NY – MONITOR

July 2011, Vol. 59, No. 7

Editor: Amitava Dutta-Roy, Life Fellow

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- “Growing up with the Information Age,” Mr. John LeGates, April 2011, reproduced here with kind permission from Program on Information Resources Policy (PIRP), Harvard University, Cambridge, Mass. A note from the Monitor editor precedes the paper.
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CONTRIBUTORS

The Monitor thanks the contributors for the interest they have shown in sharing their ideas with us and thus enriching the NY Monitor for the enjoyment and benefit of our readers. To our present and future contributors we say: please write or continue to write for us!! We would like to convey our appreciation of their suggestions especially to make this issue more interesting to Carrie Loh, Georgia Stelluto, Laura
Durrett (all at IEEE), Darlene Rivera (Chair, NY Section), Dr. Charles Rubenstein (Director, IEEE Region 1) Peter Mauzey (Member-at-Large, NY Section). Thank you all! – Amitava Dutta-Roy, Editor

IEEE New York Monitor

July 2011, No. 59, No. 7

QUOTE OF THE MONTH

“Wonder is feeling of a philosopher, and philosophy begins at wonder.”

SOCRATES, Plato

Socrates, the Greek philosopher is said to have lived between approximately 469 BC and 399 BC

A few words from the editor

This is the first time that the Monitor is being published (albeit online) in the month of July. It will be posted in August as well. Traditionally, it was never published during these two months when New York sizzles. And this year we will beat earlier records of heat index in this city. We, however, thought that the Monitor should be published every month of the year conforming to the practice of most regular mainstream magazines. Really, Monitor is more than a mere newsletter. It is a professional publication in which people would like to contribute and companies would want to advertise. Posting online has an advantage; we do not depend on the printer and the postal mail service.

As usual we start this issue with a quotation of the month. (The calendar of events is given separately on the anchor page and the calendar is updated every 15 days.) If you have suggestions for quotations for our future issues you are most welcome to submit them. By doing so, you will increase the degree of our joint interactive efforts for the improvement of the Monitor.

A report on an EMBS event under “Section Activities” follows next. This excellent report has been submitted by Matt Irwin, 2011 chair of EMBS and has set an example for others in the NY Section to follow. Congratulations, Matt!

At this point we would like to remind the Chapters members of the New York Section of the IEEE that in November 2011 there will be the annual election of the new Section officers for 2012. A call for nomination of the officers by David K. Horn, chair of the nominating committee is posted in this issue that gives the details of the processes.

The IEEE sponsors an international online programming competition for the student members that last year attracted more than 2,500 intellectual warriors. You want to compete? If yes, read about it and enter. The URL for obtaining more information about the rules is given later in this document. If you do decide to compete we wish all the best from our Section.

On June 8 last Dr. Rajeev Shorey, SM IEEE, president, National Institute of Information Technology University (India) and formerly at GM Research Laboratories (also in India), gave a talk on “Emerging Trends in Vehicular Communications” at a meeting jointly organized by VTS/LMAG. After the talk many attendees requested Dr. Shorey for a copy of the slides. Unfortunately, as Dr. Shorey arrived back in India his brother passed away. For this reason he took some time to send the slides. Anyhow, there are now here and you can see and download them by scrolling down from the anchor page.

What follows next is an article written by Mr. John LeGates of Program on Information Resources Policy (PIRP), Harvard University, Cambridge, Mass. Mr. LeGates is the co-founder of the program and it is
being reproduced in installments with the kind permission of the author, PIRP and the Harvard University. Mr. LeGates writes about how it was to grow up with the information age. We have a lot to learn from his experiences. Just before the beginning of the article there are some comments from the editor about the contents of the article and why we decided to reproduce here.

At IEEE-USA we found a book by Prof. Tom Moran that emphasizes this and gives practical ideas for engineers for writing well. You can get more information about the book and how to get it by scrolling down this pdf document or click to arrive at the relevant spot.

A few days ago we came across an article in the New York Times in which the author writes about the art of spelling. The article is both funny and serious. I am sure you would like to read it. But because of the copyright restrictions we cannot reproduce the article here. But we will give you the URL where you will find it. We only hope that in spite of its new subscription policy the Times will allow you to access the site.

Do you know about the two candidates for the presidency of the IEEE? They are Dr. Roger Pollard and Dr. Peter Staecker. Read about both in the IEEE Web site and their own Web sites before you make your decision. You can see the links to these sites by scrolling down from the anchor page. But please do vote. The IEEE needs your participation in this important election. By the way, an interesting point is here is that one candidate is a Life Fellow and the other will join that rank within a few months. It just goes to show the life members are still active and full of energy and experience that they are willing to share with the IEEE for the “advancing technology for humanity.” Life Members live longer and work harder than they did in the past. More than 26,000 active life members of the IEEE provide a pool of hitherto untested pool of talents and experience. Is there anyone for the “Engineers without Borders?”
AN APPEAL

The Monitor appeals to you - student members, members, senior members, life members and Fellows, of the IEEE and their friends and colleagues - for informative articles and reviews on their own fields of activities or personal experiences – travel, a new book, contacts with other engineers - that would be of general interest to our heterogeneous readership. We need your cooperation to maintain the Monitor and its high standard that is so important for all of us.

Thank you!

Section Activities

Brain Computer Interfaces for Severely Disabled Persons

A presentation by Dr. Sanjay Joshi (EMBS, NY: June 28, 2011)

A report by Matt Irwin*

The New York chapter of the Engineering in Medicine and Biology Society (EMBS) hosted a lecture on June 28th by Dr. Sanjay Joshi entitled “Brain Computer Interfaces for Severely Disabled Persons.” Dr. Joshi is an Associate Professor of Mechanical and Aerospace Engineering at UC Davis and recently completed a year as a Visiting Associate Professor in the Department of Neurology at the Columbia University College of Physicians and Surgeons. Our group was fortunate to hear about his work a few days before he left New York to move back to California.

Dr. Joshi spoke about the current state of brain-computer interfaces (BCI), where electrical signals measured from the brain are used to infer user intention and control external devices. He summarized the existing methods for capturing signals from the brain, ranging from non-invasive electroencephalography (EEG) headgear, to electrodes that are placed deep within the brain in rare
clinical cases. Dr. Joshi discussed how his group is using BCI technology to develop assistive devices for severely paralyzed persons.

The majority of the talk focused on his group’s approach for capturing signals at a muscle site instead of reading them directly from the nervous system. In this method, a single non-invasive electrode is attached near the user's temple to measure muscle activation signals. Paralyzed individuals (and grad student volunteers) can be trained to activate this muscle site in two distinct frequency bands, which are mapped to control an on-screen cursor along the X and Y axes [1]. At the start of the training, users typically struggle and visibly contract their facial muscles, but most eventually learn to produce the required signals without any noticeable physical movement. This two-channel control scheme has a variety of potential applications for assistive devices and has been successfully used in Dr. Joshi’s lab to control equipment such as a television and a motorized wheelchair.

At the conclusion of the lecture, the group had a chance to meet and talk with Dr. Joshi informally as he demonstrated a new smart phone interface for their technology [2].


*Matthew R. Irwin is the Chair, New York Chapter of IEEE Engineering in Medicine and Biology Society (EMBS). His e-mail address is mirwin@ieee.org.*
Call for Nominations for Officers of the IEEE New York Section for Calendar Year 2012

The Nominating Committee of the IEEE New York Section is soliciting nominations for the following IEEE New York Section Officer and Chair positions for calendar year 2012:

**Section Officers**
- Chair
- Vice Chair – Chapter Operations
- Vice Chair – Section Activities
- Treasurer
- Secretary

**Section Working Activity Chairs**
- Bylaws
- Chapter Organization
- Historian
- Long Range Planning
- Publications
- Special Events
- Webmaster

The terms of office for the elected Section Officers and Working Activity Chairs is for one calendar year starting in January 2012 and ending at the end of December 2012. IEEE New York Section members in the grades of Graduate Student Member, Member, Senior Member, and Fellow are eligible, as long as they are members in good standing, to hold office in the IEEE New York Section. Please ensure that the individuals or individuals nominated are both eligible and willing to serve in the proposed position or positions.

Nominations should be e-mailed or postmarked no later than August 15, 2011, and should be addressed to the undersigned.

David K. Horn
IEEE New York Section, Chair Nominating Committee
129 Rosemont Avenue
Farmingville, NY 11738
E-Mail: pastieechairny@gmail.com
Do you enjoy competing against your peers? Do you like to win? Did you know that one of the member benefits for IEEE student members is the ability to participate in the IEEE student competitions? IEEEEXTreme 5.0, will be held this year on 22 October. Last year over 2,500 students from around the world competed in the 24-hour online programming competition. Teams of up to three IEEE student members can be formed at Student Branches established at universities and colleges throughout the world. Last year's winners, SurpriseTeam from Belarusian State University, Europe, won an all-expense-
paid trip to the team’s choice of an IEEE event/conference. Check out the IEEEXtreme website, www.ieee.org/xtreme to learn more. Student Branches can register teams starting in September.

Growing up with the Internet Age

John LeGates

Comments from the editor:

The Monitor is now going places. In our quest for reliable sources of information that would be useful to our readers we have just come across a recent article that narrates the experiences of a person who has been “with IT” from the early days when researchers were still struggling to make computers talk to each other. (Mind you, there is no typo or deliberate pun in the preceding sentence! The IT means, you guessed it right, information technologies.) The article was originally written in 1998 and now an updated version has been published by PIRP at Harvard University, Cambridge, Mass. We believe that articles of this caliber will prove not only interesting to our heterogeneous readership but will give guidance to the younger folks as to how a successful multifaceted career in EE and related fields may be built with hard work, a vision of the future and patience, lots of it.

But what is this PIRP at the first place? Let us explain. The letters actually stand for Program for Information Resources Policy. It was the brainchild of two like-minded scholarly personalities, John LeGates and Anthony Oettinger. Remember that in the early 1970s researchers and developers were frantically trying to build ad hoc networking systems. Most developers were secretive about their work and suspicious of the rivals. But companies and individuals rushed into the field of networking. It was like a gold rush. Money had to be made quickly. Many potential users did not quite understand the full implications of networking. Monopolistic telecommunications companies, both private and state-controlled, were the dominant forces in the market and their grips were tight. They stifled the voice of users, small and large, individuals and companies. There was no coherent policy to be found anywhere.
Around that time both LeGates and Oettinger perceived that it would be good to create a neutral environment suitable for impartial studies of the growth of networking and communications and, especially their impacts on society, business and global economy. The studies would be undertaken by independent scholars from all parts of the world and their reports would be published in the form of monographs. Funding would come from companies, organizations and foundations that believed in the philosophy of growth of information technologies for the benefit of their businesses and the entire world. The reports would show where we were going to. They would show successes and failures, benefits and risks of emerging networking and communication technologies and businesses. Hopefully, the reports would be read by decision makers, regulatory authorities and people’s representatives. In other words, LeGates and Oettinger wanted to plant the seed of a high-level think tank, the first of its kind in the field of information and communications technologies. The scope was vast but the available resources were limited but someone had to start somewhere! The combination of the efforts of these two persons and the strategic support from Harvard University could not be better suited for realizing such a lofty idea. Between the two co-founders, they had the intellectual caliber and practical business sense to evaluate proposals for studies at PIRP. Both comprehended the social aspects of the impending networking era. Their names and ideas attracted a few organizations to “invest” in the idea and the PIRP was born. The co-founders soon received proposals for studies. In some cases they also invited researchers around the world to write on specific important topics relevant to countries where they were working. A concrete example is at hand, my own experience. In 1970’s and 80’s I taught and consulted in Brazil and I knew, first hand, how ruinous were the effects of the monopoly of the Brazilian telecommunications authority on consumers and business. In 1992 I received a request from the PIRP to write a paper on the Brazilian telecommunications” published by PIRP in the same year. In the paper I truthfully and impartially described the monopolistic practices of the two state-owned Brazilian telecommunications companies, Telebras and Embratel. The former controlled domestic telecommunications services and the latter controlled the prices of overseas communications and access to the Internet. The company’s policy and pricing was such that would allow Internet access only to the elite and affluent. After the publication of my paper by PIRP I was criticized by both monopolies. Wow, finally we succeeded to shake a few heads at the right places. That was my goal and PIRP provided the platform to air the frustrations of the users of telecom services in Brazil. Fortunately, Telebras no longer exists and Embratel, now in private hands, has lost its monopoly. It would be honest to say that the monopoly did not end solely because of that paper but certainly it contributed that little bit.

Now, a wee bit about the co-founders: LeGates, a mathematician at training from Harvard could see the need and elegance of mathematical formulation and analysis of networks. His interest in this field led to his involvement with the development of early network systems. He worked, among other organizations, at Bolt, Beranek and Newman (BBN) that could boast of supporting many of the Internet pioneers. Mr. LeGates was also a member of the famous ARPANET NWG of the DoD, the U.S. federal agency which funded the seed projects that finally led to the initial deployment of the Internet as we know it today. LeGates also served on the panels of the National Academy of Sciences/National Research Council and the board of the National Telecommunications Policy Conference.

The co-founder of PIRP Anthony Oettinger, a distinguished mathematician joined the faculty of Harvard University in 1954 and later he became the Gordon McKay Research Professor of Applied Mathematics. He is a Life Fellow of the IEEE and now a professor emeritus at Harvard. A description of his
accomplishments would fill pages. You may wish to read more about him and LeGates, the two co-founders of PIRP. If yes, please go to http://www.pirp.harvard.edu/people.shtml.

The Monitor asked Mr. LeGates about the founding of the PIRP program and its purpose. We reproduce his e-reply in the following.

“The Program on Information Resources Policy at Harvard was set up in 1973 by Tony Oettinger and me. Each of us believed that there was no source of decision-making knowledge in the information/communications world that was both well-informed and impartial. We aspired to create such a source, and established rules to ensure both virtues:

“For impartiality, the Program insisted on funding from multiple, conflicting, visible sources and on avoiding activity that could promote favoritism, such as consulting, joining corporate boards, doing classified work and appearing on anyone's platform. All findings would be public and would contain no confidences.

“For competence, the Program researched areas of conflict and confusion in the information world, and had each report critiqued by multiple conflicting sources, both disciplinary and stakeholder, before it was made final.

“To make both virtues work at once, the Program refused to offer solutions, take sides or predict the future. Instead its work is analytical and descriptive.

“The Program's goals and methods, its complete list of funding sources and all its publications are found at www.pirp.harvard.edu. Because most publications describe what's going on in areas of conflict and change, many remain relevant despite the passage of time.”

In the article we referred to at the very outset Mr. LeGates writes about his experiences as a developer of networking systems, an entrepreneur, an author and, more importantly, as a co-founder of the PIRP. Being much obsessed with history of technology I have read many books on early networking and the Internet, and some years ago reviewed a couple of them for the IEEE Spectrum magazine. I found that in his writing, LeGates is candid, funny and, at the same time, dead serious. He takes us to the seemingly mundane conversations between the networking evangelists and skeptics; he gives that personal touch. His informal style of writing makes the reader comfortable. Note that the author writes in present tense and that makes the article even more interesting. It is a treat to read the article. Therefore, in keeping with our ongoing discussions on writing, speaking, other “soft” skills and entrepreneurship for engineers we have decided to post his article in the Monitor. Mr. LeGates has seen a great deal about information and communications technologies (now the combination is known as ICT) from many privileged positions. Thus, even in its concise form the article is long, 76 pages. For this reason, we have to post the paper (exactly as it appears in the PIRP Web site) in installments. We also hope that you will access the Harvard URL given above by Mr. LeGates and learn about both philosophical and practical aspects of ICT. Technology changes but some physical laws, logic and thought processes remain the same. (In the past the papers were available only to the patron organizations and the contributors. Only recently that restriction has been lifted.) You will find a treasure trove of information at the PIRP site; why some projects succeeded while others failed. There are lessons to be learned.
We profusely thank Prof. Anthony Oettinger, John LeGates and Harvard University for their kind permission to post the PIRP article by LeGates published in April 2011. We hope that our readers will enjoy reading what follows below. Enjoy!

IEEE is the largest professional association in the world
INCIDENTAL PAPER

Growing Up With the Information Age

John C. B. LeGates
April 2011

Program on Information Resources Policy

Center for Information Policy Research
Harvard University

The Program on Information Resources Policy is jointly sponsored by Harvard University and the Center for Information Policy Research.

Chairman:
Anthony G. Cetinger

Managing Director:
John C. B. LeGates

John LeGates began his career as an entrepreneur in the earliest days of computer communications and networking. He was the first to put computers in schools and later in hospitals. He built the first academic computer-resource-sharing network and was a member of the Arpanet 'NIW', the original Internet design team. Since 1973 he has been a member of the Harvard faculty, where he co-founded the Program on Information Resources Policy.

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GROWING UP WITH THE INFORMATION AGE
In 1997 I was approached by a writer for The New Yorker magazine, who asked if they could do a "life and times" article about me. It would be the feature article in one of their issues - a minimum of twenty pages. Alternatively it might be longer, and be serialized over several issues. The interest in me came from my (perceived) role at Harvard as the ultimate insider in the evolution of the information age - someone who worked with and understood most of the major players. Before Harvard, I had been an entrepreneur in computer networking, and was a pioneer in some of its most visible applications.

He and I agreed that the main weakness of this idea was the high level of confidentiality of my relationships. I had kept secrets at the time, and I intended to keep them now - I would not write a "tell all" story. Going by those rules, I prepared this piece. The intended audience is the writer who would prepare the article(s). My notes are therefore hopelessly egocentric, completely unpolished and entirely unedited. They are a kind of "career and times" biography of me, a review of the evolution of the information world as I participated in it, and a partial history of the Program on Information Resources Policy at Harvard.

As a history of the Harvard Program, it is only a sample. It covers the revolution in telephony and computer communications from 1973-1997, principally in the United States. Comparable stories could be told of the Program’s involvement with media, postal services, intelligence, the military, information services and related phenomena from 1973 until 2011.

In 1998 Tina Brown resigned as editor of The New Yorker, and the interest in me disappeared as well. These notes end with that date.

Computers in Education 1965 – 1967

I am 24

The great changes in “The Information Age” began before I went to work, and they didn’t end when I retired. But my career saw transformational growth both in the way the information world worked, and the way it affected the entire world. I saw the transformation from “The Industrial Age” to “The Information Age”. I played a role myself in making all this happen, and was in a good position to witness what was going on.
In the early sixties, the “Information Age” meant the “computer age”. “Computer” meant what we now call “mainframe”. The vacuum tubes were gone and machines were transistor-based. But they were big, expensive, hard-to-use, esoteric machines. If you wanted to use one, you learned a programming language and spent endless hours punching your instructions on Hollerith cards. Then you applied humbly to the priesthood who ran the machine, took your place in line, and waited while your job went through. The machine would do only one job at a time and gave you no feedback along the way. If you did everything right, you got your results. If not - better luck next time.

Then came one of the milestone innovations - time sharing. “Time sharing” was not a real-estate concept, but a new layer on the operating system combined with a new generation of input/output devices. It began the democratization of computing. Several people could simultaneously use a machine, each appearing to have it to himself. At the same time a number of “high-level application languages” sprung up which were far easier to learn and use than the incumbent “machine languages”. For the first time a user with limited computer skills could control an operation and even interact with the computer in real time and get error messages and intermediate results. Simple modems appeared, and the user could stay at home or the office. Remote personal computing was now possible using a terminal that looked like an ordinary typewriter. Time sharing was the first form of computer communications and networking - nothing more refined than having a terminal that could access a computer that wasn’t in the same room you were. At the time that I started, the number of simultaneous terminals - the new world standard - had just increased from four to eight.

Time sharing was developed together by MIT and a small Cambridge consulting company named Bolt, Beranek and Newman, Inc. (BBN). MIT, a non-profit educational institution, promptly decided to make money off the invention. BBN, a for-profit corporation decided to explore how it could be used to help the education process. Someone on the search committee knew me and I got the job.

BBN had been founded in 1953 by three MIT professors as a consulting company in acoustics. In the early days an employee named J.C.R Licklider had a request for management. It went something like this:

“Buy me a computer”.

“What will you do with it”?

“I don’t know”.

“Do you know how to work one”?

“No”.

“Do you know what it has to do with your work here”?

“No”.

“Why do you want one”?

“Because it’s the tool of the future”

They bought it.

Licklider went on to found computer science at MIT and become the central figure there for a whole generation. BBN went on to become a hotbed of computer innovation. It probably shares with Xerox PARC and Bell Labs the record for the most significant innovations in computer history - and a comparable reputation for failing to capitalize on them. While I was there it came to be called “Cambridge’s third university”. Bright people from all fields gravitated to it when their ideas didn’t fit anywhere else. I remember being impressed with the originality and productivity of these individuals. It was entrepreneur-nerd culture long before the words became popular. It was a “we are the smartest people and we are transforming the world with our ideas. There are no rules but those we make” culture. It was perhaps arrogant. It was in any case a very enjoyable environment for me.

Computer science didn’t exist yet as a field. Many people came from electrical engineering or applied math, but some of the best came from English literature, art history, philosophy and anywhere else. Richard Bolt, the Chairman always regarded himself as an artist (painting and music composition) first and a physicist almost by accident. The first person to be granted a computer science degree by Stanford, Alexander McKenzie III, showed up at BBN, but that was a little later. He was, it happens, an old friend of mine from New Hampshire. His father had personally measured the highest wind ever known on earth on top of Mount Washington.

If there was a category of person within this melange, it was the MIT dropout. MIT was a high-pressure grind with a very heavy reliance on numerical techniques, and (at least compared to Harvard) a very rigid curriculum. Undergraduates were selected pretty much by quantitative aptitude and achievement test scores. People who developed other interests often left. They were bright, full of ideas and inexpensive to hire.

I was vastly less impressed with the bureaucracies that grew when research ideas succeeded and got government grants. These bureaucracies would then turn into grant-searching engines, painting themselves whatever color the money seemed to be looking for.
Despite my youth and inexperience, I had a free hand. I wasn’t so much exploring new territory as creating it. I was handed some computer time and connection ports, a language (Telcomp, a member of the JOSS family and I believe written by BBN), some terminals - the legendary and legendarily unreliable Teletype ASR 33 - and a vague mandate to the effect of “go see what this can do for education; and try to make some money if you can”. No one had ever tried this before and there were no guidelines.

There were related notions cooking within the company that I could take or leave, depending on how it was all going. Wallace Feurzeig was running a project on basic learning, which included Seymour Papert and the development of the “Logo” language. Paul Castleman headed a group researching the use of computers in medicine.

I didn’t like the word “terminal”, which I thought could make computing sound like a serious disease. Since we seemed to be making everything up, including the terminology, I lobbied instead for “station”. But I was overruled by the hardware people. It was my first experience of the product reflecting the mind set of the supplier rather than the intended user.

I had to make some decisions pretty fast. Within the first week I shaped the assignment to mean:

- Computers in educational institutions
- At the high school and college levels
- Dealing principally with science and math
- Both to use in teaching science and math, and as a tool for scientists and mathematicians
- Beginning in New England, and especially in the Greater Boston area
- And scrounging resources (telephone lines, applications programs, documentation help etc) for free whenever possible.

I published a price list and started selling.

Two years later I was still a one-man department, but I had grown a gratifying little empire. It was decentralized like the Holy Roman Empire; perhaps I could better compare it to a big jazz band. Everyone improvised, but I got to call the tunes.

We had about 75% of all the schools in the world that were using computers connected to us - and even paying for the privilege. We had produced a substantial body of teaching and applications software, which was being widely published and shared. We produced courses not only in the use of computers, but also in the use of computers in math and science, and in the use of computers in the teaching of math and science. Students and teachers - at least some of them - seemed to love it and benefit by it. We had evaluation projects underway to see if any of this made a difference. There were beginning to
be serious grants at the federal level to develop and evaluate the field. Massachusetts had assigned an Assistant Commissioner of Education to spend two years at BBN and decide whether we should be the model for a statewide initiative. There was a parallel effort in BBN to sell Telcomp connection to the business world and develop a major profit center. We were starting to be visible, not only regionally, but nationally. I had personally done the first stages of all of these activities, but others quickly took up my initiatives and ran with them. I became a kind of initiator, encourager and organizer for the whole field.

There were two aspects of our innovation that seemed especially promising.

One was the motivational force of the computer. Students got very excited about it. Anecdotes poured in about kids giving up playtime to get their chance at the terminal. Kids who had never shown an interest in science suddenly came to life and did well. Kids would come into the school at midnight to use the terminal if someone would let them in. Was it the novelty “gadget” syndrome? Was it the non-personal, non-judgmental nature of the machine? Were kids somehow wired to love information technology? It was too early to tell.

The other was that it introduced a kind of thinking that was otherwise absent from the traditional curriculum. We called it “iterative logic”. Wally Feurzeig told a cute story on himself. He asked a class of fourth graders what held the world up. “It rests on the back of a giant turtle”. “Very good, and can anyone tell me what holds the turtle up?” Same kid: “another turtle”. Wally was getting excited - it looked like a breakthrough in iterative logic. “Can anyone tell me what holds up that second turtle?” The same boy stood up: “Listen, mister, I’ll tell you the whole story. It’s turtles all the way down.”

During the Watergate crisis, Dr. Bolt, the Chairman, was chosen to head the panel on the Nixon White House tapes - the famous 18 ½ minute gap. He reported that the tape had unquestionably been altered. The White House representative rose and demanded “we insist on an evaluation by OUR people.” Bolt calmly responded, “we thought we were your people.” There were no further objections. His ability and integrity were beyond question. I have always believed that his humanity, endless good will, and enthusiasm were the real cause of BBN’s particular kind of flowering. Over time, we became close friends.

I became very visible, not just to my cohorts but with the public. I bought some blue shirts because white shirts were too bright for television. The notion that computers were coming was permeating America at the time. But the notion that it was coming to your school stirred up a new level of attention. How can I get in on it? What will it do for (or to) my child? This is important, but is it real? Will it break the unions? Will it slice the budget? Can we dispense with buildings and learn at home without teachers? Will a computer-delivered curriculum mean that we’re only taught by the best teachers? Will we all have the same curriculum nationwide? Will all students in ten years achieve at the level of the best students now? This was kid-philosopher heaven).
Oddly enough I was a booster of what I was doing as a trial, but not as an outcome. I doubted that this would bust the unions, eliminate the bricks and mortar and make teaching something we only did at home. What’s more, I was leery of prophecy in general. The debate was fun and important, but I didn’t see it as a tool for discovering where we would all go. That I argued, we would know if we ever got there.

I remember one conference at which I was only an attendee, but not a speaker. A young Harvard Professor named Anthony G. Oettinger began his remarks “The reason society has tenured positions at major universities is so that the holders of those positions can stand opposed to the trend and tell it like it really is”. He proceeded to demolish everything every other panelist was saying. He was almost completely ignored.

Two encounters with other worlds impressed me with a “we/they” difference:

One was the aforementioned Massachusetts Undersecretary of Education. He and I wound up spending many hours together, usually giving presentations to large groups in public colleges. He was a man with an undeniable affability and good nature. His role evolved into making a few introductory remarks about how Massachusetts was in the lead in this exciting endeavor. Then I would give the substantive presentation and answer all the questions. It slowly dawned on me that he couldn’t have done it. He didn’t understand a thing - about computers, research, education - not a clue.

But he took me under his wing and gave counsel and advice, for example on reimbursement for travel expenses. “You can charge the maximum for meals, even if you don’t spend it. Put the difference in your pocket. After all, you’re entitled to it.” I never knew if he was at BBN because he was the outstanding thinker in the Mass. Department of Education, if he was there on exile because he was hopeless, or if it was just random.

When I first met the Commissioner of Education for New Hampshire I set out to break the ice by mentioning my relationship with his Massachusetts counterpart. After my first sentence, an instinctive repugnance took over his countenance. “We don’t do things here the way they do them in Massachusetts.” I had insulted him.

Another encounter was the experience of offering identical courses to two different groups. One was students at Lexington High School, the other was math faculty at Massachusetts State Colleges (most of whom held Ph.D.’s from similar institutions). The Lexington students learned the subject, and then took it over and innovated. The college faculty could never grasp the rudiments, even by the end of the course. Was it the difference in age - or worlds with different standards?

This promising beginning looked like the explosive start of a new way of doing things, which would of course mean profits for the business and a career for me. But there was something else going on as well. Telcomp was losing a standards war.
We got started first, but a similar effort soon started up at Dartmouth. John Kemeny, head of the math department had a vision similar to ours. But he had what turned out in hindsight to be some key advantages. One was his prompt promotion to President of the University. Another was the competence of Tom Kurtz, the man who became head of the computer center - forming a team. This meant a top politician, a seasoned executive, a substantial budget, and a “captive” university. But more important, they were using a computer language (BASIC) with the backing of a major computer manufacturer, General Electric. No comparison showed that BASIC was better than Telcomp - quite the reverse. But GE had worldwide sales capability, and slaughtered BBN in the commercial markets. That gave BASIC the critical mass in written applications, and the handwriting was on the wall. We education people were essentially a bump on the elephant of the commercial world. If Digital Equipment Corporation (DEC), who supplied our hardware, had adopted Telcomp; if our Mass Department of Education man had been a Kemeny; if I had been sensitive to the larger political and business dimensions of growth, perhaps it would have come out differently. But we were beginning to lose clients because we didn’t run in BASIC.

Regardless of who succeeded and who failed, computers-in-education was off and running, and would move without me. I was approached by a former BBNer who dangled a good salary and an exciting new challenge. I took it.

Thirty years have passed (to 1998), and where are we?

In the secondary schools computers are in a quarter of the classrooms, mostly to teach about computers. The unions haven’t been busted, the bricks and mortar are still there and curricula are swinging back to the traditional subjects and methods after a movement driven by “liberal thinking” and not by technological innovation. Scholastic achievement is no higher than it was in the sixties; in fact it appears to be lower. We have at this very moment another unfunded national initiative to “revolutionize education” through the wonders of the information revolution. Professor Oettinger was closer to right than the others on his panel.

Higher education is centered on the disciplines. Computing has profoundly penetrated most disciplines, largely as a tool. As such the tool is taught along with the other tools of the discipline. The changes in the disciplines have driven the changes in teaching, and not the other way around, and in that sense computers have gotten into education backwards.

Hospital Information Systems 1967-1969

“MBH (Man’s Best Hospital)” or “The competing WASP establishment across town” is what Samuel Shem called it in his cult classic House of God (meaning Beth Israel Hospital). Regardless of moniker, Massachusetts General Hospital in the late sixties was the flagship of the Harvard Medical School hospital system, a major medical research center, the site of the invention of anesthesia, and one of only a handful of 1000+ bed hospitals in the country. It was and is a “tertiary care” hospital, meaning that you go to your doctor, who sends you to his local hospital, and if they can’t handle you, they send
you to MGH or its counterparts. MGH patients have included a contingent of kings, sheiks and tycoons who could afford and only wanted “the best”. It also routinely has the most difficult cases referred from around the world. Nonetheless 97 percent of patients admitted are discharged alive. The rest left via a quiet back door labeled “deliveries” (not unlike the department in which some of them were born).

By the late sixties there were already a number of experiments, startups and research projects poking around in “computers in medicine”. Indeed, one of the best known was at MGH under the management of Doctor Octo Barnett. However when MGH decided to implement the world’s first hospital integrated information system, it opted for a fresh start built on a non-medical background. It selected Washington Engineering Services Co. (WESCO), whose reputation was built on a massive piece of software called NPQ. NPQ maintained a relational database of naval ships. If you wanted to change something on a US Navy ship, NPQ told you what other parts would be affected, and how. From a logical point of view, it seemed as good a choice as any. Once again I was doing something never done before and there were no guidelines.

WESCO set up an office ten minutes walk from the hospital and hired a small but strong team, which included the chief designer of the SAGE system. MGH itself assigned about 30 of its own people to work with us. The grand plan was to start with tracking patients, rooms and beds; and then expand incrementally into medical record tracking, medical record content, pharmacy, laboratory, blood bank, billing and accounting. It was an administrative system in a medical environment. There was no plan to be involved in medicine itself, except as support.

I was initially in charge of man/machine interface, but quickly evolved to be overall technical director, and then in charge of the whole project, reporting to the head of the Cambridge operation. Then as the company grew I also headed the marketing effort and was #2 in the company.

Why did I rise so quickly and find myself in charge of people who had so recently been my peers? It was certainly not because I could do overall systems design, or write software, or other technical tasks better than they, or even as well. In retrospect I think it was my ability to communicate with all parties. I could understand and speak the language both of the users and of the technical people who were trying to design something for them.

We chose the then-brand-new IBM 360-40 as the mainframe computer. In those days computer systems were notoriously unreliable, and it was customary to minimize risk by building a whole system from components of the same maker. Ours, however, was too diverse, and we opted for terminals from Sanders, software by ourselves and so on.
IBM was already by far the biggest player in the computer business, and in the eyes of the public almost synonymous with it. When doing my public appearances for BBN, I was often introduced as “The IBM man”. The company was enjoying some unusual advantages.

Because of the risky nature of any computer installation, the manager in charge could expect trouble. There was a built-in need for ass-covering. One way to do it was to buy IBM. “It wasn’t my fault, I bought the best-known product, and even it failed”. IBM could also use technical standards as an anti-competitive tool, and became almost synonymous with this technique.

There was considerable debate as to how IBM had gotten to this formidable position. It hadn’t been first in the market. Univac and Sperry, now long gone, were ahead of it. Nor did it bring the biggest company to the computer business. G.E., for example was bigger. Nor did it have the best technology. Experts almost uniformly agreed that others were better. BBN, for example preferred DEC hardware. The usual explanation was that the pioneers were thinking like technology companies, whereas IBM was basically a marketing company. And as a marketing company it had done a lot of things the customer needed in the shaky early computer days. It offered software bundled into the hardware, good customer support, and end-to-end service. It was also widely agreed that the big diversified companies who had moved into computers - GE, Honeywell, Exxon - never understood how computers differed from other products.

The 360 series, however, was to elevate IBM to even grander heights and give it yet another advantage. The 360 was the first modular mainframe. As your needs grew, it would grow too, without obsoleting your investment. It was also technologically in the league with the best. By the time the 360 was retired, IBM was four times as big as the rest of the industry put together. IBM’s R&D budget was greater than the combined gross revenues of all the computer manufacturers in Europe. IBM could now keep ahead of the industry by staying ahead technologically.

“Computer networking” had now progressed. Conceptually it still meant “access by remote terminal to a mainframe computer”. But the whole thing worked pretty well, and the number of connections was up in the thirties (off-the-shelf), and approaching one hundred (the cutting edge).

Our grand plan for each application had four stages. First, understand the current information flow. Second, rationalize it. Third, automate it. Fourth, hand it over to the hospital as a turnkey system. We had built fudge factors into the budget for fixing computers that didn’t work, for training computer-illiterate hospital people, for doing things twice and various other presumptions of uncertainty.

MGH admitted about 100 new patients a day, and had half that many internal transfers. Matching a patient with a room included matching him or her to the right level of luxury payment (a single, a quad etc), the right disease type (infectious respiratory, psychiatric etc.), the right level of care (intensive, pre-operative, long-term etc.), and other requirements. For each admission, there was a form with information about the patient. It had an astonishing 92 information fields, including food allergies,
religion and mother’s maiden name. It went to dozens of places, including the medical records room and the laundry.

Even simple identification of a patient could be a problem. Boston has had strong immigration from Ireland. “Sullivan” was the most common name in MGH’s medical records. There were 30,000 “John Sullivans” down there.

The information flow was not only complex, it was also full of bugs and glitches, some of them potentially life-threatening. A recent internal sample had suggested that almost half of all laboratory reports were erroneous (wrong patient, wrong thing measured, wrong number copied down, sent to the wrong place etc.).

Our project fell behind schedule almost from the beginning. We would interview people about what they did, write it up and hand it to them for review. Their response: “Oh, it’s not at all like that.” Then we would find the sender of information disagreeing with the receiver about what was transferred. Then we found that what we had measured was the formal flow of information. But there was a whole separate informal flow that people couldn’t articulate. Then we discovered people lying about what they did in order to protect their turf.

All these problems were as nothing compared with the resistance to “rationalizing” the information flow. We were destabilizing the ways things were done, many of which had evolved rather than being assigned, were dependent on personalities or crossed department lines. People had to ask their boss what to do about our innovations. Bosses had to ask bosses. A few years later, when hospital management information system development was widespread, a study showed that 60 per cent of information entered into some systems were deliberate lies.

And of course the equipment didn’t work as advertised. Because we were using equipment from different manufacturers, we had to connect them using interface specs. These in turn proved to be inaccurately documented, or got changed without notice when products were updated.

A year into the project, the first functions were somehow starting to work. But we were way off schedule because we were way off course. The hospital meetings had escalated into a weekly hour with the head of the hospital and his direct reports. They were rethinking the whole management structure of the place. Our project had caused them to go back to basics - or more precisely - examine the basics for the first time.

Meanwhile we were also having fix-it meetings with our vendors, mostly IBM. We would produce long lists of things that didn’t work as documented. They would look sheepish and set off to fix them, in many case product-line wide. During the course of our work there was a landmark case (not with us) in which IBM was held not liable for damages caused by its systems not doing what they were claimed to do. The reason: computer systems and manufacturers were presumed not to perform as claimed, and it was a
“caveat emptor” market. A joke of the period asked what the IBM salesman did on his wedding night. Answer: spent it talking about how great it was going to be.

There were, of course, recriminations and finger-pointings, including at us. We, after all, were also not delivering as promised. But most of the gouging was at lower levels and didn’t hurt the big picture. Overall the quality of our high-level interactions was superb. The hospital recognized that they were into something bigger than expected and of real value. IBM saw us as the prestige contract that could open a huge market, and made commitments to us at very high levels. They always tried hard to make sure that nobody felt embarrassed, and delivered the fixes and patches we needed. They often became the fall guy, since theirs was the simplest thing that wasn’t working, and they always took it like gentlemen (I remember no women on the IBM teams). The stresses of other early major development efforts were usually far worse than ours.

We had no way to know it, but we were at the leading edge of many intersecting confusions. Collectively they added up to the turmoil of computers hitting management reality.

Part of the problem was, had been and has continued to be C.P. Snow’s "two worlds". Computer people come with a deeply-ingrained scientific mind set. They expect things to function in a structured, articulable, way with an optimal solution (or solutions). Managers, by contrast, need flexibility, secrets, personalities, invisible substructures.

Computer people differ from other scientists in that they expect their product to be full of bugs, and constantly under revision. Managers need stability, and helpers (including machines) that do what they say they will.

There has remained a mutual distrust. Computer people often look down on managers as unable or unwilling to learn computer language and logical thinking; also as inflexible for failing to adopt innovations as quickly as they appear. They feel that they have to do the managers' work for them. A more subtle form of this attitude is the periodic berating of customers by computer people for failing to take advantage of the latest technology. Rob Wilmot, Chairman of ICL (The leading British computer manufacturer) spent a year touring Europe with charts showing how little of the available computing power users actually used, and urging them to shape up. The managers' counterpart feeling is that the techies don't understand the basics of the business and refuse to translate their offerings into English. Their gadgets need to be fixed before they work right even the first time. They want to redesign them before they've built them.

Another fundamental hardship is that the introduction of computers requires a top-to-bottom rethink of procedures that are being computerized. The procedures usually weren't thought through in the first
place - they more likely evolved. The automation demands a what-is-this-really-about, back-to-basics examination.

And that examination usually winds up challenging the corporate knowledge that has become embedded in the organizational structure. Departmental functions change and lines get redrawn.

And that in turn means that people lose and gain influence, stability, corporate hiding places and career paths.

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**Founding Companies 1969-1972**

A new formula for success was starting to make waves in the business world. “Found a new company and grow it with a new technology or market niche. Own equity. Sell it. Be rich”. The era of the startup and venture capital had been around for a while, but it was starting to roll.

Meanwhile my own curiosity was pushing me towards a new realm. I had started as a child scientist and turned into a young philosopher. I had selected a career. I had a pretty good grasp of how “thinking technology” functioned, and was getting a handle on the behavior of management structures. Each step seemed to me just a more mature level of the same inquiring instinct - I wanted to understand how things work. Now I was ready to explore the whole life cycle of organizations. It was time to found a company.

We spun off the Cambridge office of WESCO as Cambridge Information Systems (CIS). WESCO kept much of the stock, and we raised a chunk of new money from venture sources. The Cambridge head became CEO, his first such position. I was #2 (EVP) in charge of the MGH project, and the company’s technical and marketing efforts. I had stock options that would mature with continued employment.

Our work with MGH was being billed as “time and materials” consulting, and was profitable for us. However we aimed to develop hospital management modules, which we could resell as proprietary products, with additional tailoring and training as a time-and-materials service. We would have better margins than consulting provides.
I launched a local marketing effort, which brought in another contract, Boston City Hospital. Meanwhile, as part of the MGH medical records project, we had attacked the automation of cataloging, taking out, and refiling some three million documents. We developed one of the first bar-code readers. We launched a separate effort to develop and market it as an independent product line.

Boston City Hospital was another very large hospital. The City ran it, but in conjunction with all three Massachusetts medical schools. Harvard, Tufts and Boston University, used it as a teaching facility. It was said that the emergency ward provided the best crisis-care experience this side of Vietnam. They needed to upgrade the medical records system, and then move on to rebuild other systems.

“Upgrade the medical records system” sounded fancy enough to get funded, but when we got there, we found that it had a simpler meaning. The national accreditation committee was coming around in three months, and the medical records department was going to flunk. The accreditation code required records to be back on the shelf shortly (a month, I believe) after the patient was discharged. There was a big backlog. We were to clear it up.

The system was in severe disarray, with dysfunctional people (probably patronage jobs), and no orderly procedures. They had no idea how big the backlog was or how to fix it. Meanwhile the Medical Records Director occupied a spacious, well-furnished office and paid no attention to the problems. The same day he signed the $40,000 contract for us, he signed a $285,000 one to redecorate and refurnish his office. His secretary worshiped him.

In a few days, we redesigned the whole system so that it worked. Then we spent the bulk of the money to use Boston’s pool of cheap, talented students as shlevers. The average unshelved record was two years old. The most recent was four months and the oldest twenty one years. One patient had sixteen different records. How did they get past the last accreditation?

We did the job and the customer was overjoyed. We started developing proposals for more important things with BCH. I launched a nationwide sales campaign by mail. I approached all the non-V.A. 1000 bed hospitals (about twenty). There was favorable response - all we could handle.

Meanwhile our team was developing a wholly unexpected problem. Our CEO seemed to get a personality transplant along with his new title. He became isolated, autocratic and inconsistent. He started having an affair with one of the MGH group leaders. Instead of the team talking problems through, we were handed solutions, orders and deadlines - many of which didn’t make sense. I started getting feedback from our potential partner on the bar-code reader, and from MGH that he was impossible to work with. One of our long-term senior people told me “after I leave here, he’ll be the only CEO I’ll look back on with no respect or affection whatsoever”. I, as #2 man, should do something. But what?
I was relieved of the problem on a Thursday afternoon about two o’clock. He stormed into a group meeting virtually apoplectic and purple with rage. He announced that I had been working on the new BCH and the non-Boston hospital contracts for a month and nothing was signed. I was incompetent. I was fired.

Within two more months, the core team was all gone. Within a year, so was the company, and it brought WESCO down with it. MGH moved forward with the project on its own, sometimes using other consultants. The MGH-IIS (Integrated Information System) has been a success.

What a difference a single personality can make! Three years later I met him on the street. He was all smiles. He now understood that nobody else was making sales that quickly either. He’d been wrong to fire me. Perhaps we could start another company. Would I come to dinner? I found excuses.

Although I had moved on from BBN, I kept my friendships with colleagues and customers there. Three of us thought we saw a business opportunity. Computers had become smaller and cheaper, and could handle more terminals. Terminals were more reliable, cheaper and easier to use. The BBN/Dartmouth model had been to connect remote users to a centrally managed mainframe via telephone lines, and charge them for the service. We envisioned a smaller model in which a school would own a “minicomputer” and set up terminals in the classrooms or laboratories. We knew how to build the teaching modules and we had the contacts to sell them. We would place them as turnkey devices in schools, along with tailoring and training. We could use materials and knowledge that we had developed ourselves, and that were also emerging from Dartmouth and elsewhere. We would build it in BASIC. We would have a mix of consulting and product margins.

Shortly after I left CIS, we founded a company - Computer Advisory Services to Education, or CASE. The filing fee was $25, and the legal work $75. There was no outside money, and we were the only employees and shareholders.

From the beginning we were in demand as consultants. But like most entrepreneurs, we worked at night and on weekends to develop the business plan for the minicomputers. We learned how to formulate a proposal with cash-flow, profit-and-loss, and assets-and-liabilities budgets. We negotiated a tentative Original-Equipment-Manufacturer agreement with DEC, giving us a 40% discount.

DEC was thriving by building “minicomputers”. These were smaller than IBM-type mainframes, and offered far more power per dollar. IBM seemed to have missed that niche. DEC was a lively, loosely-structured exciting place, which attracted the same kind of people I had seen at BBN. Riding that niche, DEC would become the world’s second-largest computer maker. But as it got big, it would lose its edge. There would be endless debates about whether it could be more structured and still keep the spirit and the people. DEC would in turn miss the microcomputer market and go into a decline.
Ken Olsen, the founder and CEO of DEC provided an introduction to American Research and Development (ARD), who had backed them at their start - and thereby become legends. We presented our plan to General Doriot, the CEO.

ARD turned us down, converting CASE into a successful small consulting company.

A small consulting company is a good way to make a living, but not a great one. In most of them, you spend two-thirds of your time selling yourself, and the other third doing billable work at triple your pay. (We were spared that problem, customers lined up outside our door) On the positive side, you are your own master and you have the prospect of building a larger consulting company and making more money. On the negative side, the work is uncertain, the hours long, and the impression that you are your own master partially illusory - you are also your customers’ slave. It is hard to get rich selling the company, because you are its principal asset.

We considered the conundrum: we’re doing well and making money. But we’re using up time in which we could be doing better and making more money. After another year or so, we decided to simply close it down. [The rest of this paper will be continued in the next few issues . . .]

**Book recommendation**

Amitava Dutta-Roy

We have discovered that the IEEE-USA is a great source of information. Members can purchase many downloadable e-books from its Website. The topics covered by these books are wide. The books are inexpensive, immediately available, no shipping & handling fee and no taxes.

The readers may remember that last month we published an article on soft skills for engineers by Carl Selinger, a noted expert on teaching such skills. We also attached a video clip. No soft skill is more important than the ability to write well, convey your ideas to your colleagues, your boss or the prospective investors in your company. More often than not engineers think that to learn and practice to write well is not worth the effort. Mr. Selinger gave instances in which your writing skill can really affect your career.

At IEEE-USA we found a book, “Writing for Success – An Engineer’s Guide” by Prof. Tom Moran that emphasizes the need for writing well and gives practical ideas for engineers for writing well. The book consists of four volumes out of which the first two are available from IEEE-USA. Each volume (29 pages) costs $9.95.

I have gone through both volumes and found the writing style of Prof. Moran very inspiring. They are not the usual “Learn to Write in Sixty Minutes” kind of books. He is thoughtful and deals with the
weaknesses of a typical engineer. Being an engineer himself and having gone through various stages in his professional career he knows the art of writing very well. He shows how to plan whatever you are writing and for whom. Is it intended for your boss, your colleague or a meeting that many might attend? He reminds you to have in mind the results you desire from your writing. Then he draws charts (in a typical engineer’s style charts) that you should construct before you start writing. I find both volumes a good deal for the money and would recommend to all our members who may want to write well.

Here are the descriptions of the contents of the book provided by the IEEE-USA:

**Writing For Success — An Engineer’s Guide — Volume 1**
This book is not a technical writing text. Its purpose is to serve as an inspiration and guide to help engineers approach their writing tasks with the same confidence and skill that they take to the technical problems that confront them so that emails, reports, test-plans, and other documents they write are as useful and successful and valued as their engineering efforts.

**Writing For Success An Engineer’s Guide — Volume 2 — The Road to Excellence**
Good writing comes from hard, diligent work. Engineers understand what that means in their profession. In writing, that effort means giving our writing a close read, and testing it in every way. As in our engineering efforts, these tests are conducted to identify problems. And when problems are found, we must then develop effective solutions. With writing, these tests involve using our critical eye to detect any aspects of our writing that are unclear, wordy, vague, inaccurate, missing, or unneeded. We understand the purpose of our writing and read it, edit, rewrite and reread it, until we are sure it accomplishes that purpose as directly and effectively as possible.

Now, before you spend your money on the books you may want to know about the author, Prof. Tom Moran. Here goes his abridged bio:

Tom Moran is a professor in the Center for Multidisciplinary Studies at Rochester Institute of Technology. He holds a BS in Mechanical Engineering from California State Polytechnic College and a MS in Mechanical Engineering from California State University at Long Beach. He did additional graduate study in aerospace engineering at the University of Southern California.

Moran was a research engineer at the Jet Propulsion Laboratory (JPL), worked on the MILES simulator program at Xerox Electro-Optical Systems, the B-1B aircraft at North American-Rockwell, the MD-ll aircraft at McDonnell Douglas Aircraft and various aircraft and satellite programs at G&H Technology. While at JPL, he studied writing under Lillian Richter, wife of Cal Tech seismologist and physicist Charles Richter. Subsequently Moran has written 13 books and has had articles appear in numerous publications, including the Los Angeles Times, Washington Post, Seattle Times, Los Angeles Magazine and California Living.
I am sure you would like to search for more books published by the IEEE-USA. You will find the link by scrolling down from our anchor page.

Are you a spelling bee?

Amitava Dutta-Roy

The other day I came across an article, “The Price of Typos” by Virginia Heffernan in the Opinionator Section of the New York Times of July 17, 2011. The author initially makes fun of the people who do not correct typos. Gradually, she gets serious about the contemporary problem of typos, spelling mistakes due to ignorance, mistakes by celebrated authors. She discusses about the editors and publishing houses. I found the article fascinating. You will find the link to this article by scrolling down from our anchor page.

This is the end of the July issue of your Monitor

Thank you for visiting our Website and we hope that you enjoyed reading it

Please visit us again; we will be back with a new issue in August

Keep cool