The engineer at large

Corporate support of research greater than commonly believed

After a 10-year upward trend in corporate support of academic research in the United States, the amount of such support given is significantly larger than is generally believed. This is surprising considering the downturns in the business climate during the past 10 years.

So concluded a report the National Science Board delivered to the President and Congress. The report, *University-Industry Research Relationships: Myths, Realities, and Potentials*, said that in most recent public discussions of industry-university relationships, between 3 and 4 percent of academic research and development is attributed to industrial sources, but that this figure underestimates industrial support for academic research and graduate students. The underestimation occurs, the report said, because (1) major research universities sometimes do not report R&D expenditures from industrial sources; (2) industrial gifts and loans of scientific equipment are rarely included in the data base; (3) many universities do not count gifts for research from corporate-sponsored foundations as industrial support; and (4) an estimate of the portion of unrestricted corporate gifts of operating and capital funds eventually spent on research facilities, equipment, and faculty and student fellowships is also missing from the data base.

The report stated that "there are sound reasons to believe that we may be at the threshold of a permanent new state of corporate-academic research relationships," but said that though more resources can become available if universities move closer to a partnership with industry, the universities may relinquish some of their unique capabilities for unrestricted exploratory research and freedom of action. The ultimate basis for a healthy strengthening of university and industry cooperation should be increased understanding of each other's role, the report concluded. Single copies of the report may be obtained from the U.S. Government Printing Office, Washington, D.C. 20402.

High-tech corporations plan 1983 engineering staff increases

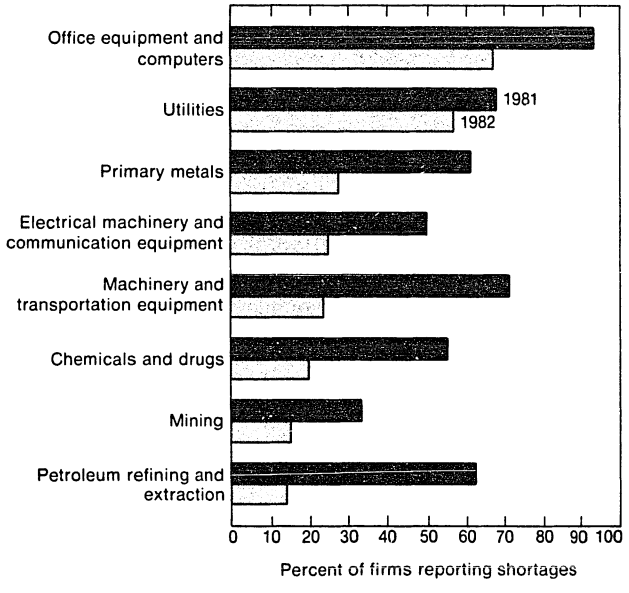
An employment and salary survey of 1102 high-technology corporations throughout the nations showed a great deal of optimism for 1983 engineer hiring. The survey, conducted by Robert & Roman Inc., an engineering recruitment organization in Fort Lee, N.J., found that 68 percent of the responding corporations plan to hire at least one engineer and 53 percent plan to hire four or more engineers in 1983. The highest percentage of planned hiring was reported in New England and Washington, D.C., the lowest in the Pacific Coast region. Most respondees planning to hire engineers would prefer engineers with three to five years experience.

The median salary indicated by respondees for 1982 was $24 788 for an engineer with one year experience, $29 697 for an engineer with three to five years of experience, and $36 412 for an engineer with 10 years of experience, all with B.S. degrees. Engineers with advanced degrees received an average 11-percent higher salary than those with B.S. degrees only. The respondees indicated that 1983 salaries for engineers with B.S. degrees will be approximately 5.4 to 9.1 percent higher than 1982 salaries.

Engineering and science firms find it easier to hire graduates

Regardless of the industry, firms surveyed by the National Science Foundation reported that it was easier to hire recent graduates in 1982 than in 1981 [see Fig.]. But though difficulty was generally reduced, major shortages of new graduates were still reported in computer, electrical, and electronic engineering; computer science; system analysis; and electric utilities.

Defense-industry employers also reported shortages declining in most fields, though more than 30 percent of the defense contractors surveyed still reported shortages in the availability of electronic engineers.



Percent of firms reporting shortages of new graduates in engineering and science by industry for 1981 and 1982. Data not separately available for industries are not shown. Source: National Science Foundation

Employment Guide for Engineers offered by U.S. Activities Board

The IEEE U.S. Activities Board Employment Assistance Task Force has published an *Employment Guide for Engineers and Scientists* to provide U.S. members with job-seeking suggestions. Copies are available at $7.50 for IEEE members and at $10 for nonmembers from the IEEE Service Center, 445 Hoes Lane, Piscataway, N.J. 08854, catalog number UH0156-0.

Role of electronics in photography increases

Chemistry is losing its monopoly on photographic technology, as filmless electronic still cameras and electronic image-enhancing systems for film negatives have been demonstrated by major companies and Eastman Kodak Co. of Rochester, N.Y., has indicated a commitment to combining electronics with chemistry to develop new products.

Hiring patterns, however, may give the clearest picture of the future of electronics in photography—Kodak has created a separate electronics division and has lately been hiring two electrical engineers for every chemical engineer.

Salaries for electronics engineers outpace inflation

Growth in opportunities for engineers in the electronics industry is significantly outpacing the general economy, according to a study recently completed by Engineering Career Associates of Sunnyvale, Calif. The study reviewed compensation for 17 professional positions, including engineers who are individual contributors, in management, or in sales or marketing, and also reviewed emerging trends and new technologies. It concluded that electronics-engineer salary hikes far exceed the annual 4.6-percent inflation rate recently reported by the U.S. Bureau of Labor Statistics.

For a free copy of the results of the study, write to Engineering Career Associates, Department DX-80. Box 7100, Mountain View, Calif.

Thin-Film Recording Head

IBM

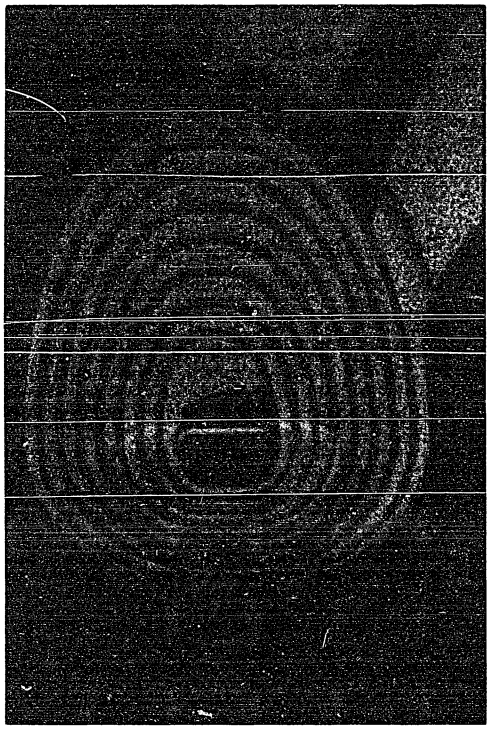
To: Bob
From: Bill
Subject: IBM Technology

Here's the partial list I promised you of our past and present technological achievements. There are lots of things here that should be of real interest to the scientific, engineering and academic communities. What's your choice for the next topic in this series?

Vacuum tube digital multiplier
IBM 603/604 calculators
Selective Sequence Electronic Calculator (SSEC)
Tape drive vacuum column
Naval Ordnance Research Calculator (NORC)
Input/output channel
IBM 608 transistor calculator
FORTRAN
RAMAC and disks
First automated transistor production
Chain and train printers
Input/Output Control System (IOCS)
STRETCH computer
"Selectric" typewriter
SABRE airline reservation system
Removable disk pack
Virtual machine concept
Hypertape

System/360 compatible family
Operating System/360
Solid Logic Technology
System/360 Model 67/Time-Sharing System
One-transistor memory cell
Cache memory
Relational data base
First all-monolithic main memory
Thin-film recording head
Floppy disk
Tape group code recording
Systems Network Architecture
Federal cryptographic standard
Laser/electrophotographic printer
First 64K-bit chip mass production
First E-beam direct-write chip production
Thermal Conduction Module
288K-bit memory chip
Robotic control language

Bill -
I think the story of our disk technology is a winner.
Bob



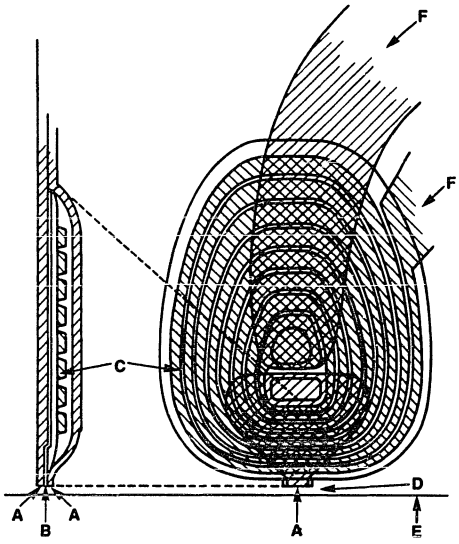
Copper conductor coil of thin-film recording head in the IBM 3380 disk file.

No matter how fast the central processing unit of a computer becomes, many applications will be limited by accessibility to stored information.

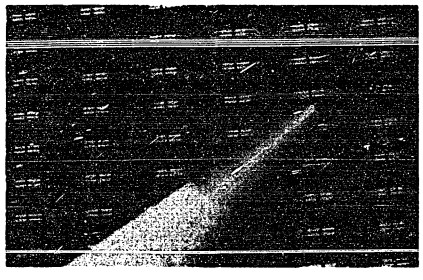
IBM's RAMAC, announced in 1956, was the first commercial magnetic disk storage system. The technological leadership which made RAMAC's development possible continued through the 1960's and 1970's and eventually resulted in the first "thin-film" recording head used in a product. The key to this IBM achievement was several inventions which led to the development of a process for manufacturing such recording heads.

Today, the IBM 3380 Direct Access Storage Device (DASD), which incorporates this technology, is the most advanced disk product available. This disk file can store more than 2.5 billion bytes of information and can read and write at the rate of 3 million bytes per second.

Thin-film heads are magnetic recording heads which contain thin layers of materials. The materials are deposited and shaped on a ceramic substrate using a variety of techniques, including photolithography. These techniques have made it possible to create thin-film read/write



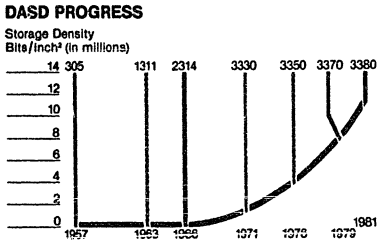
Two views (side and front) of a schematic cross section of the thin-film head showing the pole tips (A), pole-tip gap (B), conductor coil (C), air layer (D), disk surface (E), and signal conductors (F).



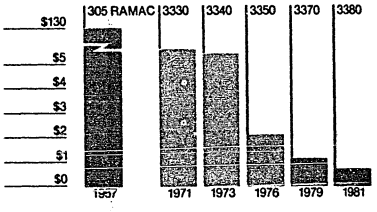
Multiple thin-film heads before slicing into individual slider units.

Thin-Film Recording Head

The curve of DASD progress shows an increase of almost four orders of magnitude in storage density over the last 25 years.



Compared with RAMAC, the industry's first disk file, the 3380 can store 6000 times more information per area of disk surface at 150 times less cost per byte.



heads with precise geometries. For instance, the gap between the pole tips is less than 25 microinches.

The mass production of thin-film heads has been accomplished by combining novel ways of using technologies such as etching, sputtering and plating. IBM scientists and engineers have been able to attain the efficiencies of batch fabrication (more than 2.5 million thin-film heads had been shipped as of the end of 1982) while at the same time maintaining strict control over the electrical and dimensional parameters.

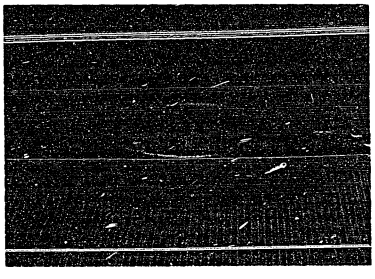
As the magnetic disk rotates (at a constant 3600 rpm) it creates a film of air upon which the recording head "flies" at a height of less than 13 microinches, a distance shorter than the wavelength of visible light. The thickness of the coating on the disk surface itself has been reduced from 1200 microinches to less than 25 microinches, a factor of 48 improvement over the RAMAC disk file.

Such improvements in disk technology have produced a significant increase in the storage density of disk files. For example, the number of bits of information stored on a disk has increased from 2000 bits per square inch in the RAMAC to the 12 million per square inch found in the IBM 3380. The thin-film head in the IBM 3380 achieves more than 800 concentric recording tracks per inch across the disk surface, 40 times greater than the RAMAC disk.

The vast improvements in DASD storage density—almost four orders of magnitude in the last 25 years—have been essential to the continued growth of advanced online, realtime computer applications such as airline, car and hotel reservations, electronic banking and many other forms of interactive computing.

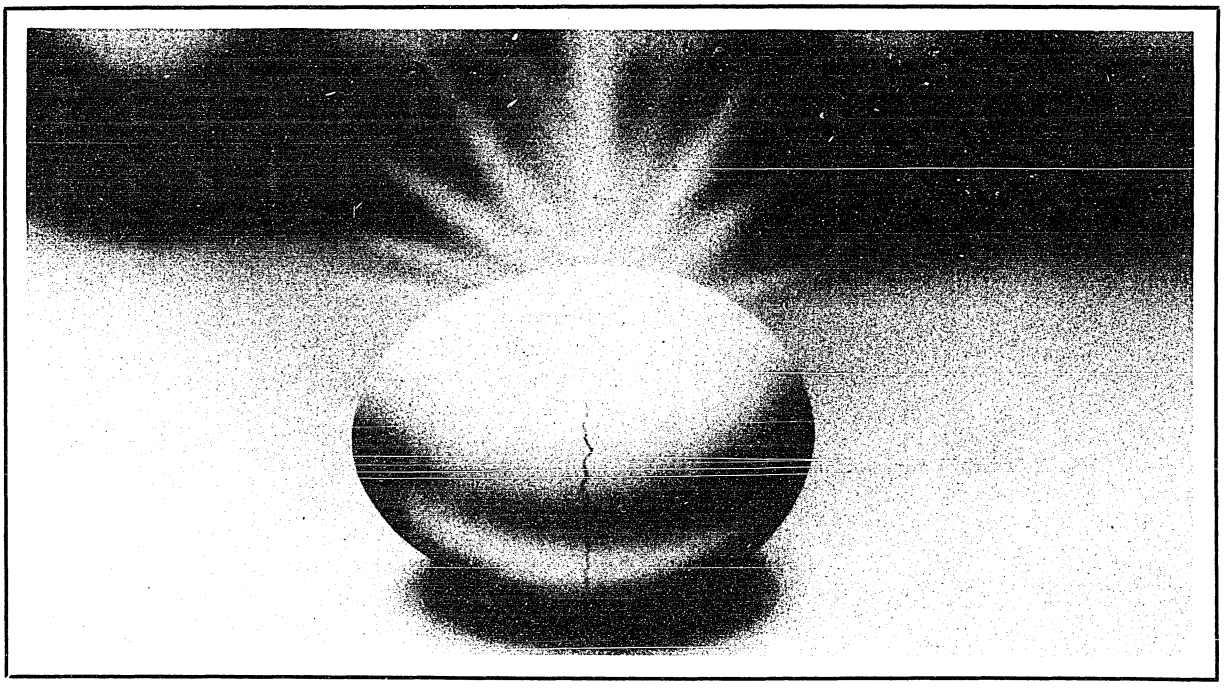
One of the impressive achievements of DASD technology has been the dramatic reduction in the cost of storing information. In 1956, the RAMAC file stored one million bytes for $130 per month. Today, the IBM 3380 stores the same million bytes for less than $1 per month.

IBM scientists and engineers worldwide have contributed to the development of thin-film recording heads and disk storage devices. These contributions are only a part of our continuing commitment to all areas of research and development in general, funded with more than $8 billion over the past six years.



A 3380 suspension arm, carrying four sliders, and disk.

A recent article in the IBM Journal of Research and Development was devoted to IBM disk technology. For a free copy write: IBM Corporation, 5600 Cottle Road, Dept. 293 0290, San Jose, CA 95193.



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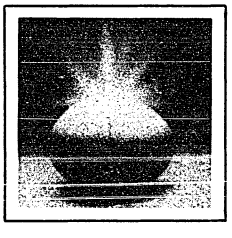

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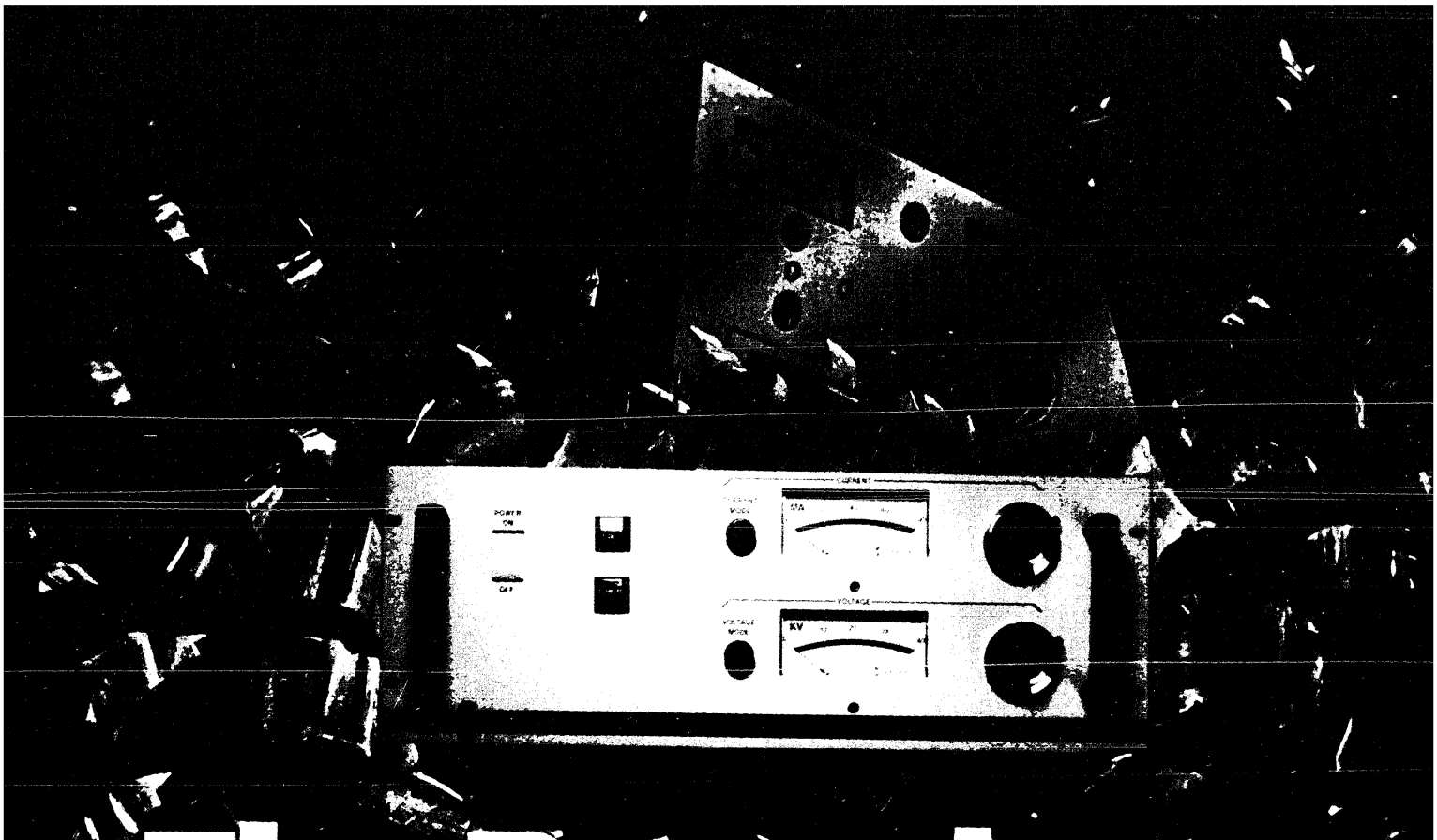

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Spellman

High Voltage Electronics Corp

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The National Security Agency

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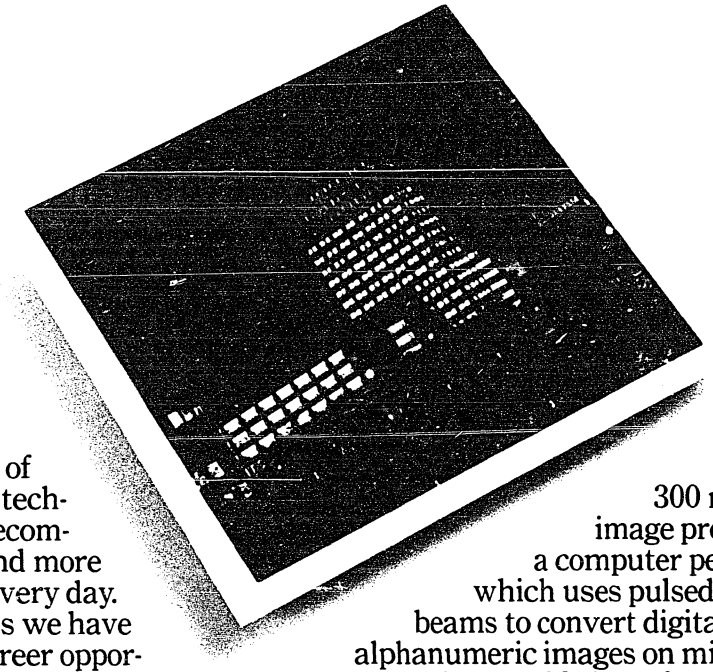
One of the nation's top companies in sales of electronics-related equipment is Kodak.



Kodak's application of electronics technology is becoming more and more extensive every day. That means we have growing career opportunities for electrical/electronics engineers.

In projects as diverse as the design and production of output driver chips for the logic and control unit of Kodak Ektaprint copier-duplicators. Development of advanced analog and digital technology and sophisticated software techniques for blood-chemistry analysis with the Kodak Ektachem 400 analyzer. And exploration of potential product improvements in the Kodak Komstar 300 micro-image processor, a computer peripheral which uses pulsed laser beams to convert digital data to alphanumeric images on microfilm at speeds up to 20 times faster than many ink-jet paper printers.

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