in Kampala, teaching secondary school as far away as three hours by bus, and growing tomatoes in the village. Lecturers sometimes missed classes due to these other commitments and had little time for students.

Students were demoralized. The faculty staged a strike for a “living wage”; it was not the first. When the students staged their own protest concerning an increase in fees, shots were fired in the air to disperse them. In a similar strike a few years earlier, two students were shot to death.

The Colonial Years

The 1922 Annual Colonial Report on Uganda states that, “except for a Government technical college, which came into being during the year, educational work among the natives is in the hands of missionary societies.” Because it was built on Makerere Hill, this technical school was called Makerere College. (There are numerous places in Uganda whose names are based on events in the lives of the Kabakas—kings of the Buganda kingdom. Concerning the origin of the name Makerere, the story goes like this. About 1680, Kabaka Jjuuko set out in secret one night on a journey to marry a girl from the village of Nabuititi. Although he intended to travel further, dawn found Jjuuko on the hill now known as Makerere.

Jjuuko, annoyed to find daylight over-coming him so soon, exclaimed “Makerere,” a Luganda word for “the place where dawn finds someone.”) In the 1920s, mathematics at Makerere was taught as an ancillary course at an elementary and practical level for students preparing for trades like surveying, agriculture, mechanics, and carpentry. In the 1930s and 1940s, teacher training and more advanced technical training became key objectives. The



Vincent Ssembatya after his graduation, with sisters and brother (at the equator).

emphasis, however, remained on practical aspects, mathematics as a tool and manipulative skill for persons destined to perform specific tasks in the British colonial economy. The college provided vocational courses for medical, veterinary, and engineering practitioners for the African Civil Service, and also for schoolmasters.

Makerere College was run like a British public school, students sporting uniforms with tasselled caps and green socks with red stripes at the top. The administrators and instructors during these early years were predominantly British, and this remained the case until after independence. In 1954,

for example, there were only five Makerere graduates on the academic staff (out of almost 100), none in mathematics. John Crabbe was chairman of mathematics during the 1940s and 1950s. Margaret Macpherson, in her chronicle of Makerere during these early years, recounts that, in addition to his departmental duties, Mr. Crabbe was in much demand at student dances. There were tutorials in ballroom dancing during the 1940s. In 1952 High Table in Hall was introduced and, at about the same time, students began performing in an annual Shakespeare play and wearing deep red gowns at academic processions.

In 1950 Makerere officially became the University College of East Africa, with a total of 237 students, from Kenya, Tanganyika and Zanzibar, as well as Uganda. The teaching of university level courses at Makerere began in the 1950s, a period of emphasis on the upgrading of standards to levels of its partner school, the University of London. By 1961 there were 912 students at Makerere, 278 Ugandan (32 female). By 1966 the Makerere student population had grown to 1500 and by 1972 to 3427. In 1956 the new Zoology building was dedicated by L.S.B. Leakey, and in 1958 her Majesty Queen Elizabeth the Queen Mother dedicated the new library.

During the 1950s and 1960s, life at Makerere was about the best that could be had in Uganda. Students paid no tuition, and in fact were given travel expenses, a book allowance, and pocket money (popularly called “boom”). Each student had his or her own room and considered it a right to have luxury items like honey and eggs served at meals. Those who graduated could expect, at minimum, what was referred to as the “4-3-2-1”, a car (four wheels), a three-bedroom house, two children, and one wife. Many achieved more in several of these categories.

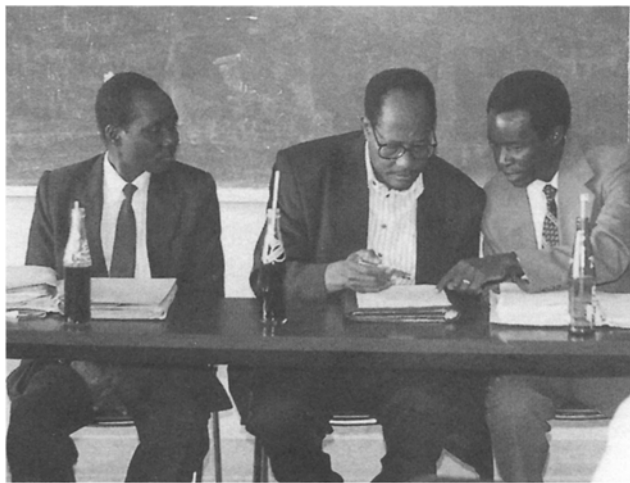
Uganda gained independence in October 1962, but aspects of the

British academic system remain throughout Uganda's educational system. Even now, invigilation (proctoring) of exams and oversight of grading by external examiners are the norm. There are seven years of primary school, four years of secondary at "O" level (ordinary), two years at "A" level (advanced) for those passing the "O" level exams, and three years at Makerere for those accepted. Uganda also has numerous technical colleges, teacher training colleges and commercial colleges. About three million children (over 60%) attend primary school; less than 10% of those go on to secondary school; and the enrollment at Makerere University is about 8000.

By the end of the 1960s Makerere was offering a wide range of university-level mathematics courses. The curriculum and standard of instruction were quite respectable by any criterion and the programs were attracting some of the best and brightest students. Visiting scholars came from Europe, America, and the British Commonwealth.

The Uganda Mathematical Society

By the late 1960s there were groups, such as the Mathematics Ring (mostly primary and secondary school teachers), and projects, such as the Entebbe Mathematics Project for East Africa, which brought together active mathematicians. Patrick Mangheni is the current chairman of the Department of Mathematics at Makerere University and was chairman of the Uganda Mathematical Society from 1993 to 1996. Being one of the most brilliant mathematicians in the country, he quickly advanced through the school and university system in Uganda and later attended Oxford University for his Ph.D. in functional analysis. According to Professor Mangheni, "By the early 1970s, there was a widespread feeling, especially at Makerere University, that Ugandan and Uganda-based mathematicians had attained a critical mass that could sustain a vi-



Patrick Mangheni, Chair of Mathematics (right), Daouda Sangare, Secretary General of the African Mathematical Union from Ivory Coast (center), E. Opyene, lecturer at Mbale University in Uganda (left).

brant mathematical society, a regular publication, and frequent meetings and lectures. As a young undergraduate student at Makerere in those days I remember attending several recreational mathematics meetings devoted to games, puzzles, and mathematical talks, at which plans for a country-wide mathematical society were discussed (albeit informally)."

The Uganda Mathematical Society (UMS) was formally established on the 25th of November, 1972. Since its inception, the UMS has enjoyed major support from Makerere University and the Institute of Teacher Education in Kyambogo for its infrastructure and leadership.

Professor Paul Mugambi was elected first president of the UMS. He had gone to the University of Southampton, England, for his masters degree and later to the University of Rochester, U.S.A., for his Ph.D. in non-linear dynamics. He returned to join the faculty at Makerere in the early 1970s, where he was the only Ugandan among the senior ranks for a number of years, then became the first Ugandan to chair the Department of Mathematics. At the time of his election to the chairmanship of the UMS, he made the following statement: "Some of us felt a need to establish a national society which would encompass more than a 'hobby' interest in mathematics. The society hopes not only to foster a lively interest in the subject but also to encour-

age developments in the teaching, studying, and usage of mathematics. We would like to encourage communication among teachers at all levels on topics like syllabus reform, school text books and mathematics itself. This can be carried out at conferences, seminars, or writing in the (Uganda Mathematical) *Bulletin*. Another aspect of communication we would like to foster is one between users of mathematics in industry and government, and teachers of mathematics. This sort of cross-fertilization may lead teachers to teach the subject more meaningfully and employers to gain an insight into the mathematical training in this country."

Dark Days

Political events at the time made it impossible for the Uganda Mathematical Society to fulfill its objectives. Like most of the continent, Uganda has been jinxed by colonialism, corruption, and political disasters. But even by African standards, Uganda's post-independence history was brutal. Major-General Idi Amin came to power in 1971 through a military coup. By the end of 1972, the Asian population (about 50,000) had been expelled (Amin claimed that the final decision to expel came to him as a directive from God in a dream). The only dissenting voice was from the Makerere University Student Guild. By the beginning of 1973 Amin's administration was, in the words of former Makerere historian Phares Mutibwa, "a combination of guile, buffoonery, and utter ruthlessness, killing anyone even remotely suspected by him or his subordinates of being unfriendly." The army was, in particular, suspicious of the loyalty of educated people. Because most of Amin's ministers were soldiers, there was a general dislike by the military regime of the intelligentsia of the country. Victims of Amin's purges included Makerere administrators, and reportedly more than 100 university students were massacred in 1976. Many faculty left the country, often

tipped off about their imminent arrest just in time. The 1979 invasion by Ugandan guerrillas from Tanzania led eventually to the (second) regime of Milton Obote, a dictatorship many consider even more bloody than Amin's. During the years of Amin and Obote it has been estimated that one of every ten Ugandans was killed.

The current crisis in higher education at Makerere—decay of the infrastructure, chronic shortage of staff, loss of faculty morale—is typical of universities in many African countries. What makes this particular situation poignant is that in 1971 Uganda was by far the most economically viable country in East Africa. The years of chaos squandered all the advantages the country possessed. By the time Yoweri Museveni, then leader of the National Resistance Army and now elected president, overthrew interim head General Tito Okello in 1986, the effects of political turmoil were extreme.

Accompanying the economic collapse was a deterioration in professional ethics and a devaluation of education. Businesses previously owned by Asians were redistributed arbitrarily and essentially looted, leading to what was called “magendo,” quick money without having to work for it. In the 1950s and 1960s a faculty member's status could be roughly measured by the altitude of his or her residence on Makerere Hill, with the most desir-

able residences at the top. As salaries declined during the Amin years, the bottom became most desirable, where water still reached the taps and where gardens were large and fertile enough to grow food. According to Dr. Mutibwa, “Previously, students worked hard at school in order to make it to Makerere University. The Makerere graduate was assured a respected position within the community and a commensurate salary. During Amin's regime what came to be of value was money, and it did not matter how it was made. Positions of power were obtained through violence and influence. Makerere became a symbol of those who would never make it in life. A typical remark: our friend X will never be happy; she is going to marry a Makerere graduate.”

Standards for mathematics courses in the secondary schools collapsed, and there was a sharp decline in career opportunities in mathematics. The *Bulletin of the Uganda Mathematical Society* made sporadic appearances until 1980 when it could no longer be published for lack of money and interest. According to Professor Mangheni, “The departure (and failure to return home) of most mathematicians crippled mathematical activity in schools, colleges and the university.” Dr. L.S. Luboobi, a professor specializing in biomathematics, was elected Chairman of the UMS in July 1989. He had attended the University of Toronto,

Canada, for his masters degree and then the University of Adelaide, Australia, for his Ph.D. But by the time Dr. Luboobi took over the chairmanship, the UMS had practically ceased to exist.

New Life

The motto of Makerere University is *Pro futuro aedificamus*, “we build for the future.” In October 1995 the Uganda constitution was adopted, and in May 1996 a democratically held presidential

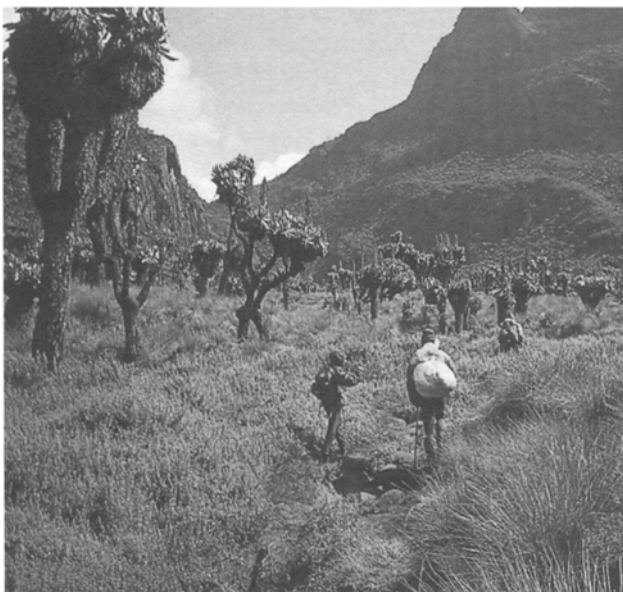
election took place. Even during my visit in 1993–94, there were conversations (some more serious than others) in the mathematics commons room concerning the possibility of restoring Makerere's former eminence.

If it happens in mathematics, three senior faculty are largely to be credited: Paul Mugambi, Livingstone Luboobi and Patrick Mangheni. This trio has acted together as the invariant center of mathematics at Makerere University for 15 years. They are esteemed among their colleagues for perseverance that enabled them to get through the difficult years.

Professor Mugambi is regarded as the grandfather of mathematics in the country. Over the past 25 years he has played a part in the training of most of the faculty now in the Department of Mathematics at Makerere University and has served as Dean of the Faculty of Science. Professor Luboobi was head of the Department of Mathematics before he was elected Dean of the Faculty of Science, a position he still holds. He is the exception at Makerere, the professor that can be found working in his office at all hours. He currently represents the UMS in the African Mathematical Union and is the Organizing Secretary for the Pan-African Mathematical Olympiad. Professor Mangheni, in addition to his duties as chair of mathematics, is a partner in Rank Consults (a computer firm in Kampala), is on the board of directors of the Uganda Polytechnic Kyambogo, Uganda Airlines, and the Bank of Uganda, and is chairman of Uganda Computer Management.

About 20 dynamic junior faculty are either under training or have just concluded their training at various universities, including the University of Bergen in Norway (with which Makerere University has a linkage), the International Center for Theoretical Physics in Italy, the University of Florida in the U.S.A., the University of Southampton in the U.K., and Makerere University in Uganda. Their fields of research include biomathematical modeling, combinatorial optimization, differential equations, numerical analysis, functional analysis, statistics, and computer science. The department hopes

Wandering the hills of Uganda.





Andrew Vince and companion near the summit of Mt. Margarita.

to have about ten faculty with Ph.D.'s and over thirty with masters degrees by the year 2000.

Under Professor Luboobi's tenure as chairman of the UMS, regular Executive Committee meetings were resumed, public lectures under the auspices of the Uganda Mathematical Society were inaugurated, and the *Bulletin* was revived. The society is now running a series of talks, the first given in 1996 by Geoffrey S. Watson, emeritus professor of statistics at Princeton University. Most of the secondary schools in Uganda participate in the mathematics contests sponsored by the UMS every year. Winners are given prizes. In 1995 two of the best students at advanced secondary school level represented Uganda in the African Mathematical Olympiad in Morocco, one finishing in third place.

Thanks to NUFU (a Norwegian-based program for technological development) and the African Development Bank, most of the offices in the mathematics department have recently been equipped with computers. Plans are underway to link the department to the Internet. (Foreign aid, in general, has been pouring into Uganda over the past several years. A favorite donated 4-wheel drive vehicle on the streets of Kampala was the one with the "Rabbit Multiplier Project" logo.)

The undergraduate curriculum now includes courses in calculus, probability and statistics, linear and abstract al-

gebra, classical mechanics, real and complex analysis, topology, differential equations, numerical analysis, and computer science. At present, the Department of Mathematics offers courses only to students majoring in mathematics, physics, chemistry, geology, economics, statistics or library science. However, the "Makerere University Five-Year Development Programme" addresses the problem of acute shortages of staff and lecture rooms, and there are plans to expand the mathematics curriculum to offer electives for all students. There is also a distance-learning project in progress and a proposal to establish a Center for Mathematical Sciences in Modeling and Biomathematics.

The push for expansion of academic programs and improvements in infrastructure has been supported by the administration. Professor P.J.M. Sebuwufu, vice chancellor of Makerere University (Yoweri Museveni, president of Uganda, is the chancellor), has been a proponent of such programs.

1996 Uganda Mathematical Conference

The UMS has organized two major conferences in the last four years. The theme of the 1996 Uganda Mathematical Conference was "Issues in Mathematics and Mathematical Education." Over 300 participants came from countries such as Cameroon, Malawi, Nigeria, Zimbabwe, and Uganda. Funding for the conference came from the Ministry of Education in Uganda, The British Council, Uganda Airlines, and the NUFU project of Norway. The success of the conference was in large part due to the talents of the organizing secretary, Mrs. Janet Kaahwa, a lecturer at the Institute of Adult Education in Makerere University and current chairperson of the Uganda Mathematical Society.

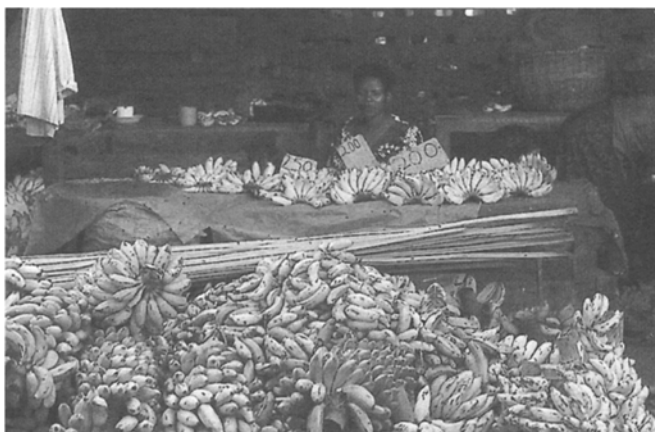
Many participants attended in order to listen to the main speaker, Professor John K. Backhouse of Oxford University, who has probably had as profound an influence as anyone on the direction of A-level mathematics in Uganda. The mathematics textbook co-authored by Professor Backhouse has been the standard for secondary school for over

30 years. Many secondary students held new copies of "Pure Mathematics," waiting for an opportunity to get Professor Backhouse's signature in them. Finding seats for all the participants was problematic.

Primary and secondary school mathematics is a priority of the Uganda Mathematical Society. Most of the mathematics textbooks used in Uganda are imported and, despite their merit, lack a local flavor. Many in the UMS believe that a Ugandan student may better relate to a problem stated in terms of quantities of matoke (the main banana staple) sold at the Nakasero Market than to the same problem stated in terms of quantities of Shetland sweaters sold at Harrods. The isolated attempts by Ugandans to write materials that are geared toward Ugandan students, however, have been frustrated by lack of funding, lack of support and motivation from the government, and failure to meet the standards set by publishing companies. The UMS intends to organize writers' workshops and invite resource people to facilitate them.

At the conference, and in informal discussions, no uniform vision of the future of the university emerged among Makerere's faculty of mathematics. Certainly, for most the role of mathematics in a developing country is not simply a return to the path that was closed two and a half decades ago. Issues today arise from deep sources: ethnic rivalry for education opportunities (there are over 40 tribes in Uganda), elitism in a country with enormous material difficulties, the imposition of a student tuition, low faculty salaries, a vocational versus a liberal education. With respect to the latter, the secondary A-level curriculum (primarily algebra and trigonometry, mechanics (particle kinematics and rigid body dynamics) and statistics) was designed with a view toward university entrance and ignores the more than 80% of the students who fail to make it to the university. More than 75% of the students who sit for the A-level mathematics exam fail on their first attempt, with resulting damage to morale.

The issue of tuition, known as "cost-sharing," is a volatile one. A current crisis revolves about a 50,000 Uganda



Matoke on sale at the Nakasero Market, Kampala.

shilling fee (about \$50 US) imposed on the freshers of the 1996–97 class. Faculty and administration, in general, claim that a tuition is essential to the economic viability of the university and believe that the fee will not prove an unbearable burden on a student's family.* Students regard the move as a return of Makerere to its colonial past, to a university for the elite, and, more broadly, as "a retreat from the democratization of education in Africa." On October 23, 1996 a student general assembly called for a strike against cost-sharing, a decision that surely must have evoked memories of the two students killed by campus police on December 1, 1990 in the course of a demonstration against cuts in student allowances. The October 1996 strike was also in reaction to the recent closing of Northcote Hall, one of the student residences. Northcoters have, according to certain students, a "pride in their visibility" or, according to the administration, a proclivity toward "hooliganism." In any event, the closing of the hall was in reaction to alleged poisoning of food with pepper and glass by several Northcoters. As part of the strike, there was an attempt by demonstrators to reopen and occupy Northcote. By midnight of October 23, police with tear gas and batons had driven the students out of Northcote, and about 50 students

were arrested and later released. In response to the demonstration, the Makerere Council has expelled 35 students, including Student Guild representatives. Students claim the expulsions were an attempt to silence protest against "cost-sharing."

Within the past year, faculty salaries

at Makerere University have risen, and increased expectations for faculty participation in university life are sure to follow. Whatever occurs in the mathematics department will depend in large part on the teaching and example the junior faculty, themselves newly trained mathematicians, impart to their students.

After a variety of talks at the UMS conference, the participants were entertained on the last day with a "Mathematical Cultural Show," presented by children in primary four and five from Kampala Parents School. The show was carefully crafted to challenge viewers to figure out the mathe-

matical patterns in the various dances. As is mathematically fitting, no solutions were revealed.

Acknowledgments

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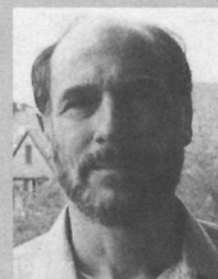
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Vincent Ssembatya, a faculty member at Makerere University in Uganda, has recently come to the University of Florida to pursue a doctorate in mathematics.

Andrew Vince, a faculty member at the University of Florida, was a Fulbright professor of mathematics at Makerere University during the 1993–94 academic year.

*In fact, secondary school fees are five to ten times as much. Students argue that the actual amount is not the issue, but that a precedent must not be set; once any tuition is introduced, the amount can subsequently be increased with a minimum of bureaucratic procedure.