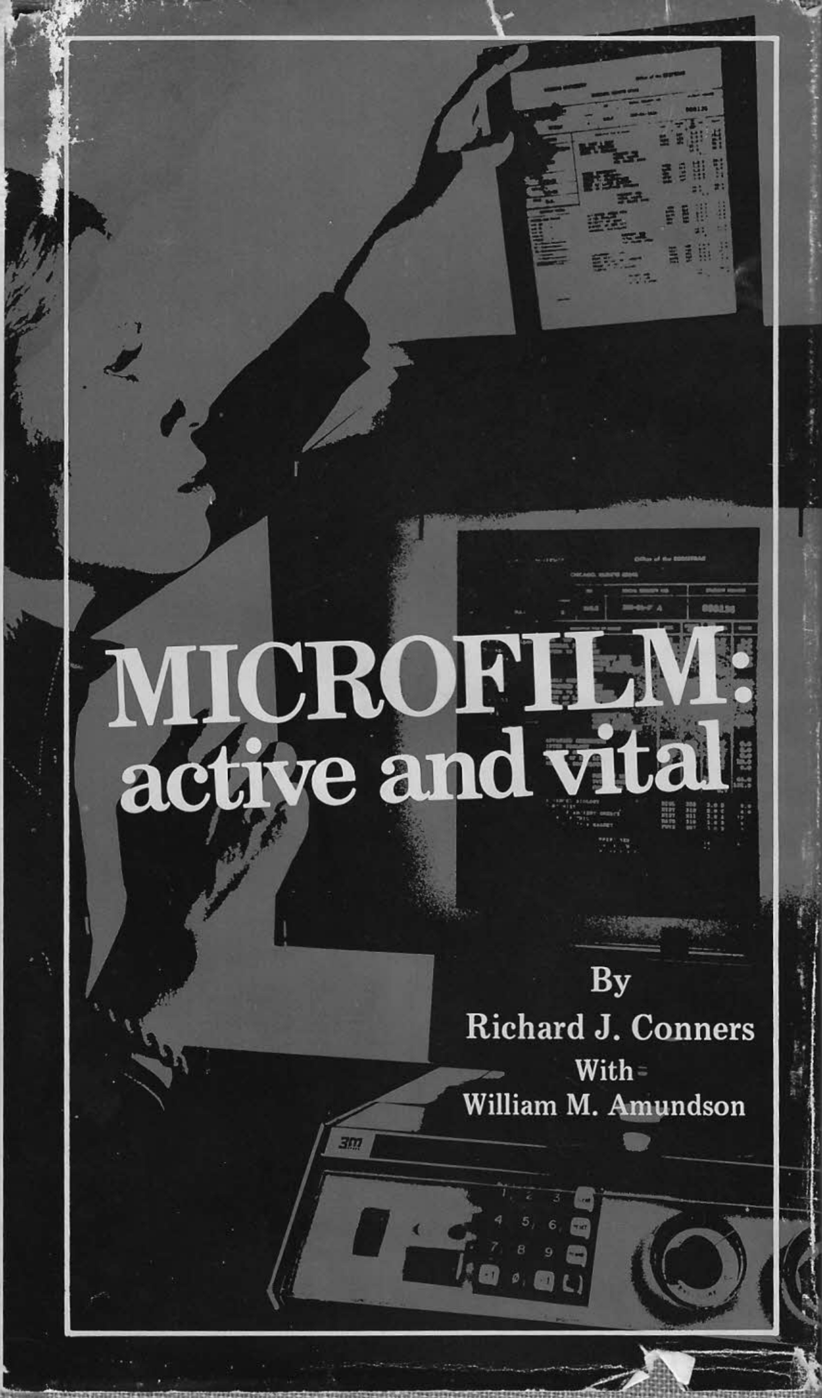

MICROFILM: active and vital

By

Richard J. Conners

With

William M. Amundson

$4.95

Art Kutchera

Art -
All I know about
microfilm - in one short lesson!
The best to you
Dick [illegible]
4-19-76.

MICROFILM: ACTIVE AND VITAL

By Richard J. Conners

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many of its current applications across the spectrum of society, both here and abroad.

Much activity has been compressed into a relatively few years. The scope of this book does not permit giving credit to all who have taken part, and contributed greatly, to an exciting span of years. But those who are omitted, from whichever part of the microfilm industry they serve, are no less a part of the accomplishments outlined on these pages.

D. W. "Scotty" McArthur
Vice-President
Microfilm Products Division
3M Company
St. Paul, Minn.

September 1975

INTRODUCTION

Microfilm. Many people still conjure up pictures of spies, lurking around with cameras at the ready to record secret documents on 35mm film. But, espionage uses — though famous and colorful — represent only transient episodes in a story of remarkable progress and steady growth.

Microfilm has long since come of age, passed out of its frisky adolescence, moved into robust maturity. Today, it gives vital service to business, government, science and education. It has helped bring order to our lives and discipline to our tasks. It has made possible systematic management and communication of information. It has freed us from the prospect of wallowing in a sea of paper. It has been married to the computer, and the union is proceeding very nicely after some uncertain early days.

Microfilm touches your life every day. It is likely that your birth certificate is recorded on microfilm, the title to your property, your marriage license, your medical history, your employment record, your credit history, your bank checks.

When you travel by plane, microfilm helps speed your way. When your automobile gets sulky, microfilm records will aid in its speedy recovery. When you reach age 65, a microfilm record of your Social Security contributions will speed retirement payments to you.

What does microfilm, in its various forms, accomplish? The purpose of this book is to answer those questions. How does it serve business, government and culture today?

Let's start by looking at the years after World War II. Business broke loose. Not only in this country, but in other nations as well.

It was estimated some years ago that business was spewing out some 25,000 documents a year for each employee. It wasn't only the incredible amount of space this paper output was taking up; there was the problem of managing the often haphazard mountains of information, making it quickly accessible to provide the directions that all levels of commerce and government must have. The game of helter-skelter is a costly one.

Security and preservation of records also are a vital consideration. It is known that a large majority of businesses that lose their records through one means or another go out of existence. And original documents can be worn out from years of constant handling and reference.

Mailing quantities of paper has always been expensive, especially recently. Mailing microfilm, in any of its forms, is cheap.

Paper itself is expensive. Microfilm is far less costly.

Everyone is familiar with the simplicity and speed of dialing telephone numbers, either with the standard finger-rotating technique or the more recent push-button method. It is as simple as that to bring up a microfilmed document from among

hundreds of thousands or even millions of pieces of material.

Microfilm is international. In fact, some of its more storied early uses — before it became an active tool of business and industry everywhere — were by non-Americans.

The famous Russian spy, Richard Sorge, brilliantly and daringly used microfilm in Tokyo in the days before and during World War II. Tall, handsome and suave, he passed himself off to the Japanese as a German newspaperman. Under that guise, he gained access to military and industrial installations. The microfilmed information he

This is not typical of how records were stored before the introduction of microfilm, but some organizations did (some still do) have a rather haphazard system. (Courtesy: Delaware State Archives.)

transmitted to Moscow materially helped the Russians in their war strategy.

Hans Fuchs, Igor Gouzenko and Colonel Penkovsky all used microfilm in espionage. All were skilled in handling miniature cameras.

But if wars and intrigue marked its early days, microfilm came to fill more pressing daily needs as our business structures and government became more complex and the job of handling data became literally impossible with paper.

Make no mistake about it. The need for wider applications of microfilm technology was urgent in our nation's recent past. It takes only a slight exercise of the imagination to visualize what life would have been like without it.

PAPER ARMAGEDDON?

Imagine a nation buried in its own paper — literally. It could have happened.

The nation's capital inoperative. Scores of huge complexes, dwarfing the Pentagon, needed just to house a spreading malignancy: filing cabinets stuffed to overflowing with paper records. Finally, the capability of man even to find his own vital records is overwhelmed. Government workers are lost for days in a tortuous maze of files, and rescue operations cannot keep pace. The census operation breaks down, Social Security records cannot be located, defense department activities are hopelessly stifled, welfare payments cease. Government, wallowing in a sea of paper, is completely helpless; its machinery sputters and dies.

It is a paper plague. Chaos and anarchy are its products, spreading, engulfing the nation and the world.

Of course, the prospect of this happening seems incredible. But, fortunately, we can leave the matter in the hands of science fiction writers, because we know now that it won't happen — microfilm technology gave us the resources to avert the paper deluge.

The story of microfilm is not unlike the stories of many of our other technologies. It came because it had to come. It came because men, who sensed the emerging needs for benefits microfilm could provide, were willing to push through the pioneering work of development that had to be done.

MICROFILM: ACTIVE AND VITAL

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1

Microfilm Beginnings

Nobody can say precisely when microphotography began. The passage of more than 100 years has shrouded its beginnings.

It is known, however, that in 1839 John Danzer of Manchester, England, installed a microscope lens of sorts in a camera and produced a microphotograph of a document.

But some time in those mid years of the nineteenth century the French took over. In that era when the daguerreotype and the first sheet films were being developed, a Frenchman, Rene Dagron, is said to have obtained the first microfilm patent in 1859. He was the man responsible for the "pigeons over Paris" that microfilm history buffs like to talk about.

The time was during the Franco-Prussian war in the 1870's. Paris lay under seige. The enterprising Dagron circumvented the German lines by a simple but, for those days, spectàcular device. He photographed critical messages on film small enough to be banded in a tube attached to the legs of carrier pigeons. The birds flew the films over the German lines and into Paris, where they were projected and read by French military leaders.

During the course of the war some 2 1/2 million messages and documents are reported to have been successfully flown into Paris. But despite the spectacular nature of that wartime achievement,

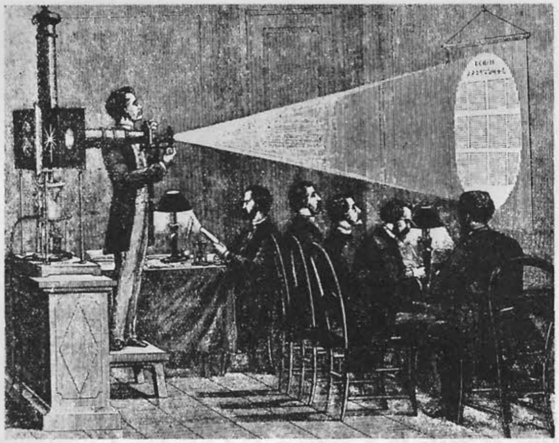


Illustration of a primitive microfilm projection system, circa 19th century. (Courtesy: The Bettmann Archive.)

microphotography mostly lay dormant for many years, even though it had proved itself nobly.

Nobody seems able to explain why microphotography did not take hold faster than it did. Dagron, with his pigeon post service, dramatically demonstrated many of microfilm's advantages, particularly its space-saving and weight-reduction capabilities, its ability to preserve and protect valuable documents, and its extreme flexibility of use.

Little of importance happened to microfilm again until the 1920's, when the scene shifted to the United States. A banker in New York invented a camera that would make a positive record of checks that were returned to depositors or forwarded to other banks. The camera utilized a panoramic method of photography in which the document to be photographed and the film would travel together past a slot while the picture was being taken in synchronization.

What did this mean? Principally, that the bank could maintain a legal record of transactions, economically and quickly. It meant new security for records. It meant that time-consuming handwritten descriptions of checks would have to be made no longer.

The banker's name was George McCarthy, and he deserves a high place of honor in the history of microfilm.

Another surge forward? Not really. Progress was still slow, as it has been with so many other technological breakthroughs in our history of almost reluctantly accepting solutions to problems.

Other banks, however, perceived the advantages of microfilm — even if slowly. They saw that here, in McCarthy's development, was a way to produce economically an actual facsimile of a check, complete with all of its endorsements. If any problems arose, the bank had access to it. And the retention and storage of hundreds of thousands, and even millions, of microfilmed checks required little space.

Other businesses began to fall in line. Insurance companies, libraries, newspapers, governmental agencies. Here was a way to preserve and protect documents of all sorts. Security was the watchword.

But during this rocky period of our history, when the stock market plummeted, the depression set in, fascism was spreading in Europe, and a powerful leader with the initials of F.D.R. began to revamp much of our social structure, microfilm remained primarily a static medium. The exceptions were few.

Three "F's" characterized microfilm's use in those days. Film, file and forget. Roll film, at that time, was hard to handle. To find the particular document you wanted on a roll required a lot of "search" time. Access and retrieval were problems.

THE IMPETUS OF WAR

Many persons now in their middle years had their first experiences with the benefits of microfilm in the wartime years that followed the strike at Pearl Harbor on December 7, 1941. Right after that date, the U.S. government went into the microfilm business in a big way — and in a very visible way.

The name of the business was V-Mail.

Millions of our young men were in military service, scattered throughout the world. Battle-weary, scared and lonely, they were eager for the personal comfort of news from home, for letters from family, wives, sweethearts and friends.

Uncle Sam was not insensitive to their needs. But he knew that there were problems of transporting millions of letters, as well as the expediting of delivery to the waiting G.I.'s.

Microfilm, proven in a long-ago war, was the answer. Perhaps a billion letters from this country to soldiers overseas were reduced onto microfilm for shipment. At their destination point they were photographically enlarged into readable copy. It was by far the biggest microfilm venture up to that day. It had a solid humanitarian base.

But other developments, far less visible to the general public, were developing to push the microfilm industry a few more paces forward.

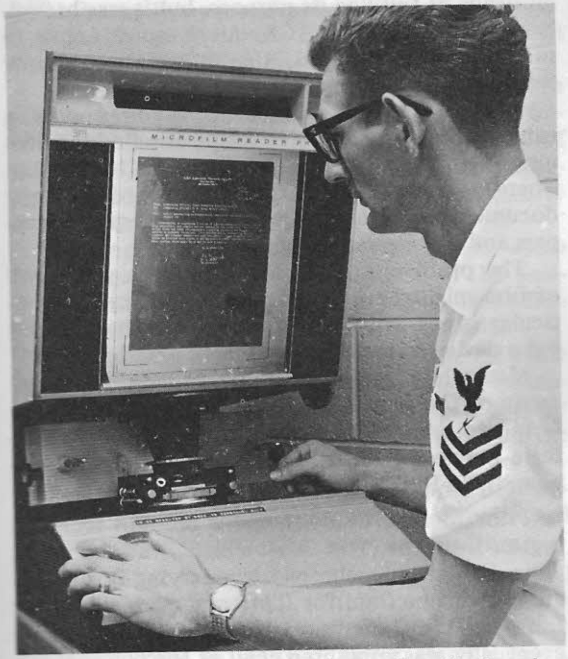
The frantic moments of improvisation that followed Pearl Harbor brought about a lot of strange needs. For example, the government, finding itself committed to fighting in areas about which relatively little was known, appealed for all possible kinds of information that might reveal something about the topography and other characteristics of enemy territory.

The response to this need was fantastic. Photographs, postcards, maps and all kinds of material from the public and from education, business,

publishing and other sources poured into Washington.

But having boxes, crates and cartons stacked in corridors and rooms and basements — having all these receptacles and areas strewn and overflowing with the material that streamed into Washington in all shapes and sizes — created a problem of horrendous size.

How to classify? How to find, from among the hundreds of thousands of pieces of material, the



The U.S. government turned to microfilming during World War II. Uses have since expanded greatly. Photo shows a reader-printer in use at the Pearl Harbor submarine training facility.

picture of that hydroelectric installation or that bridge in enemy territory? How to get it quickly to military intelligence?

The responsibility was assigned to a new organization, the Coordinator of Information (COI) in Washington. It was headed by Robert W. Sherwood, playwright and author. His advisor was Richard de Rochemont, the man who produced the newsreel feature, "March of Time."

Up until this time, roll microfilm was used exclusively. It fulfilled its purpose, but it was basically a storage medium. If frequent, quick access to material was required, the information simply would not be put on microfilm.

The process was simple: it required only a camera, film, and a device for positioning the document to be recorded. The film was 16mm size. There also was 35mm film for recording larger documents such as engineering drawings, newspapers and other publications.

The problem at the time was that a whole roll of film might have to be searched to find the particular image you were looking for. There wasn't yet a device to make such a search practical.

Meanwhile, we were in World War II, where many of the functions of the COI had been transferred to another new agency, the Office of Strategic Services (OSS), headed by the colorful William "Wild Bill" Donovan.

Prior to this, de Rochemont brought to Washington from the West Coast a classification expert, John F. Langan, who had been trying to develop an efficient method for filing and retrieving stock films held by the motion picture industry. He eventually was appointed chief of the pictorial records division of the OSS which, by the end of 1942, was receiving half a million photos each month. Standard 8 by 10-inch glossy prints were made from those considered useful.

Photographs were stacked in forbidding piles. The prospect of continually having to search through hundreds of thousands of these each time a particular print was required seemed appalling. Indeed, it appeared to be an impossible task.

Langan, however, had begun to explore this problem a couple of years earlier. He had started with the idea of mounting a frame of film in a tabulating card. An earlier experimenter, Dr. Atherton Seidell, had advanced the possibility back in 1934, but nothing practical had come of it.

But the needs of war had not been present at that time. Nor had the money.

Early in 1943 — the war a little more than one year old — Langan pushed his experiments forward. He began testing ways to attach a frame of microfilm in an aperture cut into a standard tabulating card. This took some doing, particularly with respect to finding the right adhesives.

Nothing seemed to work, until Langan came upon large sheets of plastic adhesive in the basement of the National Archives Building. This adhesive was used to laminate valuable documents.

The material was perfect for his needs. He made some 300 microfilm aperture cards, cutting rectangular holes in the tabulating cards with a razor blade. Then he stuck frames of microfilm in the apertures with the adhesive.

And the process worked, launching a new microfilm format, another important step toward making microfilm an active, everyday medium.

Langan next worked out a coding and punching system which, hopefully, would make it possible to machine-select and retrieve individual aperture cards according to many different classifications. IBM equipment was enlisted, and the experiments were a success almost from the beginning.

Now, for the first time, the way was clear to manage the huge files of strategic photographs that had been piling up.

Without the system developed by Langan (with the help and encouragement of men like Dr. Wilmarth S. Lewis, head of the OSS central information division, and the cooperation of IBM representatives), it is unlikely that the U.S. could have achieved some of the military successes it did in those years of the early 1940's.

2

World War II Ends; Progress Slows

The war hastened the development of the microfilm aperture card as a means of information management and storage. But after V-J day in August, 1945, the aperture card was confronted with the job of proving itself in peacetime.

The benefits were to be dramatically demonstrated in the years ahead. Other microforms would emerge to meet other miniaturization needs more precisely. But the job was to take the combined effort and skill of many men.

Among them were Col. Atherton Richards, who had served as deputy director of OSS during the war, and William J. Casey, who was chief of intelligence for the OSS in the European theater. Having had direct experience with the far-reaching capabilities of the microfilm aperture card system, they began to cast about for peacetime developments.

Logically, Langan came into the picture again. He had applied for patent rights on the system during the war, and the two former OSS officials acquired a license from him. They formed Film 'N File, Inc. With this move, the skeleton of an organization to promote and sell a microfilm system was present, but that was about all.

The embryo company needed some kind of manufacturing facilities; it needed sales representation. American business was almost completely unaware of microfilm, except as an oddity. But the paper mountain was growing in those bustling catch-up days in American industry that followed the war.

Film 'N File officials cast about for a firm that could develop and manufacture equipment for making, mounting and reading aperture cards. They decided on a paper-handling equipment manufacturer, the Dexter Folder Company of Pearl River, N.Y. Then the need for sales representation took priority. The first organized effort in this area was conducted by an independent microfilm dealer in New York, Richard W. Batchelder. He was an early expert in microfilm development and had served as a part-time civilian advisor to the OSS.

But, the going was slow. How do you sell a hard-headed businessman accustomed to paper the idea that a tiny piece of microfilm mounted in a tab card will be a superior record keeper for him?

About this time a former newspaper reporter, who had been attached to General Eisenhower's headquarters during the war, came onto the scene. He had been impressed with the potential of the microfilm aperture card for handling administrative paper work. His mind was churning with an idea for a unitized business record that combined microfilm and punched cards.

The man's name: A. X. "Robbie" Robbins. His missionary zeal impressed Richards, and Film 'N File had its first full-time employee. His job: make a comprehensive study of how business and industry could apply microfilm technology as a practical, working tool.

Roughly coincident with this development was contact made with another firm, the McBee Company, which subsequently agreed to handle national distribution of the Film 'N File microfilm aperture card systems.

In 1947, a law enforcement agency, the St. Louis Police Department, was an early customer to see the potential of microfilm in aperture cards. The department had the problem of speedily handling and identifying "mug" shots. They found a remarkably successful answer in the microfilm aperture card system.

Still, at this time and for some years to come, the bulk of what microfilm business there was came in roll form, which provided the maximum security most users sought. One thing, however, that roll film at that time could not provide was accessibility. Finding an image consumed a lot of time and tied up a roll on which other vital materials might also have been reproduced.

The disadvantages were recognized by two men in the title abstract field. They were Russell Ellsworth and John B. Bell, who operated the Idaho Title Company in Boise. They were impressed with the advantages of aperture cards as demonstrated in a presentation made to them by a Salt Lake City consulting firm, Business Engineers, a distributor of Film 'N File systems.

There was, however, a real problem: equipment — cameras, mounters and viewers to handle large title instruments. Those seemed soluble problems, and Bell and Ellsworth moved to obtain sole distribution rights for Film 'N File systems in the title and abstract field. They agreed to purchase millions of aperture cards if Business Engineers could deliver 300 inexpensive viewers and 100 low-cost cameras with the cut-off devices they needed. It would be necessary to supply cameras for every county in Idaho, and provisions would have to be made so that as few as 10 or 20 frames of film could be exposed each day without exposing an entire film. Bell and Ellsworth tried unsuccessfully to develop the equipment themselves.

Here is where a man who has played a major role in the development and expansion of the microfilm industry entered the picture. He is D. W. "Scotty" McArthur, who was service manager for Business Engineers. Although McArthur had done outstanding work in modifying and improving equipment serviced by his firm, he had virtually no photographic or microfilm experience. As a tribute to his ingenuity, McArthur was assigned the job of building the microfilm camera and viewer.

A Salt Lake City plant was selected as subcontractor. McArthur then journeyed to the Church of Jesus Christ of Latter Day Saints in Salt Lake City. He sought practical know-how at a church that was one of the largest users of microfilm in the country. Microfilm was — and still is today — used by the Mormons to maintain extensive genealogical records of its members.

The camera assigned to McArthur for development had to accomplish tasks that exceeded the capabilities of most microfilm cameras used in those days. Existing cameras used as much film per frame as needed, varying according to the size of the document being photographed. McArthur designed the first camera geared specifically for aperture cards; the length of film pulled down for each frame was constant and matched the size of the aperture.

There were additional camera innovations necessary for the title and abstract field. The new camera permitted daily removal of the exposed film without affecting the rest of the roll. A cutoff device provided a day's "take-off" of the exposed film. McArthur's camera also had the capability of making partial exposures so that both the back and front of a document could be photographed on the same frame.

The camera, and a low-cost reader also developed by McArthur, met the special needs of the title people in a dramatically provable way. Installed in

each of Idaho Title's branches, the system reduced costs from 19.5 cents to 3.9 cents for each document reproduced.

Microfilm had proven itself and was on its way in the title field. Ellsworth and Bell now had a real story to tell. And for Scotty McArthur, a significant new career had opened.

But the title field was only a minute part of the commerce of the country. Microfilm now had to branch out and prove itself in other fields and applications. The pioneers in the emerging industry were themselves convinced that other rich markets were out there, but the question was how to develop them.

3

Microfilm Moves On, and So Does the Aperture Card

The new camera and viewing equipment received accolades from New York. Scotty McArthur was invited to the East for special meetings. The Dexter Folder Company, impressed with the new units, contracted to build several hundred over the next several years.

Richards of Film 'N File sought to hire McArthur. On a summer day in 1950, the two men met and discussed the future of the microfilm aperture card system. Richards offered McArthur a job as chief engineer of Film 'N File.

Modern-day microfilm aperture cards provide a convenient, compact, low-cost method of filing and maintaining important data.

Meanwhile, some of Richards' high-level contacts began to show signs of paying off. He knew the famous and influential president of General Electric Company, Charles E. Wilson, and one day showed the giant firm's chief a microfilm aperture card.

Wilson referred Richards to Arthur H. Rau, a GE engineering administrator in consulting services. Rau momentarily brushed aside the obvious potential of microfilm for keeping all kinds of business records and persisted in exploring its uses for engineering drawings.

At the time, GE, like many other industrial firms, was recording its drawings and other engineering documents on roll film for security purposes. But they were mostly just being filed away, and Rau was concerned about their ready accessibility in the event of a disaster.

There were problems of reduction ratios and the size of the microfilm aperture that would be necessary. It should be noted that GE's largest drawing size was 36 by 48 inches. What would be the minimum reduction ratio for a document of that formidable size? What would be the maximum reduction to make the drawing readable when enlarged? Calculations were not difficult. It was determined that a reduction ratio of 30X required the size of the aperture to be 1 1/4 by 1 5/8 inches. The GE engineer then suggested that Film 'N File standardize on one hole size and vary reduction ratios to accommodate drawings of varying sizes.

"How many aperture cards will General Electric buy if they can be developed to handle engineering drawings?" Rau was asked.

"Millions," he replied.

The events of subsequent years at General Electric and elsewhere — in companies large, medium and small — have proven that his estimate was modest.

Actually, the first sale of a microfilm aperture card system to handle engineering drawings was not to GE. The breakthrough came with Hamilton Standard, a division of United Aircraft Corporation, and the sale was made by Graphic Microfilm, a New England dealership for Film 'N File that was on the verge of being unceremoniously removed from its duties. Near the end of a discouraging day calling on prospects who were not rushing to sign orders for aperture cards, J. C. Curtin, then president of Graphic Microfilm, and Dave Decker, Film 'N File's new sales manager, neared the town of East Hartford, Conn., the home of Hamilton Standard. As a cap to a depressing day, their automobile ran out of gas as they approached their destination. The dispirited men hiked to a gas station and bought a dollar's worth of fuel. They arrived at Hamilton at 4 p.m., not over-confident.

As it happened, Hamilton Standard had run out of space for storing original engineering records. The supervisor of the department, Henry H. Clark, knew the space-saving benefits of microfilm, because his firm had been using it in roll form for a number of years, primarily for security purposes.

But Hamilton Standard and Clark were faced with cumbersome and time-consuming problems of retrieval of desired documents reproduced in roll form.

Clark, however, had been exposed to aperture card systems which offered quick filing and retrieval without the need for a complicated index.

When the tired microfilm representatives sat across from him, Clark gave them an unexpected shot of adrenaline. "I have been authorized," he said, "to issue an order for 25,000 aperture cards. My management has instructed me to do anything necessary to save space."

A large order? About $200. But significant because it was the first order for aperture cards in

the engineering drawing market.

The first really significant market for microfilm aperture cards had been opened, even as the giant GE was priming to become a high volume customer.

Other orders quickly followed. The Heald Machine Company of Worcester, Mass., placed an order the same size as Hamilton Standard and eventually became the nation's largest user of aperture cards in the early years of the 50's.

But the beginning of that decade saw a microfilm industry with limited sales, despite the important breakthroughs in the title and engineering drawing fields for aperture cards. Microfilm in rolls still supplied the major portion of the market, and it performed its functions in a satisfactory, though limited, manner. Many developments for roll microfilm were on the horizon, of course, to vastly expand its flexibility for multitudes of applications.

McArthur, fresh from his engineering drawing equipment successes, joined Film 'N File in Octo-

D. W. ("Scotty") McArthur, center, and other microfilm enthusiasts inspect the new "Designer 184" readers at Filmsort in 1958. This machine was noteworthy because, while it had a large screen, it could rest on the top of a table or desk.

ber, 1950, and set about to design further improvements. Out of these efforts came the "Filmsort" Inspector, a tabletop viewer with an 11 by 11-inch screen; and two models of a larger unit, the Surveyor, with an 18 by 24-inch and a 24 by 36-inch screen.

McArthur then turned his attention to the development of another microform: the jacket.

MICROFILM IN A JACKET

One of the big problems with roll microfilm was the organization and classification of stored data. Often, unrelated material was contained on the same 100-foot reel. The aperture card, although it made possible classification and faster accessibility, was not taking business by storm.

The problem led to another microform. McArthur and others at Film 'N File were searching for ways to expand microfilm's market, to give it greater flexibility, and to adapt it to special needs.

These considerations spawned the microfilm jacket, and it was a simple but effective idea. It consisted of two sheets of clear cellulose acetate bonded by ribs of extruded acetate to provide channels for the insertion of strips of 16mm or 35mm film. The size of the jackets varied: 3 by 5, 4 by 6 and 5 by 8-inches.

The user could classify his microfilmed data, insert it in individual jackets and have a compact, unitized record. He had related material stored together, ready for quick reference through a reader in much the same way as he would view an aperture card.

The jackets could accommodate a large amount of material. As many as 120 pages of standard 8 1/2 by 11-inch documents could be reduced to strips of 16mm microfilm and placed in a single 5 by 8-inch plastic jacket. Each jacket could be visibly titled for convenient filing.

The idea was worthy of promotion and sales effort, and it turned out to be an income-producer in the early 50's before another form, microfiche, began to move in on it. The first major jacket sale, to a New York title company, was made by Earl B. Bassett, who had joined Film 'N File in mid-1951. A former Coast Guard photographer and printing salesman, Bassett was a fireball on the subject of the rosy future of microfilm systems. He had traveled the Western part of the country by bus, toting a viewer and hand mounter, selling aperture cards for Business Systems, Inc.

Traveling to New York, Bassett perceived that McArthur's jacket had a lot of potential. One day he called on a Manhattan-based title company and whetted the interest of the firm's president in a jacket, a 3 by 5-inch plastic unit with two 16mm microfilm channels. The president set up a couple of presentations for Bassett, including one to the board of directors. A quick survey determined the prospective sale was a big one, approximately $100,000. The Company's needs totaled up to $75,000 in filming, 50 Inspector readers at $300 each, and more than a quarter of a million jackets at 3 cents each.

Bassett's presentation was a tremendous success. And it sold the jacket idea.

Other companies, in the title field and elsewhere, followed suit.

One of the interesting applications was by a southern hospital. This institution installed a complete microfilm jacket system to more systematically organize its overflowing medical records library. Jackets provided a compact and readily accessible format.

The word spread. In 1953 and 1954, jackets accounted for more than 30 per cent of sales, and actually outsold aperture cards from 1953 to 1955.

4

Uncle Sam and Others Take Notice

Television had its influence on the growth and acceptance of microfilm. In the early days of TV, people everywhere were becoming accustomed to looking at images on a small screen. This caused microfilm to move, slowly at first, then with greater impetus.

Government and business leaders were becoming more and more impatient with inefficient, wasteful record keeping on paper. Copying techniques, pioneered by 3M Company and others, were focusing attention on the benefits of better image-forming techniques.

Film 'N File changed its name to Filmsort, Inc., to take advantage of the brand name that already had been introduced for aperture card, jacket and reader products. The firm became a division of Dexter Folder Company, the original equipment manufacturer for the predecessor company.

Next major target: the U.S. government and other governmental agencies (of whom it is often said that there are no more devoted keepers of voluminous records).

Filmsort assigned responsibility to Carl Rose, who had been a government official with the Reconstruction Finance Corporation, to sell the benefits of microfilm systems to Uncle Sam's spawn of departments, services and agencies — including the Meat Inspection Service of the Department of

Agriculture.

This arm of the USDA had a problem not unlike that faced by thousands of private businesses. It had the job of maintaining a file of some 205,000 original labels covering 9,500 different products put out by 1,000 meat packing firms under 7,500 brand names.

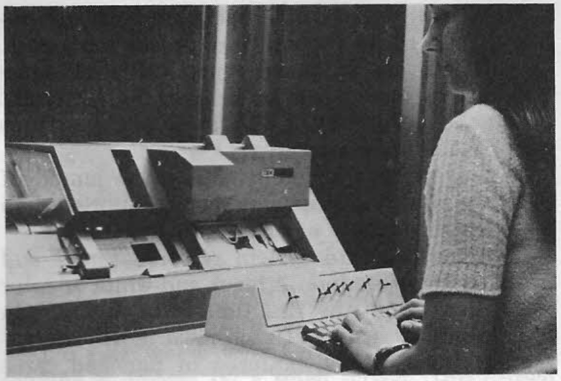
It was a record keeping shambles — a jumble of different sizes and shapes and colors, imprinted on a bewildering variety of surfaces.

An aperture card system restored sanity and order to the procedure. A black-and-white or color microfilm frame (the first time color was used in the system) was shot of each meat label. The microfilm frames were mounted in punched cards and stored in just a tiny portion of the space formerly required. Duplicate decks of cards were prepared, and the Meat Inspection Service was able to search its files in a matter of seconds or minutes, instead of hours or days.

Some inroads were being made at the same time in additional private industrial firms. One was the Otis Elevator Company, which was having its "downs" with engineering drawings. The firm had run out of space in Manhattan for its 150,000 engineering documents, and had been forced to transfer its file to a site 15 miles away. Unfortunately, this meant delays to engineers in getting prints, with resultant costly holdups in meeting tight schedules.

Clearly, a reference file in Manhattan — one that took up virtually no space — would provide the answer.

Aperture cards, of course. The ingenious microfilm salesman, Earl Bassett, overcame the doubts of an Otis official about the capability of the cards to retain their vital pieces of film. He asked the official to put the tip of his index finger firmly against the microfilm window. Then Bassett



With today's modern equipment, information can be keypunched onto aperture cards in seconds, providing a fast, efficient data storage and retrieval system.

pushed him all around the office on a swivel chair mounted on rollers. The card tore, but the adhesive bond between the card and the microfilm remained intact.

The executive may have been shaken up somewhat, but he got the message. In April of 1952, Otis began transferring its file of 150,000 engineering tracings to 3 1/4 by 5-inch "Filmsort" microfilm aperture cards. They were compactly stored at the Otis executive headquarters in three filing cabinets. Now it was a simple, fast process for Otis engineers to obtain engineering drawings needed and to study them on the readers provided.

Another interesting convert at that time — a non-engineering firm — was the Dun and Bradstreet office in Boston. The office's credit reports had been stored in 19 filing cabinets, each with five double-sectioned drawers. The office switched to microfilm cards, and the employees were among

the gainers. The 450 square feet of reclaimed space made possible by the microfilm system became the site of an employee snack bar.

The story was spreading, and the appointment of new microfilm dealers for the aperture card systems provided further impetus. Companies like Thompson Products Company, a major aircraft and automotive parts firm, joined the satisfied customer list with 150,000 engineering drawings. More and more title firms were moving to microfilm, too.

Businesses, alert to cost-saving procedures, sensitive to the need to replace outworn techniques, were responding to microfilm's benefits. Still, there existed the need for more active systems, for the capability of making hard copies of microfilmed materials quickly and economically.

Those needs would be met — and soon.

THE MILITARY BACK IN THE PICTURE

With the close of World War II, the military's great need for microfilm was significantly reduced. However, the advent of the Korean conflict again brought microfilm to the fore in military circles. In fact, the U.S. Air Force had conceived its own aperture card system in 1951, and the Navy and Army were pushing ahead with all kinds of feasibility studies. But the demand persisted for more automation and for better reproduction equipment. The Haloid Company and RCA Victor were working on the problem, as were many other companies and a host of defense and intelligence organizations.

Standardization and compatibility were needed, too. There were too many companies who had entered a young field and who were proceeding in too many directions. There were questions to be decided on reduction and enlargement ratios, on frame sizes, and on aperture locations.

Filmsort sponsored a meeting of interested parties, government and industry, in New York in September of 1954. The purpose: to begin to make some sense by fostering uniform standards.

A suggestion made by Scotty McArthur led to the establishment of the Department of Defense 0009 Committee, which was to publish the first military specifications for the use of microfilm aperture cards in engineering drawings.

One of the questions, very simply, was: where to put the hole for the microfilm chip? The Remington Rand location won out, and another hurdle was cleared.

Uniformity. Standardization. Greater compatibility. McArthur fought for these goals. So did others. The term, "total systems concept," came to the fore. Achievement of that objective required new equipment.

The government was on the threshhold of being a massive user of microfilm, not only defense agencies but other departments as well.

U.S. representatives specified their needs. They wanted small volume, low-cost, card-to-card printers and readers for use at decentralized locations, as well as a high-volume machine.

By 1957, General Electric, through Arthur Rau (who years before had shown his strong interest in microfilm aperture cards) began operating the first commercial, mechanized, integrated, engineering data handling system in the country using aperture cards.

Rau was an effective missionary to American business on behalf of the aperture card system. In a paper he presented to a meeting of Technical Drawing Associates in Pittsburgh in October, 1957, he bestowed accolades on what the installation had done for his company. His summation said:

"I believe that practical mechanization or automation of our paper work is one of the answers to many of today's problems of expanding markets, competition and growing labor shortages, and presents one of the greatest challenges and opportunities of today. The potential applications are almost limitless, and any investigation is bound to bear fruit if it is only the uncovering of obsolete methods and procedures. Simplification of paper work routines and practices is a prime requisite that will eventually lead to automation."

He cited chapter and verse of his company's problems in his presentation, with specifics on savings, and he told how government military services were experiencing similar benefits with unitized microfilm systems.

In an industry-wide seminar sponsored in the same year by McArthur, who had now become Filmsort's general manager, it was determined that the total systems concept was crying for the ingenuity of innovation. New equipment, better procedures and inventive developments were needed to take advantage of the fact that aperture cards had, indeed, been sold.

5

Microfiche (and Its Ultras)

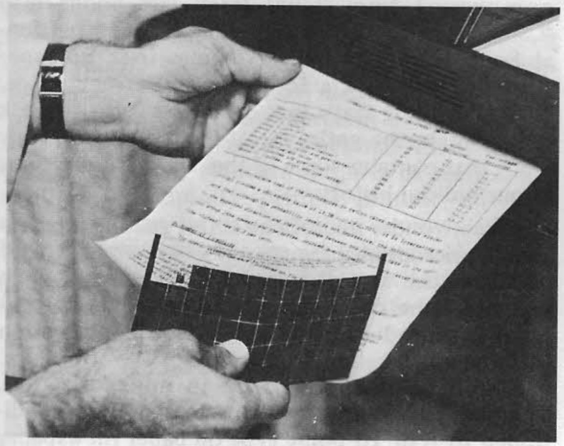
One of the favorite words of people in the microfilm world is "unitization." It represents a strong trend among both manufacturers and users of microfilm.

In the early days of microfilm, when documents were filmed on 35mm or 16mm films primarily for storage and security purposes, they were simply filed away. Totally unrelated documents might be included on the same roll, and it was a wearisome task to find a specific document or piece of information.

Unitization actually came about in many ways. It was achieved by putting only related documents on a single roll. Today's cartridges provide sophisticated indexing, and retrieval is automatic and swift at the press of a button. The jacket provided a convenient means to store, and then give quick access to related materials. The aperture card, of course, offers a high degree of unitization.

Thus, all commonly used microforms today provide unitization, each with its advantages, depending upon user requirements.

One of the later entrants into the microform field was microfiche, and it has found very important and widespread applications. Coming from the French word, "fiche," for "card," microfiche is a sheet of microfilm that contains a series of images, usually arranged in a grid pattern. The sheet is usually 4 by 6 inches in size.



Microfiche, one of the later entrants into the microform field, is usually a sheet of 105mm microfilm which measures 4 by 6 inches, and contains a series of images in a grid pattern. Depending upon the reduction, hundreds of pages of information can be filmed on a single sheet of fiche.

Normally, reductions of from 18X to 48X are used in microfiche production, and a single sheet of film can contain hundreds of images. A common reduction of 24X may contain 98 page images, reduced from 8 1/2 by 11-inch documents on a 4 by 6-inch card. A 40X reduction reproduces 420 pages on the same size film sheet.

But those reductions mark only the beginning of what becomes rather dazzling to contemplate. One midwest publishing company uses a 75X reduction and offers space-conscious law libraries a complete law book of more than 1,600 pages on a single fiche! The firm's material covering all appellate court decisions in the nation — state and federal, from the 1870's until the early 1940's — are compressed from 2,300 thick law books into 2,300 sheets of tiny, durable fiche. In conventional book form, the bulky volumes took up more than the length of a football field in shelf space. Nine slim filing trays that can sit on part of a desk now contain the entire set of the monumental law work that contains some of the landmark decisions in our judicial history.

Small wonder microfiche is fast gaining momentum in micropublishing.

Microfiche is well suited for unitization. Each separate fiche on which related or sequential material is reproduced uses eye-legible identification material as a labeling device.

Ultrafiche is another step in miniaturization. The possibilities are staggering to the mind conditioned to 8 or 10 point type on paper (newspaper text, for example). The ultra reductions range upwards from 90X. Mind-boggling developments already have demonstrated that some 3,300 images of 8 1/2 by 11-inch original page size can be reproduced on a single fiche at a reduction of 150X. Film quality, camera technology and sophisticated readers and reader-printers make it possible to get a blowback of the minuscle images without significant loss of detail.

How far the reductions will go as a practical consideration is a matter of industry-wide speculation today. Some industry leaders contend that reductions in the extreme ranges are not desirable, resulting in "flyspeck" images that are too sensitive and too hard to handle except on highly expensive equipment. But the doubters may be proved wrong as technological development refuses to listen to cautious voices.

Microfiche actually had its genesis back in Europe in the 1930's, when Dr. Joseph Goebel invented a camera technique that permitted the positioning of several images on a sheet of film. Albert

Boni of the United States developed, at about the same time, a lithographic process that produced micro images on an opaque card, permitting production economies and mass distribution.

Micro-opaques today represent another microform not as widely used as others. The opaque is created from any standard negative or positive microfiche. Its opacity permits printing on both sides, and thus its data-handling capacity is doubled. The necessity for special viewing and enlargement equipment, however, has constituted a drawback to more universal usage of the form.

6

Films in Microfilming

Anyone who points a camera at an object probably knows generally what film does. Very simply, it captures and retains an image. It accomplishes this magic because it is coated with a light-sensitive emulsion.

The process was developed some 140 years ago, so far as microfilm applications were concerned. The gelatinous material — single or multi-layered — on a sheet or strip of transparent material carries chemicals that create a latent image upon exposure. Processing techniques produce a final, visible image.

Among significant developments in recent years that contributed to the great growth in microfilming, improvements in film technology deserve a good share of the credit. Better cameras, readers and reader-printers, more flexible microforms, high-speed duplicating and retrieval devices — none of these are truly meaningful unless the film itself is of superior quality for reproduction, retention and archival (long-term storage) purposes.

Microfilm is basically a fine-grain, high-resolution film that contains a greatly reduced image that can be displayed or printed in eye-readable size by magnification. Throughout most of its history, microfilming relied on three types of photosensitive emulsions: silver halide, diazo and Kalvar. In the mid 1960's, a new technology emerged, and

Dry-Silver film was developed. This opened a whole new range of possibilities, which will be discussed later.

Silver halide is a compound of silver and a halogen, such as chlorine, bromine, iodine or fluorine. It is highly archival and records fine-line work with a minimum of distortion. When processed, silver halide film produces an image in a negative form, with a black line from the original document appearing as a white-line image on the film copy. Silver halide film is commonly used as a master microfilm from which other copies will be made.

Diazo microfilm is sensitized by means of diazonium salts. It can be developed in seconds and does not require a darkroom. It can produce either a negative or a positive, depending upon the processing method.

Kalvar, like diazo, produces either a negative or a positive. It disperses diazonium salt in a thermoplastic resin. Exposure decomposes the compound to form a gas, which is trapped in the resin. Application of heat softens the resin and permits the gas to expand, forming microscopic bubbles that scatter light and form the image.

Film laboratories are hard at work on new processes and improved techniques, many of them not now much beyond the experimental stage. They include the use of lasers, holography and other developments aimed at a greatly improved final product — higher speeds, better resolution, greater stability, superior printing capability.

DRY-SILVER FILM

It was in 1964 that the first product based on Dry-Silver technology was introduced by 3M Company. The product, which will be discussed at length in the following chapter, was a print paper for producing enlarged hard copy from microfilm.

It offered, for the first time, a completely dry method for blowing back images from microfilm, eliminating the need for liquid chemicals, toners or powders.

The first film product based on the new technology came along in 1968, as 3M was readying the introduction of its Electron Beam Recorder for the computer-output-microfilm market.

This technology was to have far-flung and exotic uses, from the humid jungles of Viet Nam to satellites probing the cold reaches of the sky for weather information, from sonar recording in the depths of the seas to military intelligence.

Its development came about, as so many things do, from more or less casual business conversation. It began with 3M's Marsh Hatfield spelling out to David Morgan, who was working in the laboratories of the Microfilm Products division, some of the marketing problems that existed in the early 60's.

The Filmac products pioneered by 3M were doing a good business, but Hatfield suggested that something different, more advanced, easier to handle, was needed for the long haul. The Filmac hard copy prints were wet, conductive, and didn't quite have the feel of paper. Hatfield outlined the need for a completely dry paper, non-conductive, less costly.

What could be done? Was anything available? The discussions continued, and other people were drawn in. General agreement developed on some kind of a light/heat system as being the way to go. The experience with Thermo-Fax copying products could be valuable. 3M probably had as much experience with heat development as anybody.

Unfortunately, words usually over-simplify the process of developing a completely new technology, for that is what Morgan and his laboratory colleagues accomplished. Endless experimentation,

trial and error and patience combined with wearying hours in the lab resulted in a process that even to this day has only begun to demonstrate its possibilities.

In the most basic terms, Dry-Silver technology is a photographic process that produces a useful image, either on paper or film, by exposing the recording medium to a light pattern and developing it with heat. The recording medium emerges from the developing process dry and ready to use.

The work being pushed forward in 3M laboratories in the early years of the 60's was of extreme interest to the United States government, particularly its military branches. In fact, Department of Defense experts believed that the technology being developed was of such critical importance to the national interest that the government should aid in its development.

We had become involved in Viet Nam, with our military commitments growing. Fresh water was a scarce commodity in that land, and water was required for conventional photographic processing. The logistics of hauling in water were complicated; purification was a difficult process. A process that would eliminate water and chemicals completely would solve a very pressing problem for the military.

Airborne uses of the Dry-Silver process also became quickly apparent. Space in military aircraft is restrictive. Weight is a problem, and water and liquid-handling systems are heavy. Disposal of liquid presents yet another messy problem. Using the Dry-Silver process, air crews could literally develop their photographs in seconds, dry and ready to use, right in the plane.

Small wonder that the U.S. military was happy to cooperate with what was going on in the 3M laboratories.

Many important side benefits from the Dry-Silver process have evolved. We are a nation deeply and properly concerned with ecology. Pollution is a headline word. With Dry-Silver material, there are no chemical wastes to dispose of; no liquid chemicals are used, nothing is destroyed. Toxic fumes can be an annoying problem in photographic development, but not with the Dry-Silver process. Exhaustive tests have shown the materials used to be non-toxic.

The continuous tone capability of Dry-Silver film has proved to be outstanding. It can, for example, produce 21 shades of gray, which is remarkable for a reproduction medium.

Cost is another factor. The product uses only 1/3 to 1/2 of the silver content of classic silver systems.

A term that users like to consider is shelf life. How will a product store and hold up? Will it deteriorate? The shelf life of Dry-Silver film has more than lived up to the most hopeful expectations. Samples were stored, unexposed, at room temperature for 48 months. No effect or change in functional characteristics resulted. Storage for a year at 110 degrees Fahrenheit had negligible effect; storage at 140 degrees resulted in no change in the film's image forming capability.

The Dry-Silver process, first in hard copy paper, then in film, was a response to the challenge to make microfilm easier to use. That challenge has been accepted, not only at 3M Company but at other firms which have made significant contributions to the growth of the industry in its service to information handling and management.

Exactly how Dry-Silver materials will fit into this pattern of growth, what its ultimate contributions will be, nobody can predict with exactitude. Dry-Silver technology, though proven, is relatively new. Basic research continues; as does a search for practical applications.

7

Dry-Silver Picture

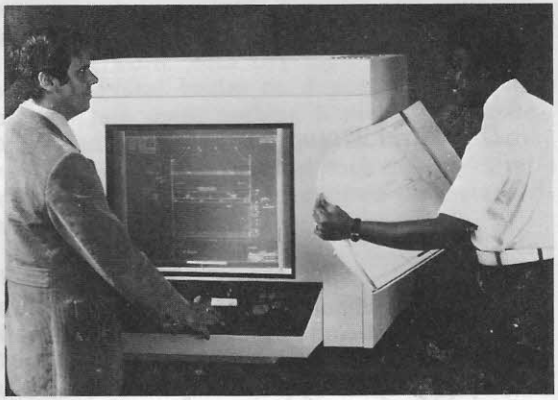
Dry-Silver technology. Perhaps to the average person it will not convey the drama or the glamour of precious metal finds. But the introduction of the Dry-Silver printing process by 3M in 1964 was a significant event in the microfilm industry.

Up until this time, it had been necessary to use chemicals, toners or powders to make prints from enlarged microfilm images. Necessarily, a "wet" process has all the disadvantages and handling problems that the use of chemicals produces. In addition, conventional photographic paper used in wet processing is expensive.

Again, as so many times before in the evolving microfilm industry, the challenge was to make the job easier and less costly, thus expanding usage.

In searching for a simple dry process of printing from microfilm, 3M was able to draw upon the knowledge of its research people who had developed the "Thermo-Fax" infra-red process for copying paper documents – paper to paper. Business had responded enthusiastically to the copying process for a multitude of needs for quick, easy reproduction of original documents. Here, too, information communication and management were involved.

3M chemists, headed by David A. Morgan, now laboratory manager for 3M's Imaging Products project, Microfilm Products division, responded to



The 3M "201" Dry-Silver reader-printer produces low-cost, dry-processed 18 by 24-inch prints in 15 seconds from aperture cards or roll film. The large, bright viewing screen and 15X lens permits viewing at full or half size, depending upon the reduction ratio of the microfilm.

the assignment of finding a fast, dry process for microfilm printing. The answer was a Dry-Silver photographic process. It was an answer that solved a lot of problems. It, too, nudged aside a lot of objections to conventional microfilm printing.

Basically, the Dry-Silver process is unique in that it requires only heat and light to make prints from microfilm. An image is exposed to a light pattern and developed with heat. No wet chemicals are required; no toxic fumes are given off; there are no wastes to dispose of; the silver used in the process is recoverable.

Quality is excellent, comparable with conventional photographic paper at a competitive cost.

Dry-Silver printers have emerged from 3M to accommodate all kinds of microforms. They can be operated automatically at high speeds to meet

any microfilm printing need, and none require messy, costly chemicals.

The National Microfilm Association's annual convention in Washington in 1966 was the occasion for the introduction of one of these units. It was the "333" Dry-Silver Printer, with the capability of producing low cost prints up to 18 by 24 inches from aperture cards. The machine was a boon to the engineering drawing market. It permitted the automatic production of up to 25 prints from each of 200 aperture cards that easily could be stacked in a carrier, turning out six copies per minute.

In the busy mid-60's, 3M had introduced the important "400" series reader-printers, using 3M's

The Dry-Silver printing process, developed by 3M Company, eliminates many objections to other methods of microfilm printing. It requires no wet chemicals, gives off no toxic fumes, produces no wastes, and provides for complete recoverability of silver used in the process.

proprietary zinc oxide papers. These machines took their place as the first inexpensive reader-printers with universal application. With the capability of making six-second, 8 1/2 by 12 1/2-inch hard copies from microfilm in cartridge, as well as from any other kind of aperture card, roll, microfiche, and jacket format, the versatile "400" units again expanded the market to new applications across the spectrum of business. The "400's" placed on the market were motorized; they had odometers and could scan an entire 100-foot roll of film in 15 seconds; they had the option of manual as well as automatic operation. They eliminated the manual handling of film in many instances; they offered Page Search capabilities that made it possible to have push-button retrieval of a specific image from among thousands in seconds; they began to present interchangeable lenses to make possible the viewing and printing of different reduction ratios on the same machine.

These systems were supplemented in the late 60's by the "500" series of reader-printers which offered the advantages of Dry-Silver technology for printing — no messy chemicals, no mixing and no noxious odors.

The "400" and "500" series each are major sellers in the mid-70's and dominate the world market for reader-printers.

The Electron Beam Recorder and Laser Beam Recorder, yet to come with the introduction of computer-output-microfilm, were also to use Dry-Silver film technology.

Dry-Silver paper surfaced dramatically in the early 1970's with the wide distribution of the Tektronix Dry-Silver recorder for EDP output, oil exploration, medical instrumentation, etc. Several thousand units were installed throughout the world by mid-1975.

In 1973, the huge news gathering and dissemi-

nation organization, the Associated Press, announced a revolutionary new photo transmission system. The laser beam, for the past few years the subject of excited speculation about its near science fiction potential for a host of scientific and industrial applications, shared the spotlight with Dry-Silver. The AP calls its photo transmission system Laserphoto. It uses a laser beam as a light source, and produces prints of high photographic quality on the 3M Dry-Silver paper without the need for chemicals or processing.

In describing the system, AP said that it would permit delivery of pictures to AP member newspapers on digital circuits across the nation four times faster than the previous transmission method provided. A standard 8 by 10-inch photograph could be delivered, completely produced at a receiving station thousands of miles away from the transmitting point, in two minutes. At the receiving point, the laser beam traces out the picture information on the Dry-Silver paper. The laser exposes the paper, and it is developed in a heated roller processor, with no need for chemicals.

The AP plans to replace all of its photo receivers and transmitters over the next couple of years. Equipment replaced is based on a wet paper process that uses photo-sensitive paper and requires the use of liquid chemicals.

The Associated Press announcement was an exciting development, but it is only one breakthrough of the many envisioned in the future of Dry-Silver technology. Already occurring are such applications as weather photo production in many countries, police facsimile systems, space satellite Dry-Silver recorders for analyzing earth resources data, etc.

The success of these programs resulted in the formulation of 3M's Imaging Products project during late 1974.

8

Cameras: No Mess, No Fuss

A basic unit for any complete in-house microfilm system is, of course, the camera. You have always had to "take a picture" of the document you wanted to reproduce on film.

As microfilming expanded its services to business and government, different types of cameras were used, depending upon need.

- Planetary cameras: the document being photographed and the film remain in a stationary position. The document is on a flat surface, and the camera "shoots" it.
- Rotary cameras: the documents being photographed move on a transport mechanism that is connected to a film transport. The action is simultaneous, with precise synchronization, and hundreds of documents per minute can be filmed at the press of a button.
- Step and repeat cameras: it is possible to expose a series of separate images in rows and columns following a pre-determined format.

But there was a problem not too many years ago that hindered the progress and acceptance of microfilm. That problem was the darkroom — costly, tedious, time-consuming. Technical skill was required, which increased expense, or it was necessary to send undeveloped film to outside processing stations — again an element of cost and delay.

The solution: eliminate the darkroom bottleneck.

But that neat answer took a lot of doing, years of research and trial-and-error experimentation.

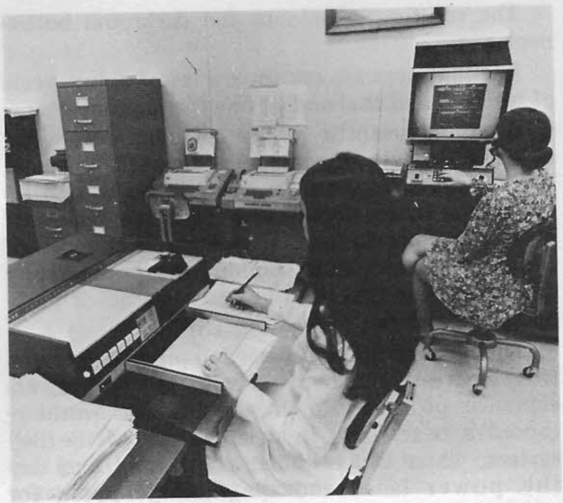
A young scientist at the 3M laboratories had much to do with providing the answer. His name: Arthur Kutchera, and the product he was so instrumental in developing was called the "Filmsort 100" Processor-Camera. It was the first piece of equipment that could combine the photography and processing functions in one easy, quick push-button operation.

The birth of this badly-needed product — which would have so much to do with the growing acceptance of microfilm in the business world — caused a near flood in a laboratory of the Bell system, where it was undergoing testing. One day the power failed and the machine opted for mischievousness of a sort. Its developmental fluids immediately dumped out on the floor, and the laboratory was nearly flooded before the problem was solved.

But such mishaps were episodic. The "Filmsort 100" made the darkroom, with its expenses and delays, an anachronism in the growing world of many kinds of microfilming jobs.

The product was followed by improved designs from 3M and other companies that could perform additional functions faster, and could handle larger documents. But they had in common the capability of photographing and producing, in seconds, a finished film. Just at the touch of a button. Dry, ready-to-use, and mounted in an aperture card.

Companies that had balked at spending $15,000 or more for a microfilm system now could buy the combination processor-camera for only $3,200. More and more small companies now would be able to reap the benefits of microfilming,



The "3400" microfilm cartridge camera enables users to film, index and file their own documents. Materials are fed into the front slot of the machine, filmed instantaneously, and ejected into a hopper. When the operator finishes with the cartridge, she writes the number of the last document filmed and the camera's ending odometer setting in the lined space on the label on the side of the cartridge, then rewinds the film automatically. When the cartridge is used again, it is advanced to the point just beyond the odometer setting, eliminating any chance of overprinting.

saving space and money and achieving more efficient information management.

EMERGENCE OF THE CARTRIDGE CAMERA

As the 70's approached and microfilm was gaining acceptance far beyond engineering drawing and space-saving storage uses, there still was a need for a complete, low-cost system that would permit users of any size to film, index and file their documents conveniently and quickly.

That need was answered in 1969 in the form of a neat little piece of equipment that perches on a small table or desk. The machine is the "3400" cartridge camera, and it is the basic link in a complete microfilming system that serves a multitude of needs in business, education and government. It is part of the move to the "complete systems" concept begun years ago.

Let's first take a look at what probably happened in most offices in the past when an executive wanted a piece of information or a record of some kind.

His secretary walked to a file cabinet (probably passing a whole bank of cabinets to get to the right one). She bent down and pulled out the drawer, shuffled through a bunch of folders to find the proper one, removed the folder, shuffled papers until she found the document desired, replaced the folder in its correct sequence, closed the drawer, went to the office copying machine, made a copy, returned to the file cabinet, reopened the drawer, relocated the file folder, returned the document, replaced the folder in its place, reclosed the file drawer.

Time-consuming. Inefficient. Unnecessarily complicated. The procedure was followed because many smaller offices did not think they could afford what they believed to be expensive microfilming equipment, even though it had been accepted and used, with great economy, in larger operations.

The development by 3M of the "3400" Cartridge Camera followed the pattern set years earlier by 3M and other companies in the microfilming industry — to expand usage into every segment of the economy. Operation of the "3400" Camera is remarkably simple. The user takes a 100-foot cartridge of 16mm microfilm — so small it can be held in the palm of a hand — snaps it into the camera, presses a button to automatically thread the film, then feeds in the documents to be filmed. The information is instantly transferred to the microfilm cartridge, with an odometer indicating the location of the documents being filmed.

The camera is space-age fast. It can film up to 60 documents a minute, and approximately 2,400 8 1/2 by 11-inch pages of paper can be exposed on one cartridge.

So the documents are on microfilm, and the procedure was quick and easy. Now what happens when the executive wants a piece of information?

The office worker simply goes to the conveniently-located reader-printer, loads the cartridge, checks the index and pushes a button. Up pops on the big, bright screen a clear image of the desired document. Press another button, and in six seconds out comes a sharp 8 1/2 by 11-inch paper copy. No tedious shuffling, bending, searching and other time-wasting motions and frustrations.

A host of advantages for the user are found in this microfilming system. Space-savings are obvious. Requirements for record storage are reduced by as much as 96 per cent. And these are days when office space rents for $10 and $12 per square foot and up, with the accent on the up.

Paper is bulky and has to be worked by hand. It is heavy and expensive to mail. Paper can be easily damaged, lost or misfiled. It deteriorates with age. A microfilm system fights these file failures.

It is small wonder that the "3400" Cartridge Camera, and the system of which it is a part, received such instantaneous and enthusiastic reception everywhere it was shown. The purchasing agent of a Pennsylvania manufacturer that install-

ed the system reported that the company microfilms all of its records, including invoices, correspondence, accounts receivable ledger cards, accounts payable records, engineering drawings and factory records, just to mention a few. Storing the records in any other form but microfilm is simply a waste of space, the purchasing agent said.

Many companies using the convenient cartridge camera system today go another step further in their program. They locate reader-printers at satellite stations — department locations, sales offices and other plants. They have found it easy to make duplicates of the microfilm cartridges and send them to the satellite locations. Not only is space saved and efficiency increased, but mailing costs to distant points are greatly reduced.

The cartridge camera is finding new ways and new places to serve every day.

9

Reader-Printers Emerge

The year was 1957. In St. Paul, Minn., scientists at 3M had been working on a way to reproduce microfilm images on paper efficiently and economically. There was a crying need for a reasonably priced reader-printer in the industry. Present equipment required a large financial investment, and the high-volume capabilities of the machines simply were not needed for many applications.

A few years before, 3M researchers, under the leadership of Dr. Carl Miller, had developed the "Thermo-Fax" method of dry copying. It enabled business and industry to make low-cost copies of documents of all kinds.

At 3M's Central Research Laboratory, answers began to emerge, and they reflected long, hard, developmental work — test, retest, reject and try all over again. The process finally selected involved a photoconductive paper with zinc oxide as a photoconductor. A light image was directed onto the paper and light-affected areas became photoconductive for a short period. A material was deposited on these areas to form a visible image. In depositing, metallic compounds were plated out of an electrolytic solution.

In its approach, 3M was seeking a general purpose microfilm reader-printer that could handle all forms of microfilm, including 16mm and 35mm roll film, aperture cards, jackets and the newest

Sophisticated reader-printers produce high quality prints from microfilm images at the touch of a button.

entry into the market, microfiche.

A prototype of a reader-printer that met these requirements was developed. It was called the Model 23 and was the first piece of equipment capable of making highly-legible, blown-up prints of microfilm images at the touch of a button.

The Central Intelligence Agency of the federal government tested the prototype. Impressed by its performance, the agency ordered a number of the units. The Model 23 had an auspicious introduction to the waiting market at the National Business Show in New York City in November, 1957. Orders began to pour into St. Paul, and the first deliveries of the new machine were made in the spring of the next year.

Later, the Model 23 was rechristened the "Filmac 100." Its introduction represented a major technological breakthrough, and it presaged the broadening of the microfilm market everywhere.

There still existed, however, a special and pressing requirement in the engineering drawing field. The "Filmac 100" admirably filled the need for 8 1/2 by 11-inch size in screen and print. But engineering drawings require much larger display and print reproduction. Several companies were seeking to fill the void, but the equipment they offered was bulky and highly expensive. There existed in the field an excellent continuous printer developed by Xerox, but it was for mass production purposes.

In the spring of 1959 a bolt of lightning hit at the Washington, D.C., convention of the National Microfilm Association. It came in the form of a lightweight, compact, low-cost reader-printer for engineering drawings. It was called Model 29 (later "Filmac 200"), and it was the star of the show. 3M was the producer. People thronged about and blocked the aisle to view the unit. They expressed amazement at its capabilities in relation to its size and cost. Its statistics were indeed impressive, even incredible in view of what the market had offered until then.

It was priced at $919. (Other available machines averaged about $8,000.) Prints cost 20 cents each, and were produced in six seconds (several times faster than with other equipment). It had an 18 by 24-inch viewing screen and produced both 18 by 24-inch prints and 18 by 12-inch half prints. It weighed just 300 pounds and could perch on a tabletop. (Other machines offered weighed up to 850 pounds.)

There were other salient and salable benefits: "Filmac 200" operated with push-button ease. It had a minimum of moving parts, which promised low maintenance. It had unusually good exposure latitude, which means it could make acceptable prints from films of varying quality without the necessity of having to change its six-second setting.

The new unit had everything. And, of course, it completely fulfilled the specifications laid out by the DOD 0009 Committee in its standardization efforts.

The "Filmac 200" produced a significant expansion of the microfilm aperture card systems market. Its price meant that it now would be feasible for small engineering departments as well as large ones to gain the benefits of an active system of information management. The day of the passive, limited-access aperture card system was on its way out.

MORE STEPS FORWARD

Motivated by its successes in microfilm machine technology, 3M paused in 1959 to assess its overall place in the growing industry. The decision was made to complement its microfilm equipment with an active microfilm format.

The logical place to look was to the Filmsort Company, now a part of Miehle-Goss-Dexter, a large printing equipment manufacturer. Filmsort was doing well, and its "hole-in-the-card" products would fit in with 3M's plans to become a supplier of total microfilm systems.

The acquisition was announced in the fall of 1959. Joining 3M in the process were McArthur, Bassett and Robbins, as well as several other Filmsort employees. It was a marriage into which each party brought a dowry of practical value. Filmsort contributed its aperture cards, its mounting equipment, its card-to-card printer, and its readers. 3M, of course, contributed its "Filmac 100" and "Filmac 200" reader-printers.

3M established a Microfilm Products Department, and McArthur was named its manager.

One of the first projects undertaken by the new department was to improve the adhesive material in the "Filmsort" aperture cards. Machine improvements and high speed requirements were placing greater demands on them, and some cards stuck or popped off in the machines.

3M, highly experienced through many years in the adhesive business (witness "Scotch" brand cellophane tape) met that challenge with comparative ease, and the aperture cards no longer presented problems in the machines.

Another difficulty in those years was the inability to produce quick, high-quality duplicates on film of the microfilm images. This produced an obstacle to the interchange of data.

An industry-wide effort to solve this problem was launched, and diazo film manufacturers were asked to work on the development of a film that

The "Filmsort Uniprinter 086" produced duplicate aperture cards at the rate of hundreds per hour, fulfilling the requirements of many organizations.

would be compatible with all reproduction methods and would permit three and four generations of duplicate film cards to be made. The film manufacturers responded. They came up with a product that showed little or no loss of resolution even through the fourth generation. This was another important breakthrough for the microfilm industry, contributing to its growth and expansion.

How best to make duplicate cards? Equipment was available, but the process took too long; operation was manual. 3M answered with a card-to-card printer that enabled an operator to turn out 300 duplicate aperture cards an hour, but that did not fulfill the high-volume requirements of the large engineering organizations.

In tandem with Bell Telephone Company, which established requirements and standards, 3M produced the "Filmsort Uniprinter 041." It was an automatic card-to-card copier that could produce duplicates at the rate of 2,000 an hour.

The Bell system itself was the first customer for the high-speed card-to-card printer. And it became a major user of the equipment throughout its scattered system when it began distribution of duplicate aperture cards instead of prints of engineering documents. In 1961 and 1962, Bell produced some 30 million aperture duplicates! Thousands of desk-top readers at Bell locations completed a massive system.

MICROFORUM

Microfilm had come a long way since the postwar years, but more had to be done. Reluctance, suspicion and resistance to new ways to do things were still more than a lurking presence. Much solid educational work of a service nature was necessary at this juncture.

An effort in the direction of industry-wide education was launched in 1962 by 3M, whose successes in microfilm equipment development had led to the establishment in St. Paul of a Microfilm Products Division. McArthur was named its vice president.

One of the first jobs of the new division was to establish a facility that would be able to give prospects a broad overview of what microfilm could accomplish. This meant a systems laboratory that could guide the user and potential user through a maze of new developments, forms and equipment available. No one technique, no one system, could serve everyone. Requirements were as varied as the needs placed upon microfilming.

MicroForum was established in St. Paul and later in Washington, D.C., serving as facilities to which a potential user could bring his problems and see how they could be most efficiently and economically handled through a microfilm system designed for his specific needs. It was recognized, too, that the MicroForums could serve to explore new ways to meet new requirements. Today the two MicroForums remain a powerful force in opening new avenues in microfilm capability.

10

Case In Point: NMA Conference

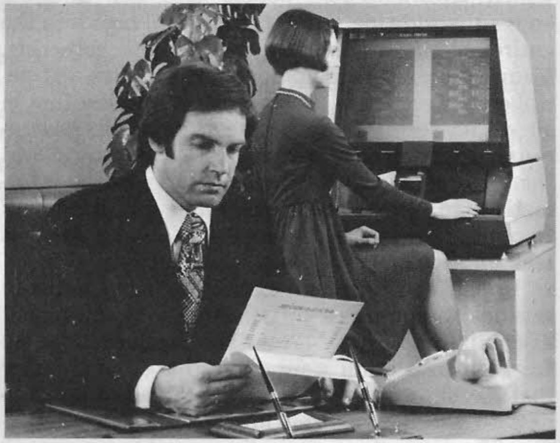
Cobo Hall in Detroit was the scene of the 1973 annual conference and exhibition of the National Microfilm Association. Seminars and workshops at which knowledgeable people discussed and examined worldwide developments and trends in the entire microfilm industry marked the gathering. Manufacturers of equipment and supplies and peripherals were there, as were users of microfilm in all of its forms from business, industry, government and various institutions. The crowd was there to see and show its wares, to exchange information, to discuss techniques and applications and to ponder the future of micrographics and all of its technologies.

Users filed through exhibition halls between sessions to appraise a glittering array of equipment in exhibitors' display areas. The products lined up for their inspection were expressive of an industry that has shown remarkable growth and responsiveness to the needs of an information-glutted society. The equipment, providing sensible answers to these needs, was the result of sensitive and dedicated research and development by the many manufacturers, large and small, which serve the field.

If there was any one thing that characterized the exhibition area in the Cobo Hall complex, it was the large number of readers and reader-printers on display, their innards working obligingly at the press of a button to deliver images and prints. The hardware was mostly of an outstanding calibre, and many exciting new refinements and product developments were to be found in booth areas all over the exhibition floor.

The visitor had to conclude that whatever his need might be for efficient and space-saving information handling, the answer was there. This reflected the maturity of the industry, which had advanced to the point where it could tailor systems to meet the most specific requirements. Hardware. Software. Systems design and counseling.

Just as computers have known "generations," so have reader-printers and other microfilm equipment. Each new generation shows some capability



In 1973, 3M introduced new reader-printer improvements and capabilities with its "600" Dry-Silver unit. The machine permits simultaneous viewing of two 8½ by 11-inch pages and offers automatic threading and multiple speed motorized drive for 16mm cartridges, among many other features.

that is unique, or at least a clear improvement over the preceding generation. To review all of the fine equipment dressed in Sunday clothes in Detroit would not be possible within the allotted pages of this book.

The 3M Company took the occasion of the NMA show to unveil reader-printers that showed some interesting improvements and new capabilities. Such was the nature of the entire exhibition. One of these products had a split-screen look. It was the new 600 Dry-Silver reader-printer.

The 600 has a big, brightly illuminated 14 by 18-inch screen which permits the user to view two standard 8 1/2 by 11-inch pages simultaneously. The unit offers automatic threading, multiple speed motorized drive for 16mm cartridges, and the ability to take another new 3M convenience product – the "Easy Load" cartridge, which gives an operator a do-it-yourself capability with a 16mm open spool film. He simply inserts the spool into the cartridge and snaps it shut.

A high degree of flexibility is offered with the 600. Either 8 1/2-inch or 11-inch wide paper can be used, whichever is most suitable to the needs of the user. There is an additional cost savings feature, too, in the new machine: its variable print length capability – 6 to 18 inches – permits it to make prints of engineering documents, wiring diagrams and other material directly proportional to the image size, thus shaving supply costs. Prints can also be made as large as 11 by 18 inches.

Speed, too, characterizes the 600. Dry-Silver prints can be made at the rate of up to 10 8 1/2 by 11-inch copies per minute.

The 3M sales force had another new product to show in Detroit. It was the 201 Dry-Silver reader-printer with its own unique capabilities for the handling of engineering drawings in 35mm aperture card or roll film form.

The 3M 500CT microfilm reader-printer produces completely dry, enlarged paper copies in ten seconds, using only heat for development. The unit features a large 12 by 16-inch screen and automatic cartridge loading.

This unit has an 18 by 24-inch screen, and it delivers low-cost dry-processed prints in full 18 by 26-inch size, or in half size. The latter is an interesting capability; in instances where only half of a drawing is wanted, the screen may be masked and a half-sized print delivered — at half the cost of a full-size print.

The 201 operates at the touch of a button, and it produces sharp, clear prints in 15 seconds. It eliminates the need for liquid chemicals, drums or toners.

The products trotted out at Detroit were the latest creations in a line of constantly refined and improved reader-printers — motorized, featuring instant retrieval and unbelievably simple indexing systems. 3M's 500 Page Search Reader-Printer, for

example, retrieves specific film images in scant seconds with digital keyboard input and push button simplicity. It can accomplish this task from a file of up to 10,000 images.

And it does a lot more. Like so many sophisticated pieces of equipment in this day, it has a built-in electronic "brain," a logic package. It can zip from one image to another in a file, in either direction. And then it packs up the entire film in its cartridge automatically when the search is ended.

Page Search does this job with blip-encoded 16mm microfilm, positive or negative, and it handles with equal ease dry or wet process silver film, diazo or Kalvar. It has a turret which rotates and provides lateral film traverse which makes it possible to handle all formats — comic and cine mode, duo and duplex film. A wide range of interchangeable films is available for varying camera reductions — from 14.88X to 29X.

3M's 500 motorized reader-printer is kind of an all-purpose player. It provides motorized retrieval of information on 16mm and 35mm roll microfilm and manual retrieval from microfilm jackets, aperture cards and microfiche. Variable speed advance permits scanning of film at the rate of from 10 inches to 400 feet per minute. The versatile unit projects a bright and evenly-illuminated image on a glare-free screen, 10 by 11 1/2 inches in size, and it delivers a sharp, dry 8 1/2 by 11-inch copy in just 6 seconds. This unit has 360 degree turret rotation for swift positioning of a microfilm image, and 10 magnification ratios are available.

The days when users had to search through seemingly endless rolls of film for a specific image, a necessity that actually discouraged use of the medium, is long past. Simple and highly efficient indexing systems featuring odometers or electronic counters make scanning and location a simple job.

11

Swift Retrieval Systems

Storage of information is one side of the coin; retrieval is the other. This does not disregard countless other factors that enter into the entire information handling and management complex. But the fact remains, you have to have a method of keeping your information and you have to have access to it.

Film's high information density, hundreds of times greater than paper, places it in a unique position as far as storage of large amounts of fixed data is concerned. Information density ranges from 8,000 to more than 1,000,000 characters per square inch of surface.

Thus it can be granted today that microfilm provides the best storage medium for many kinds of data, although certainly not for all kinds; no product or system meets every need. Storage of data on film at the very least does away with the need for the huge amounts of space required to store paper. Data can be stored on magnetic tape, and for many purposes that represents the best way, but input and equipment costs are usually considerably higher than with microfilm.

We are not now talking strictly about COM, but about other technology and equipment that have evolved and can be used instead of COM, or can be used in partnership with the computer.

Let us say that we have decided to put a vast

amount of fixed data on microfilm. Okay, how do we retrieve it? How fast? What methods do we use? Microfilm technology has some interesting answers.

Indexing and coding roll film take several directions and are basic to the retrieval process. One way involves the use of a flash card photographed right on the film to identify or separate groups of images. Another way is automatically to stamp sequential numbers on the documents as they are being filmed. Bar or code lines between frames will rise or fall to position related groupings. Blip marks below the frames are used for high-speed electronic control. One sophisticated system uses a photo-optical binary code adjacent to each document or group of documents. Of course, the odometer plays an important role in the retrieval process.

The readers and reader-printers have to be equipped to "read" the particular coding system used. Then it can be a simple push-button process to find in seconds the document image wanted.

Manual image retrieval equipment of the highest quality still is being widely sold and used by those whose access requirements are not as critical or frequent. The needs of the user dictate the method or system to be used. That is one of the beauties of microfilm today: its ability to adapt itself to an almost infinite variety of requirements, from the very simple to the highly complex.

With so much attention focused on retrieval systems linked to the computer, it should be pointed out that many fine automated, large capacity retrieval systems not linked to the computer are readily available on the market. These terminals and retrieval systems fall generally into four different categories.

Automatic card retriever systems can be used for conventional record-keeping operations or for microfilm retrieval.

Systems in this family use tab-size cards as carriers for microfilm images. The cards are notched on the edge with one or several access codes according to the classification or topic. They may serve as mounts for one microfilm image, or for 100 or more images. The tab cards are filed in retriever trays that can hold as many as 4,000 cards. A keyboard console is used to retrieve the notched and coded cards. After being mechanically indexed out, the cards are inserted into a reader or reader-printer.

In another class is the automatic microfilm roll reader terminal. "Blips" or marks on the microfilm images, which usually are on 16mm film and contained in cartridges for easy storage and handling, provide quick access to individual images through

The 3M Microdisc system is a random access retrieval system which combines the high density storage efficiency of 16mm microfilm cartridges with the rapid inquiry capability to an index stored on a magnetic disc.

keyboard control.

3M's "500" Series reader-printer was developed especially for high volume users. Employing Page-Search technology, the unit can retrieve a specific image from among 10,000 in four seconds. Dry-Silver paper eliminates the need for chemicals, and the push of a button delivers hard-copy prints in 10 seconds.

A third category of automated retrieval is represented by automatic microfiche reader terminals. They can retrieve an image on individual fiche by keyboard control, or the units can be interfaced with a computer. Most units are 4 by 6-inch fiche, on which can be stored hundreds, and even thousands, of images. Some use uncut fiche rolls.

A fourth, and more sophisticated, microfilm retrieval category is the complete system, such as 3M's Microdisc equipment. Here is the highest expression of automation in microfilming today. The large scale systems can hold hundreds of thousands of images on-line. Operated under computer control, a Microdisc system also has the capability of servicing many satellite reader or reader-printer terminals, providing large information networks. Microdisc systems offer services and capabilities beyond the needs of many smaller operations. But for those who require the ability to handle quantities of randomly filed information, they are invaluable in the services they perform with great precision and ease.

12

Computer-Output-Microfilming

Modern computers "think" in nanoseconds, which translates into billionths of a second. This means that they process information and perform computations at speeds that simply boggle the mind. It also points to a problem which computer specialists have been struggling with for years: what is the most efficient way to transfer data generated at such enormous speeds into a usable format?

The most common device used for taking data from a computer has been the impact paper printer. And if you ever have watched a printer churn out computer information, you probably were impressed. It can produce some 2,500 characters per second, which is equal to about one page of single-space typewriter output.

However, this is turtle-slow in relation to the speed of the computer. And the time lag between the two creates a dollars-and-cents pressure, because computer time rental costs run high. Moreover, that is only one problem created by paper print-out.

The paper, spewing out in bulky, ungainly streams, hard to handle and store, creates serious space problems. And these huge mountains of paper are costly. A recent study showed that 75,000 pages of ordinary computer print-out weigh 500 pounds and take up 10 cubic feet of filing space at

a paper cost of about $350. The same amount of material on microfilm weighs only nine pounds, occupies eighteen-hundredths of a cubic foot of space and costs $75.

Here is another startling statistic: computer generated paper print-out totals 285 billion pages a year in the United States, and it is on the rise. That sum amounts to about 1,425 pages of print-out per person.

Another important element of cost intrudes, too. It comes when computer print-out must be mailed; multiple copies are commonly involved in distribution to key points. Postal rates have been rising sharply. At the time of this writing, the U.S. Postal System was completing a proposal for yet another increase of perhaps 25 per cent in postal rates. Mailing and shipping costs are a staggering item for business firms of all kinds. Those costs can be cut by up to 90 per cent by shipping film instead of paper.

On top of all of this, the threat of paper shortage in the computer industry remains. This and all the other factors have led computer people to look hard at computer-output-microfilm (COM) as a major alternative.

With COM, data generated by the computer is converted directly onto microfilm in alphanumeric and, in many cases, graphic form. (Alphanumeric refers to letters, digits and other characters common to our printed language, such as punctuation marks; graphics pertains to pictorial forms – drawings, charts, designs and specially-plotted data.) A COM unit turns out data at tremendous speeds.

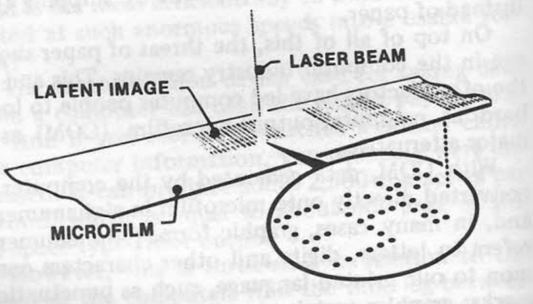
Four basic technologies have been introduced to form the images on the film. A brief examination will disclose their characteristics and their differences:

CRT imaging: This centers on the cathode ray tube. The CRT is an integral part of the system. Data is recorded by photographing the CRT on microfilm.

LED imaging: This technique employs light emitting diodes, which have the capability of radiating heat when current passes through them. In recording characters, the microfilmer exposes dots on film with light that emanates from the diodes.

EBR imaging: Introduced in 1969 by 3M Company, this system employs an electron beam recorder which writes the images directly on 3M Dry-Silver film. The exposed film is developed with dry heat.

LBR imaging: In 1974, 3M introduced a system that uses the most powerful source of imaging energy known to man — the laser beam. The company's Laser Beam Recorder



In 1974, 3M introduced the first computer-output-microfilm system to use the most powerful source of imaging energy known to man — the laser beam. The Laser Beam Recorder (LBR) writes directly onto Dry-Silver 16mm microfilm or 105mm microfiche, forming a latent image that is developed by heat and requires no liquid chemicals.

writes directly onto Dry-Silver microfilm. Like the EBR, the LBR involves a completely dry process, developing the film with heat.

Other technologies, such as plasma physics, are being considered as possible imaging methods in the future. But, whatever the technique — and each has its proponents — COM is proving itself in hundreds of installations in the United States and abroad.

Actually, although COM usually is cited first and foremost for its ability to keep up with the lightning-fast computer, thus saving the expensive commodity of time, it has many other advantages.

The information contained on microfilm, with the retrieval coding and automatic search techniques that have evolved, can be retrieved ten times as fast as that on paper. Concerning space, a cartridge of microfilm takes up less than one per cent of that required for the comparable information on paper.

When multiple copies of pieces of information are required, COM-generated film can provide a virtually unlimited number of duplicates at a cost of as little as 1/10th of a cent per page.

An impact printer normally is limited to the production of six copies of a document. When you may have dozens, scores, or even hundreds of departments and outlying points that require information and constant updates to make vital decisions, it can require greater cost and inconvenience. Mailing and shipping costs alone can be slashed by up to 90 per cent through the use of microfilm instead of paper for distribution of information.

The advantages of COM are abundant, but predictions of how swiftly it would catapult off its launching pad in the late 60's did not immediately materialize. There were many reasons.

When the general business setbacks of 1969 and 1970 set into our economy, the men responsible for capital investments began to squeeze their pocketbooks. They were not looking to spend money on innovations, and, understandably, many held back from investing in COM. They preferred to "wait and see" before introducing this newcomer into their computer departments.

Those were cautious days, as the decade of the 70's began, and businessmen bumped up against the hard fact that the bountiful prosperity that marked most of the 60's was not going to be a permanent thing. They looked at the cost of this strange creature called COM and not at the benefits and the savings it might provide.

And like any new technology, COM did not quite know itself just what it was and how it would fit and where it was going. There were mistakes and false starts in the industry.

But even the limping economy and the early uncertainties within the industry could not hold back the forward thrust of a good idea. By 1972, COM units were found sprinkled, though not heavily, throughout government, business and industry. In that year also, COM began gaining momentum, and sales of equipment and supplies, according to published reports, passed the half-billion dollar mark — a 20 per cent jump over the previous year.

The technology was proving itself.

13

COM Spurs Exotic Innovations

Battling an enemy with message-bearing pigeons and dispatching spies on missions of espionage add a strong touch of romance to the history of microfilm. And, today, romance blends with fascination as scientists seek to harness exotic technologies that can bend the capabilities of microfilm to serve the needs of the modern computer era.

At 3M, for example, researchers successfully wrestled with electron beams and laser beams as they sought to eliminate liquid chemicals and wet processing techniques from computer-output-microfilm applications. The electronic environment of a computer operation is best served by a COM system that processes film without raising the possibility of chemical spills or plumbing failures.

In the late 1950's, scientists at 3M began probing into the possibilities of electron beam imaging. It was basically pure research at the time, with three different groups addressing themselves to the study of what happens when an electron beam strikes a sensitive material.

Although exotic in its potential applications, electron beam imaging was not new. One hundred years earlier, a man by the name of Hess had suggested the use of an electron beam to produce images on a photographic plate. The cathode ray tube is an electron graphics device, in that images are produced on the sensitized surface of the tube face by the action of an electron beam, which is a stream of electrons that are moving in the same direction at about the same velocity.

3M gave its scientific crews wide latitude, and they were not burdened with the task of having to think in terms of a marketable product.

There were many dedicated men involved in the early studies, then in the refinements to come. Derrick Jones, in 3M's Central Research Lab, addressed himself to the job of proving that an electron beam could actually "write" on a sensitized surface. He built a piece of hardware in the laboratory that accomplished the job. It wrote "0" over and over again, and although that may appear to have been a minimal achievement, it was a giant stride forward.

Jones' piece of hardware interested Dr. W. H. Libby, who was then in Duplicating Products. Convinced that an electron beam could write — "0's" at least — Libby began research into how this capability could be applied in practical ways. The technology did not develop rapidly. In its early stages it was primarily a scientific pursuit. After the early experimentation the subject generally remained dormant for a time.

In 1962, when the Microfilm Division was inaugurated and left Duplicating Products, the electron beam came to the fore again.

Although other companies were probing into the possibilities of the electron beam at this time, 3M possessed a distinct advantage: its unique imaging techniques, particularly its development of Dry-Silver film, which required no liquid chemicals.

And so those two technologies, electron beam recording and Dry-Silver imaging, were to complement each other and evolve into something entirely new in the young COM industry.

Other men were brought into the project, destined to play dominant roles. They, too, were given wide latitude and encouragement from 3M top management, particularly from Ray Herzog, who was Graphic Systems group vice president (later to be named 3M president).

Three men were assigned primary responsibility for bringing the EBR to life. They were Marsh Hatfield, named technical director; Dave Wolf; and Rolf Westgard, who came to 3M with a highly-specialized set of qualifications. Westgard had worked in the Magnavox research laboratories and was knowledgeable in the marketing of data processing equipment. He was hired to provide direction in the broad field of automated handling of information.

Westgard also directed himself to the job of systems development, which was badly needed at the time and in which 3M had had considerable success in engineering drawings. He browsed about in the laboratories, alert for ideas. He also fed ideas to the laboratory people, saying, in effect: if you can do this for me, I think I can sell it.

There was a brisk interchange, and Westgard was indefatigable. He and others agreed that there was a market for a computer output device that could create microfilm directly, make blowbacks and give prints. Could this be done, directly from magnetic tape or the computer, utilizing the electron beam and Dry-Silver film? Could high quality images be produced with dazzling speed? Could liquid chemicals be eliminated completely in the processing function?

The laboratories responded to the task. Using the electron beam, they had an extremely high speed, high resolving power writing device, something like an electronic pencil. The medium on which this pencil would write would have to be affected by electron bombardment. And the more sensitive the electron graphic medium, the faster the beam would write.

The Dry-Silver coatings applied to the film were transparent and contained materials both sensitive to and insensitive to the electrons. The action of the electron bombardment caused the electron-sensitive material to change into a catalyst for the formation of dense images in the electron-insensitive composition. The catalytic image forming reaction was initiated by the application of thermal energy, or heat, with no further treatment necessary.

Thus the EBR COM system was developed, and a whole new marketplace was waiting. There was going to be resistance and skepticism, but here was

3M's introduction of the Electron Beam Recorder (EBR) in 1969 offered many exclusivities: Not only could it convert digital information to microfilm at the rate of 20,000 lines a minute, it could accomplish this in one operation with instant dry processing, on-line or off-line.

one answer to the massive job of handling and managing information speedily, efficiently and systematically. It was certainly not the answer for all information storage problems, but it clearly was a giant step forward.

3M introduced its EBR COM system in 1969, during an era in which other companies, too, were developing interesting and successful COM devices. The field was to be a highly competitive one, but the need for such devices to keep up with the computer was developing with urgent speed.

At 3M, the "old-timers" and the data-processing recruits sallied out into the markets which, if not exactly waiting, were at least willing, in most part, to listen. In EBR, they had some tantalizing exclusivities to offer. Not only would the system convert digital information to microfilm at 20,000 lines a minute, and at 15,000 pages an hour, it would accomplish this in one operation with instantly dry processing on-line or off-line. The combination of the electron beam and the Dry-Silver microfilm gave high quality image resolution.

In a talk delivered in Cologne, Germany, on October 27, 1967, Marsh Hatfield set some parameters for applications of electron beam recording on microfilm. He was speaking to the International Congress for Reprography. Back in St. Paul, production of the EBR system had begun, a fact which he alluded to only off-handedly at the conclusion of his presentation.

He talked about some of the things that had been learned about electron bombardment on Dry-Silver film, and he ventured some predictions about user acceptance of microfilm instead of paper print-out, acceptance which would determine the success of the computer-output-microfilm system.

What happened in later years was to carry out much of what he said that day in Cologne.

LASER BEAM RECORDING

The laser spent a few years in fiction's shadowland as a "villain." Its exotic and awesome powers, not fully understood, prompted writers to spin webs of fancy about its use as a death ray and an ultimate weapon. But its applications, fortunately, began shortly to extend beyond lethal ends.

The laser is relatively new in our scientific lexicon. Its possibilities were first advanced in 1958 by two scientists, and the first report of a working laser came in 1960. However, even today, its capabilities have only been lightly touched.

The word itself is an acronym (for "light amplification by simulated emission of radiation"). Unlike the electric lamp, it produces a non-diffusing light that organizes the energy waves emitted by a stimulated atom so that they travel in the same direction and at the same frequency.

Simply explained, the process produces an extremely intense radiation that can be directed at a very tiny area. The laser develops pure light, a beam that can cut a hole in a steel plate a third of a centimeter thick without using enough energy to boil an egg. That beam also can bore a precise hole in a diamond in two minutes, and perform delicate surgery on the human eye.

Laser has been described as the first coherent light source, in that all the waves in the beam are exactly in phase with each other. It does indeed possess the potential for fearsome and disastrous uses. But today it is providing important and growing service in medicine and dentistry and in expanding industrial and scientific applications.

In the laboratories of the 3M Company in the mid and late 60's, scientists were probing into laser, the super cutting tool, as the source of the most powerful imaging energy ever known — one that could be used to generate microfilm images.

The EBR was being introduced, accepted and acclaimed in those days as the first and only dry-process COM unit. It produced images of outstanding quality and was ideal for producing images on 16mm roll film. Although it had the capacity for producing fiche — which was gaining in use — EBR's output required a second stage operation for conversion to this format. The Laser Beam Recorder (LBR) has fiche and 16mm capability.

The experimentation moved ahead at 3M, and many of the leading characters in the drama of development were those who had been in on the breakthrough with EBR. There were delays; there were frustrations; there were false starts. The laser, for all of its intense power, can be tricky. The goal was a unit that would produce with superb efficiency, one that would utilize the exotic technique to peak and practical performance.

On February 13, 1974, in New York City, 3M Company introduced to the world the first Computer-Output-Microfilm system to use a laser to record alphanumeric symbols of highest quality on either 105mm microfiche or on 16mm roll Dry-Silver microfilm — again, as with EBR, developing the microfilm with a completely dry process, requiring no chemicals.

In introducing the unit, Scotty McArthur hailed it as "an important technological breakthrough" and a logical follow-up to the EBR.

The beam in the 3M laser unit originates in a helium-neon laser that produces only 6 milliwatts and operates at room temperature. An acousto-optic modulator breaks the beam into zero-to-seven deflected beams to write on a grid 7 positions high by 5 positions wide.

The unit offers flexibility and convenience. It handles a wide variety of input formats, requiring little or no software modification. It accepts 7- or

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The laser is relatively new in our scientific lexicon. Its possibilities were first advanced in 1958 by two scientists, and the first report of a working laser came in 1960. However, even today, its capabilities have only been lightly touched.

The word itself is an acronym (for "light amplification by simulated emission of radiation"). Unlike the electric lamp, it produces a non-diffusing light that organizes the energy waves emitted by a stimulated atom so that they travel in the same direction and at the same frequency.

Simply explained, the process produces an extremely intense radiation that can be directed at a very tiny area. The laser develops pure light, a beam that can cut a hole in a steel plate a third of a centimeter thick without using enough energy to boil an egg. That beam also can bore a precise hole in a diamond in two minutes, and perform delicate surgery on the human eye.

Laser has been described as the first coherent light source, in that all the waves in the beam are exactly in phase with each other. It does indeed possess the potential for fearsome and disastrous uses. But today it is providing important and growing service in medicine and dentistry and in expanding industrial and scientific applications.

In the laboratories of the 3M Company in the mid and late 60's, scientists were probing into laser, the super cutting tool, as the source of the most powerful imaging energy ever known — one that could be used to generate microfilm images.

The EBR was being introduced, accepted and acclaimed in those days as the first and only dry-process COM unit. It produced images of outstanding quality and was ideal for producing images on 16mm roll film. Although it had the capacity for producing fiche — which was gaining in use — EBR's output required a second stage operation for conversion to this format. The Laser Beam Recorder (LBR) has fiche and 16mm capability.

The experimentation moved ahead at 3M, and many of the leading characters in the drama of development were those who had been in on the breakthrough with EBR. There were delays; there were frustrations; there were false starts. The laser, for all of its intense power, can be tricky. The goal was a unit that would produce with superb efficiency, one that would utilize the exotic technique to peak and practical performance.

On February 13, 1974, in New York City, 3M Company introduced to the world the first Computer-Output-Microfilm system to use a laser to record alphanumeric symbols of highest quality on either 105mm microfiche or on 16mm roll Dry-Silver microfilm — again, as with EBR, developing the microfilm with a completely dry process, requiring no chemicals.

In introducing the unit, Scotty McArthur hailed it as "an important technological breakthrough" and a logical follow-up to the EBR.

The beam in the 3M laser unit originates in a helium-neon laser that produces only 6 milliwatts and operates at room temperature. An acousto-optic modulator breaks the beam into zero-to-seven deflected beams to write on a grid 7 positions high by 5 positions wide.

The unit offers flexibility and convenience. It handles a wide variety of input formats, requiring little or no software modification. It accepts 7- or

3M's Laser Beam Recorder (LBR) is an important technological breakthrough, offering computer users considerable flexibility and convenience. Output is at rates of two to five pages per second, with standard reduction ratios of 25X, 42X and 48X.

9-track tapes recorded at 200, 556, 800 or 1,600 bits per inch, can be operated on-line to a selector or multiplexor channel, and will interface with a minicomputer. It reproduces microfilm images at the generally accepted reduction ratios of 25X, 42X and 48X.

And the LBR is remarkably compact. It consists of two cabinets, one for the controller and the other for the recorder. The controller cabinet is 72 inches high, 23 inches wide and 29 inches deep. It contains a magnetic tape drive, the controller and the system power supplies. One of its functions is to format information before it is fed to the recorder.

The recorder contains the laser assembly suspended from a shock-mounted plate. It supports the film transport at a convenient height for a standing operator.

A film processor dry-processes and delivers 105mm fiche or 16mm film.

Format selection is simple, with thumbwheel switches. The operator quickly learns to select page size, margins, starting point, number of rows and columns and index frame locations — all to sub-millimeter accuracies.

In developing the LBR, 3M advanced another big step in its involvement in micrographics. The capability of recording directly on 105mm fiche is of paramount importance, but 3M leaders emphasize the growing importance of microfilm systems that are oriented to the computer. The development of another COM unit that employs dry development of the film, by-passing the mess and hazard of chemicals in an electronic environment, also overcomes one of the objections of many persons in the data processing field.

With the introduction of the LBR, many 3M people recalled the day when Derrick Jones at Central Research proved that the electron beam could write. He did it by sending an electron signal that wrote a seemingly interminable line of "0's" over and over again. In those days Jones was merely seeking to show that it could be done, but that seemingly humble accomplishment was one of the important steps on the way to marketable EBR, then to the important laser achievement.

One of the problems that developed to hinder acceptance and sales of COM units in its early days, when the natural enthusiasms of those in the microfilm industry soared somewhat out of bounds, was the existence of two different languages — one used with familiarity by the data processing people, the other peculiar to the microfilm people. This communications problem at first brought about some painful and frustrating experiences.

Previously, the marketplace for microfilm had been made up of people who had little or nothing to do with the computer. Suddenly, a whole new ball game was underway; a new level of sophistication had been reached. Source documentation would always be important to the microfilm industry, but the single star system no longer existed.

And so the new type of marketing expert and salesperson mentioned earlier, the person comfortable with the language and varying needs of the data processing industry, was brought in to help carry the banner of COM. He could interpret to the laboratory the individual needs of customers so that a compatible match could be made.

It developed, too, that customer education became even more important than the hardware itself. What surrounds the hardware? How can it be worked into a total system? Those were questions that had to be answered. And the answers were provided by computer oriented men like Richard J. Conners, marketing director for 3M's Microfilm Products division, who put into practice the theory that "It's a systems world."

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Thumbnail Case Histories of COM Users

How is COM being used in this highly-industrialized, extremely complex nation of ours? Where is it being used? What is it accomplishing in the way of cost savings, in the way of greater efficiency, in the way of making essential information readily available to help in making decisions?

Scan a growing list of business organizations, service units, governmental bodies, cultural agencies, and you will find COM installations busily at work. They are performing tasks that only hint at what will happen in the future. For this is still only a young technology, this business of COM. It is proving itself in the tough jungle of cost justification.

Remember this: COM represents the first three letters in the word, COMmunications.

But let's look at how COM is working today.

A major heavy equipment manufacturer had a problem with parts information retrieval. Many thousands of pieces of information were stored in the computer. Regular updating was vital, and many once-a-month duplicates had to be sent to facilities in this nation and abroad. The process required six weeks for printing, binding and delivery to distant overseas points.

Not so any more. With COM, the job has been cut to two days. COM produces a master film, and duplicate film copies are made, put in lightweight, handy cartridges and mailed to the scattered facilities. The firm estimates its savings at $81,000 a year – computer time savings, postage and shipping savings, savings in labor time and equipment previously needed to decollate, burst and bind computer print-outs.

In the District of Columbia, a governmental agency faced the problem of its computer printer being overloaded. Often, 27 copies of a single report were needed. Even a higher-speed printer didn't solve the problem.

COM proved to be a better way. The system installed is used only about 10 hours a month, but actual savings of $4,000 a month, compared with paper printing, have been realized. And computer time has been slashed by 30 hours per month, providing time for leasing to other agencies.

Cost-justification? Certainly, but agency officials say that the role the EBR equipment plays in information processing has achieved such importance that money-savings have become a minor reason for using it. The alternative would be to eliminate some of the information handling jobs

All the information in the bound book of print-out shown can be compactly contained in one cartridge of microfilm.

being performed.

A state agency in the midwest has the problem of a job bank. Some 7,000 job openings occur every day, and data on these is processed through a computer and recorded on microfilm, updated daily. Eighty prints are made from the film and distributed to state offices.

A huge stockbroker organization has a stock record file that takes up some seven million frames of film. All of this information used to be in books. The need for copies of information in these books grew, then multiplied. And the books had to be kept current. Using computer-to-paper output, it took 11 days to update the files.

COM to the rescue. Now the files are updated daily, with the records in microfilm cartridges. Storage space has been significantly reduced; access has been simplified and speeded; hard copies are quickly available through reader-printers. Savings are $12,000 a year.

Insurance companies traditionally have been buried in paper. That is why they were among the earliest and largest users of microfilm. They need information; they need it accurately and speedily.

A case in point is one midwest firm. It uses COM in many ways, but one of its principal applications is a master file that contains a complete history of all accounts. It must be updated weekly and completely reproduced on a quarterly basis. It contains some 700,000 frames of information.

Under the old system, 24 hours of turnaround time were required, including four hours of computer time and one hour of line printer time every day to process some 800 inquiries about dividend histories.

Now, with a COM system, the information is immediately available, and the computer outputs a COM tape just once a week.

An oil company in Tulsa, Okla., used to handle

90 tons of paper print-out a year at a cost of $140,000. The computer busily spewed it out — all of it necessary information. With COM, the same amount of information is being handled, but at much less cost and with much less bulk. One report, as an example, requires microfilm which weighs about five pounds. In paper form, that same report weighed 1,400 pounds.

The petroleum company used to pay about $120 to send a 5,000 page print-out of its customer accounts file to the marketing department's credit center in Kansas City. The cost with microfilm for the same amount of information? Approximately 24 cents.

A western Blue Shield office had growing pains. It reached the point where it was handling claims for five million members and managing payments under Medicare and Medicade involving six million claims in one year alone.

The paper handling problem was staggering. Records were kept in five 80-drawer electric file cabinets that took up 200 square feet of space. Ten clerks busied themselves at these mechanical units, digging out and refiling folders, handling up to 400 inquiries each day from members. More motorized cabinets, more clerks, more floor space requirements loomed.

COM virtually eliminated floor space requirements with compact microfilm files, and the need to expand personnel was averted. The roll film greatly increased file integrity, and everybody is happy, including the clerks who formerly rooted about through the file cabinets in frantic search of information.

An Arizona manufacturer had a problem faced by many companies in this information-oriented age. The firm had a persistent requirement to supply parts buyers with reliable last-minute information on parts, prices, inventories and locations.

These reports ran up to 3,000 pages in length, and 21 separate copies were required.

Before COM, buyers had to wait until midmorning every day for paper print-outs that the impact printer, with its limited capacity, had taken all night to produce. Often the material was virtually unreadable.

COM neatly eliminated that bottleneck. Now, the reports are produced in 2 1/2 hours, including pick-up and delivery time. Each copy is sharp and clear. Speed, efficiency, order. Another important benefit for the Arizona manufacturer comes in materials cost savings. The paper print-outs cost 3 cents per page. With microfilm, the cost is only 1.6 cents per page. Meanwhile, the expensive computer can address itself to far more important tasks than printing.

A public service company in Michigan found the benefits piling up from the use of COM. The utility discovered that it could eliminate a night shift of file clerks who had been kept busy updating customer account files in preparation for the next business day. Now the task is accomplished by COM, and telephone service operators are provided microfilm cartridges every day for reference when customers call in for information. Customer relations have improved, because the "look-up" time on the average call has been reduced from two minutes to less than 30 seconds.

Another utilities firm switched to COM with happy results. The firm has about one million customers, and every day some 6,000 of them are on the phone with some problem. Fast response to these questions provides good customer service and good economy. With its EBR unit linked to a highly-advanced on-line computer system, the service is indeed speedy. Within 7 seconds after a customer calls, all pertinent data about his account is flashed on screens for the telephone operator. The big utility also reports that it saves from 12 to 15 printer hours a day with its COM system.

Many firms and organizations using COM point to yet another advantage. That is the capability to print forms simultaneously with data. It meets a problem many companies face of having to maintain a costly inventory of forms that are periodically made obsolete. With EBR the forms are stored on microfilm, loaded into the versatile unit and merged automatically. Single forms can be placed on every page of a file or merged selectively with various pages.

Here is a comparison sometimes made when COM representatives are on sales or educational calls: in output capability, 5,000 electric typewriters equal 10 impact printers equal one COM recorder.

SOCIAL SECURITY; AN OUTSIZE EXAMPLE

When you are ready to claim Social Security benefits, you will be amazed and comforted at the speed and efficiency with which the records of your payments and those of your employers, however many there might have been, are verified. The process of locating your individual file from among tens of millions, takes just seconds. It is a process of pushing some buttons.

The Social Security administration is perhaps the world's largest user of microfilm systems. The incredible amount of data that must be kept and reliably and swiftly retrieved could not be managed without computer-output-microfilm and related systems.

Social Security has been using microfilm in mammoth quantities since 1936. In the late 50's the administration went to COM.

The size of the microfilm system is easily shown by some of the statistics. In its operation,

Social Security uses 2,600 readers or reader-printers. Some 28 million beneficiary records are on microfiche, with the rest on 16mm and 105mm roll film. In the equipment array are 30 document cameras, 13 vesicular and diazo duplicators, two COM systems.

The Social Security administration splices updates to 400,000 reels of microfilm each quarter. It ships 4 million cut fiche to 875 offices nationally on a bi-annual basis.

Social Security officials say they have 100 million feet of microfilm stored archivally in boxes. And who else, they ask, spends $100,000 a year just for splicing adhesive tape? Who else has nearly 800 programmers working on COM programs? Who else uses a reader-printer that makes continuous line prints from 50 different locations on one reel of film?

There are bugs in such a massive system, and there are awesome workloads. The system must keep pace with the latest inventions and improvements in the microfilm and computer fields, must be dynamic in responding to the demands of the Social Security laws, which change frequently. In addition to retirement benefits, there are Medicare and disability claims. More record problems.

The system constantly is being upgraded as new and better equipment and processes come from manufacturers. The COM systems were upgraded in 1970 to 1,600 bpi input and to the use of interchangeable cameras – 105mm and 16mm.

In reviewing their COM experience, Social Security officials fervently describe it as the most dramatic, space-saving, money-saving, labor-saving versatile tool since the pigeons flew over Paris with their microfilm loads 100 years ago.

The huge microfilm system works very well at Social Security, for which more than 200 million Americans can be grateful.

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Engineering Drawing Market: An Update

What has happened over the recent years in the field of engineering documentation? Here was one of the first areas in which the benefits of microfilming were demonstrated. It remains a large and important field, and micrographics as an industry has kept apace with its steady growth.

Complete systematization has been the road that has led to greater efficiency than ever before, to remarkable space savings and ease of handling, and to important cost savings.

Engineering drawings are cumbersome. The original documents can range in size up to 36 by 48 inches. They are subject to wear and tear. They are vulnerable to human error and carelessness. They can be defaced and destroyed by disaster, by fires that spread like a malignancy, by flood and storm, by vandalism. They can be mis-filed, lost, even stolen. They are expensive to produce; often virtually impossible to replace without costly time and financial losses.

Yet engineering documentation today is vital to virtually every phase of design, scheduling and production. Search through the many departments of today's industrial complexes, and you will find most of them depending upon engineering drawings or allied records.

Research and development, scheduling, purchasing, manufacturing, inspecting, estimating, re-

working — all require documentation to accomplish their tasks. Lacking this method of communication, we would have to improvise our way in a figure-it-out-for-yourself world. The necessary tools and knowledge to design, buy, build, quote, sell and improve the output of industry would be impossible.

Microsystems, today more than ever before, are insuring that this vital documentation is easily at the fingertips of those who need it.

At the 3M Company, for example, a complete system has been developed for handling engineering drawings, and that system can be tailored and modified to meet the needs of small and medium size companies; as well as very large firms. The demands of storage and retrieval and the needs for file integrity are not circumscribed by size.

The system reduces bulky drawings to compact, one-size aperture and copy cards for ease in filing. It provides complete file integrity and security, with all of the advantages of fast retrieval and easy access. It permits quick, economical routing to lo-

Microfilm systems have ensured the safe, convenient, compact storage and easy retrieval of large, cumbersome — but all-important — engineering drawings.

cations anywhere. It saves space by as much as 96 per cent over paper, and the microfilm will not deteriorate.

Here is the way 3M engineering records are handled — a method used in firms of all sizes across a broad spectrum of industry:

The original drawing is taken to a 3M 2000 processor-camera. At the push of a button the camera produces a finished microfilm aperture card. These cards are all the same size, regardless of the size of the original document.

The original document can be stored in a vault or in an off-site security location, where it will remain intact and in perfect condition.

The master aperture card then can be inserted into the card-to-card copier, where duplicates are reproduced in seconds, as many as needed for in-plant or other satellite locations. The master card is consigned to a security file, while the duplicates become the working copies, with indexing corresponding to the master.

Now, it is a simple job to put the card into the reader-printer and obtain large-screen viewing or get hard copies at the push of a button. Sharp, clear copies are delivered at sizes up to 18 by 24 inches. The reader-printers can be stationed at varied locations, in every department or plant location that needs access to the records.

The economy of such a micrographics system really proves itself when mail distribution is necessary. A total of 1,000 aperture cards, which are themselves reproducible, weigh 80 pounds less than the same number of full-size copies. And postage costs, like the costs of food and energy and just about everything else we buy and use in these days of the 70's, promise to keep soaring.

Military branches of the U.S. government have put the system centered around the 2000-Series processor-cameras under their evaluation microscopes. The studies, conducted under demanding conditions and with a detached show-me approach, have given the equipment extremely high marks for effectiveness and cost justification.

ENTER: THE QUANTIMATIC

There are many engineering firms and manufacturing companies with large engineering and technical departments that have high requirements for copies of drawings and other documents. They need specialized, high volume equipment that will give them consistently high quality prints at low cost.

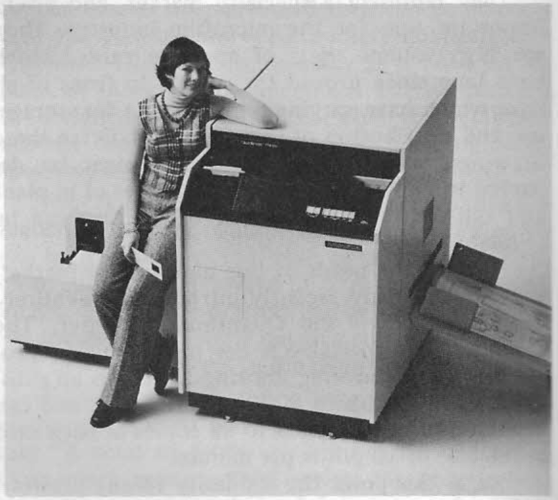
They represent a specialty market, and a very important one for the microfilm industry. They are high volume users of aperture cards, which have long since proved their value to firms of all sizes which have varying requirements for storage, use and distribution of their drawings. Often these drawings, with frequent revisions, must be delivered in copy form to a great number of in-plant and outside locations. Speed of delivery can be critical.

To meet the needs of this high volume market, the 3M Company recently introduced an entirely new product — the Quantimatic printer. The Quantimatic's specialty is the high-volume reproduction of engineering drawings. It offers an automatic feed for up to 200 aperture cards, and can be dialed to make from 1 to 99 copies of each card at the rate of 10 prints per minute.

But at this point the similarity to any previous 3M product ceases, because the Quantimatic can print on plain bond paper. This capability is a new process for 3M, whose reader-printers employ electrolytic and Dry-Silver technologies. Behind the Quantimatic's introduction are years of diplomatic-style negotiation, and research and development work.

Part of the credit goes to Japan. The basic technology was developed in that country, where it came to the attention of 3M's Scotty McArthur. He saw the potential for further development and use of the technology outside of Japan. McArthur initiated lengthy negotiations that eventually developed into an agreement giving 3M exclusive rights to the process in every country except Japan.

But this was only a beginning. Two years of intensive laboratory work was required, much of it in St. Paul, to re-design and refine the equipment, to improve it and test it — with 3M equipment and with customer equipment and cards.



The Quantimatic microfilm aperture card printer is capable of producing ten prints per minute on plain bond paper, colored stock or pre-printed vellum. It is especially suited for high volume reproduction of engineering drawings and has an automatic stack feed for up to 200 cards.

Many favorable evaluations were made as the developmental work progressed. Here was a very fine imaging technology, with the fill-in of heavy black images being particularly outstanding. There was no ghosting or "graying" of these heavy images; printing latitude was exceptionally good.

The new equipment was readied for demonstration at the annual meeting of the National Microfilm Association in Detroit in April, 1973. It acquitted itself very well at that heavily-attended exhibition and conference.

The Quantimatic, for all of its capacity, is an attractive unit that stands less than 50 inches in height, is about 33 inches wide and 48 inches deep. Thus, it is about the same size as the average home refrigerator. The operator's control panel is simple, with a comfortable glow of light indicators to guide the user through all phases of operation and to warn him if there is any malfunction or equipment requirement.

In marketing this new piece of equipment, 3M states frankly that it is designed for high volume printing and is most economically efficient for companies that have print requirements of 10,000 prints per month and upwards.

The first plain paper printer from 3M is a versatile unit. It can make full-size or reduced-size prints from U.S. standard sizes A through E, and it produces full or reduced-size paper copies of international standard drawing sizes A-2, A-3 and A-4.

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In Education: Microfilm Comes Into Focus

While microfilm will never replace paper in our educational system, it is serving as a valuable complement to the massive paperwork of many schools.

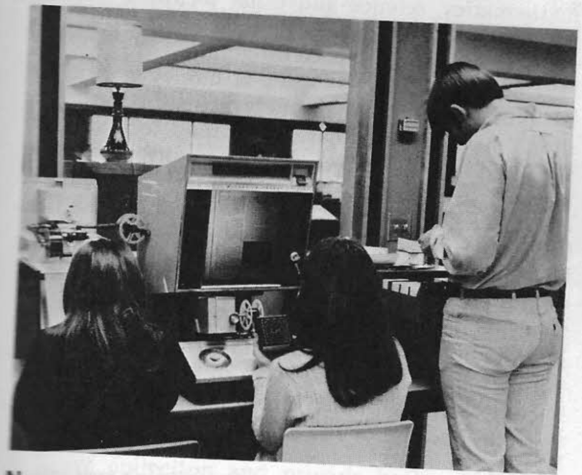
The results: space and cost savings, expansion of available information; quick, convenient access to data, and preservation of materials.

In the school library, and in administrative offices, push-button retrieval of microfilmed information is fast replacing musty old methods of maintaining periodicals, newspapers, files and records.

Even in the classroom, some progressive schools have experimented with specialized microfilmed programs to test the medium's effectiveness. Results have shown microfilm's many potential benefits as an instructional tool — greater student attentiveness, versatility of subject presentation.

Use of microfilm in education has steadily increased and diversified in recent years. Prior to World War II, it was primarily confined to the library, where old, seldom-used newspapers, periodicals and other documents were placed on microfilm. Leading academic institutions began to buy these data banks of information as replacements for space-consuming conventional paper materials.

They knew that savings in space and binding costs would justify the use of microfilm; they were



Newspaper and periodical files are maintained in many school systems, effecting substantial savings in storage space and enabling the schools to make available more materials to students. Here, students are shown viewing microfilm on a reader (left), reader-printer (center) and checking microfilm roll availability (right).

less sure, however, how the user would respond to machine-accessed printed materials, as opposed to having the original document in hand.

Microfilm in education moved slowly throughout the war, and for several years thereafter.

Then, in the late 1950s, two occurrences spurred action on all fronts: President Eisenhower's passage of the National Defense Education Act and Russia's astounding announcement of Sputnik, the first satellite launched into space.

These two events probably gave the biggest boost to the use of microfilm in the education market. Suddenly, great emphasis was placed on mathematics, science and other technical training to supply the engineering requirements the U.S. needed to develop a space program.

Under NDEA, great sums of money were spent to build up library resources. Institutions that didn't have needed materials turned to microfilm to build up their fact files. Concurrently, they turned to readers or reader-printers to facilitate easy access to the film and information these files contained.

Microfilm proponents never claimed that it would solve the problems of illiteracy, reading difficulties or social inequalities. They did say, however — and still do — that microfilm is a basic information tool, that no form of education can be accomplished without information, and that microfilm, because of the benefits it offers, has a role to play.

That role burgeoned as microfilming systems — film and equipment — improved, as the economics and convenience of microforms began dramatically to prove themselves, and as the 1960's, incredible explosion of information continued to mushroom. Use of microfilm spread to all sizes, levels and locations of educational institutions.

MICROFILM IN THE LIBRARY

In the school library, the foremost reason for the use of microfilm is space savings. As Boyd Bolvin points out in "Libraries of the Future", man's store of knowledge doubled between the dawn of the Christian era and 1750, and doubled again by 1900. The next doubling occurred by 1950, and 1950's knowledge had doubled by 1960. At this rate, the amount of knowledge will more than double every year between now and the year 2000.

Additionally, 100 new titles and four new jour-

nals are published every day. An established rule of thumb holds that a high school library should have 20 books per student; a doctoral program, 200 titles per student. Clearly, the greater the use of microfilm, the greater the amount of materials a library has space to accommodate.

Microfilm takes up about 96 per cent less space than original paper documents. For example, 52 issues of a weekly news magazine — approximately 5,800 pages — can be contained on four 16mm cartridges of microfilm, which is stored in a case approximately 4 x 4-inches in size. Three 35mm cartridges will hold the same information — or several years' issues of less frequent periodicals, or many issues of a newspaper.

Thus a school library, by using microfilm for periodicals and other documents — especially those more than two years old — can free space for a larger collection and provide better service to boot.

School libraries can buy microfilm of most periodicals and newspapers for less money than the combined cost of space and binding.

Material integrity is a further advantage of microfilmed information. Most collections of newspapers and periodicals are subject to considerable wear and tear; often a student or teacher will find that the desired article or reference has been clipped from the library's publication. Coupons, too, are a temptation and, when torn out, valuable data on the reverse side is gone forever.

With microfilm, educational archives remain intact, and the library maintains all its information for all its users. Instructors who give assignments requiring that several students study the same material are assured that all students will have access to that information in the microfilm file. It is doubtful that anyone has ever clipped anything from microfilm!

Neatness is a further advantage. A compact roll of film holding many issues of a magazine or newspaper can be shelved much easier and tidier than the stack of material it represents. Additionally, filing and refiling is normally accomplished with greater speed, efficiency and integrity — there are no missing or misplaced magazines or documents to frustrate the next potential user.

Use of microfilm is not beyond the realm of possibility for most educational institutions. All a school library needs to get into microfilming is the microfilmed data and a reader or reader-printer from which the information is retrieved.

To use the system, a student or teacher simply seeks the desired subject matter on the index, inserts the proper microfilm spool, cartridge or microfiche into the reader, advances the film to the proper setting, and reads the information on the TV-like screen. On a reader-printer, the push of a button produces a printed copy of the page in seconds.

ERIC AND VIEW

In addition to the massive amount of periodical and newspaper data available on microfilm, two major microfiche systems exist for educational use.

ERIC (Educational Resource Information Center) is a program for distribution of information to the educational community from the United States Office of Education. ERIC provides educators with background and updates on a wide range of major subjects — literature, art, reading, science, etc. Covering new developments, new discoveries, new ideas, ERIC provides a school's professional staff with a wealth of instructional materials from across the nation, enabling members to research a subject in depth, draw a quick synopsis of the current status of a scientific study, familiarize them-

selves with a pertinent area of information, etc.

A second program, VIEW (Vital Information for Education and Work), was developed by vocational education institutions and schools, using 3M microfilm hardware. VIEW provides an occupational information resource service which collects, stores and disseminates descriptions of jobs and

Libraries, which were among the first major users of microfilm, have expanded their use beyond the miniaturization of periodicals and other documents; many are now using it to handle and manage the traffic of their book business.

the educational requirements for existing and realistic entry level careers in a particular geographic area.

VIEW materials tell, basically, the "who, what, where, why and how" about jobs in the student's immediate vicinity. As of 1975, thirty-two states have adopted the program.

MICROFILM IN PUBLIC LIBRARIES

Public libraries, too, have responded to the advantages microfilm offers. It has been forecast, undoubtedly with truth, that the last quarter of the 20th century will find more words on microfilm than on paper in major U.S. research libraries.

The U.S. Library of Congress has more than 1,000,000 microforms on file today, and the job of miniaturization has just begun.

A few years ago, the New York Public Library, whose research collection is one of the finest in the world, authorized 3M Company's Microfilm Products division to microfilm and market copies of items from the research collection so that they will be available to students and scholars everywhere.

The announcement a couple of years ago by Library Resources Incorporated, the microfilming arm of Encyclopedia Britannica, that it was making available on microfiche 20,000 volumes of the Important Library of American Civilization Series was significant. The service offered the 20,000 titles for about $15,000. Interesting indeed, when it is considered that some 400 colleges now have fewer than 18,000 titles and that the acquisition of 20,000 titles would cost more than $200,000 in hard copy form.

There also is little doubt that the future will see a greatly increasing use of COM by libraries. At a recent librarians' conference, a speaker pointed to COM's widespread use by business and industry

and predicted that the tool will be a big factor in moving microfilm in libraries from a dead storage medium into a live communications instrument.

The speaker cited the use of COM at Chrysler Corporation, where 2 million pages of data a month on original film are being placed in the computer. Each month, four million pages of data are being generated and retrieved via more than 100 terminals located all over the world.

MICROFILMED INSTRUCTIONAL MATERIALS

Microfilm offers tremendous capabilities in this area, but the surface has hardly been scratched. Where such programs have been employed, they have been very effective, resulting in greater diversification of classroom activities and participation, more interesting presentation of information, stimulated interest, increased reading skills and higher test scores. Additionally, the programs have made individualized instruction possible for special study programs.

Experiments have been conducted in California junior colleges to assemble literary student reference materials on fiche. The materials include both current and retrospective criticisms on major authors and serve as a substitute for library journals no longer available.

Each student receives the fiche and retrieves the information as needed on reader-printers. So, for only 10 to 11 cents per sheet of fiche, the student has available over 90 pages of valuable information on a major author, such as Hemingway.

In California high schools, small series of journal articles have been compiled on aperture cards to serve as supplementary reading materials for individualized instruction assignments – on current affairs, for example. The material is up-to-date, easily accessible, and it provides information the student would not otherwise have. However, until there is some resolution of copyright complications, such usages will be restricted.

In still other schools, experiments have been successfully conducted to administer kindergarten through eighth grade math tests via aperture cards. The students simply view the exam on classroom reader-printer screens, or obtain a print-out, and complete the test.

What is needed in this area is for educators to initiate and develop programs and materials on a wide basis. The potential benefit of such materials is unquestionable, but available resources are limited at this time.

Use of microfilm in educational systems is growing each year, as the medium continues to prove itself across the country in libraries, in the ERIC and VIEW programs and in administrative offices.

Its potential is virtually limitless, and each school or school system will discover this for itself, at its own pace. The educational community is in the process of regrouping, owing to smaller enrollments and less available funds, so each system must look at all alternatives and decide how to get the most for its money. Again, microfilm has proved its worth in the cost area in many ways.

It is impossible to educate without information. How can teachers and students evaluate the present if they know nothing of the past? They must have the tools. That's one reason why many people believe the computer will be vital as an educational tool; the importance of microfilm is increasing for the same reason.

Microfilm already is playing an important role in the education process. It seems certain that educators of the future will make more and greater use of its technology.

17

Micro-Radiology: A Boon to Medicine

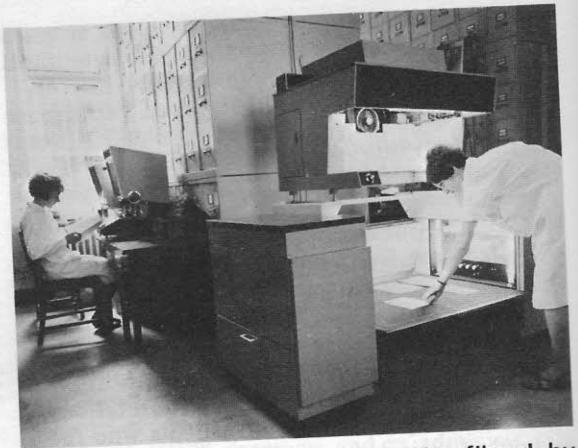
There are some 8,000 hospitals in the United States. And you can add to that figure thousands of clinics and other places where medicine is practiced.

One of the big jobs facing these institutions is to take x-rays and make other documentations of the millions upon millions of patients who file in and out of their doors every year.

It is estimated that 350 million images are taken each year to record what's happening inside the bodies of the sick and injured. On file in the overcrowded x-ray and diagnostic departments and in other scattered areas of the hospitals and clinics are literally billions of reproductions. At the Mayo Clinic complex in Rochester, Minn., alone are approximately 7 million filmed x-rays on file.

The job of maintaining these critical files is a giant one. It has become almost unmanageable in many institutions, despite the care exercised by dedicated hospital workers. Lost x-rays are not uncommon, and documents that are misplaced and mis-filed take precious and expensive time to hunt down.

In Massachusetts General Hospital a recent study showed that necessary films could not be furnished on request about 30 per cent of the time. At big Cook County Hospital in Illinois it was determined that, more than 40 per cent of the time, radiological examinations could not be retrieved on demand. The hospital was using a con-



Medical records and X-rays are microfilmed by many hospitals today. Here, records are positioned for microfilming on a 3M processor-camera, which takes only 45 seconds to produce a fully processed aperture card — a data processing card inset with a frame of 35mm microfilm. At left is a 3M reader-printer on which the microfilm is retrieved.

ventional sign-out and return system for the original x-rays.

The hospitals cannot be censured for this situation. The sheer mass of information resulting from radiological examination has become too burdensome to handle with outmoded and expensive methods.

Fortunately, an answer has been provided to the all-too-frequent cases of lost or misplaced medical documents, where an emergency often is involved and the proper care of patients is critically at stake. The science of micrographics has moved in to correct a situation which was growing worse every day.

3M Company, drawing upon its long experience in developing equipment for recording engineering documents, developed in the early 1970's a totally new system for the micro-duplication of original x-rays. It is specifically designed for hospitals, and has been adopted by many institutions to solve a host of aggravating and costly problems.

The 3M Micro-Radiology System is as simple as it is effective. At its heart is a specially-developed processor-camera, the 2000-NP. This unit is an ingenious adaptation of other equipment in the 2000-Series, with the chemistry and film changed so that it possesses an exclusive capability to copy x-rays with accuracy and high resolution to enable them to be read with complete confidence by radiologists and other diagnosticians. The system is a complete one, and it can be operated with ease by hospital filing personnel with no special skills or technical training required.

If the heart of the system is the processor-camera, its arteries include a unique camera card — a tabulating card with pre-mounted film chips. The card provides instant imaging, one-unit file size, rapid retrieval and reliable reference. In addition to the card are portable projectors that can be used under room-light conditions for viewing both aperture cards and 35mm slides. These projectors permit satellite locations to be established. There also are readers with special capabilities, plus additional accessory equipment to facilitate use.

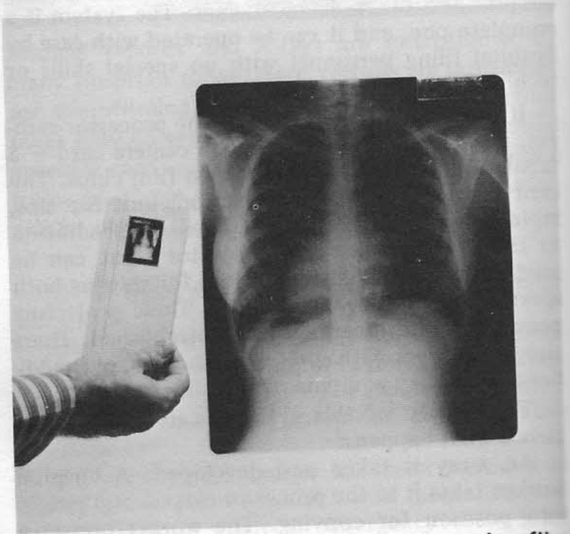
The beauty of this system is its ease of use. Here's what happens:

An x-ray is taken and developed. A hospital worker takes it to the processor-camera and puts it into position for copying. The worker presses a button and a camera card is carried through a completely automatic cycle that develops, fixes, washes and dries in less than 60 seconds.

And here is the next step that is so comforting to hospital personnel: the original x-ray is returned to the radiology department, where it will not have to be checked in and out (and possibly misplaced, lost or mis-filed). The miniaturized copies can be delivered immediately for viewing at full size in any area inside or outside the hospital.

A midwestern hospital installed this system, and what happened thereafter attests to its effectiveness. The hospital is a 2,500 bed teaching institution with 24 full-time radiologists and 34 residents in the radiology department, which conducts some 350,000 examinations a year.

It was not only that about 40 per cent of the x-rays were not available on request; there were further problems of wasted time and unnecessary



X-rays can be accurately reproduced on microfilm aperture cards which also can be key punched with diagnostic and statistical data for eventual data processing and computer applications.

activity in the file room. Often, repeat examinations were required.

After installation of the Micro-Radiology System, the hospital kept careful records. It discovered that under the new system less than 4 per cent of radiological examinations could not be retrieved on demand, as compared with more than 40 per cent under the old system. That's a reduction of more than 90 per cent. And it further developed that in all instances those films which could not be found immediately were the original radiographs.

Some interesting figures on time savings developed from the experience of the hospital. With the house staff no longer having to trek to the file room and wait for films to be located, some 26 hours a day of staff walking and waiting time were saved. The films, in miniature form, were simply delivered to the staff members. About 16 hours a day of the file clerks' time in the main x-ray department also were saved.

Other cost savings and convenience benefits have been reaped by the hospital and others which have adopted the new microform system. The cost of the camera cards is estimated at 12 cents each, including chemicals and films. But up to four images can be put on one film, and national averages show that this is the number of x-rays usually required for an examination.

The system is not limited to x-rays as such, but also can copy such documents as EKG's, reports, charts and graphs, many of which will be in opaque original form.

Camera cards can be sent through the mail in a standard envelope with regular postage, and 60,000 of them can be filed in a single 10-drawer filing cabinet. Filing space reductions of up to 90 per cent as compared to original radiographs have been achieved.

The physician can view vital medical documents in his own office, take them to a conference room, send them to a consultant or make them available for student study. The film chip in the camera card can be easily slipped out and inserted into a standard 35mm slide mount, thus increasing its versatility. It also can be projected to large size for classroom and teaching stations.

The camera card is unique and designed to accommodate a variety of vital information. It can be inscribed with patient data, and key punched with diagnostic, statistical and other information for eventual data processing and computer applications.

The system, although it employs micrographic techniques, is different from ordinary microfilm systems. It was developed specifically for hospital and physician use to copy, in precise detail, with extremely high resolution and tonal reproduction characteristics, very specialized medical documents. Thus, camera, film and viewing equipment also are highly specialized.

And another benefit may develop. The patient who likes to sally forth from the hospital and talk about his operation can now flip out his own card and stage a screening for his family and friends to show them just what was removed.

18

When Disaster Strikes

Microfilm's beginnings can be traced to the discovery of its capability for providing document security. Nowhere is this more dramatically demonstrated than in disasters, which can strike with savage indiscrimination.

The tragic wake of lives lost and property destroyed is recounted in the headlines that follow floods, fires, earthquakes, tornadoes and other calamities. Damage often runs into many millions of dollars. Losses suffered in the destruction of vital records and documents of all kinds may be less visible and dramatic, but these losses often are impossible to regain.

The raging flood waters that pounded through Rapid City, S.D., in early 1972 left behind a huge toll of records destruction. Schools, libraries and hospitals were victims. So were businesses; some were literally wiped out.

Most businesses today are totally dependent on their records. In the Rapid City tragedy, many firms found their records reduced to soggy masses of unrecognizable pulp.

Much of the loss was total; some could be partially retrieved through laborious effort. But "business as usual" could not be the byword during the days, weeks and months that followed the waters. Many dejected business owners had to call it quits.

Fortunately, one large hospital had begun microfilming its medical charts about a year before the flood. These records came through with little or no damage. Patient records that had not yet been microfilmed were heavily damaged or destroyed.

At the South Dakota School of Mines and Technology, a periodical collection of 18,000 volumes was totally destroyed. It was fortunate that much of the archival material in the library could be cleaned sufficiently to permit microfilming and preservation on waterproof film.

The story of document destruction pervades every area of our lives.

Filed paper records destroyed by fire, flooding or other disasters can curtail a company's activities for months, or even wipe a business out. Microfilmed copies in vaults or off-site locations can provide the necessary security for precious records and documents.

It was not until 1935 that the United States Bureau of the Census began using microfilm for records management. Census records were piling up faster than space could be obtained to house them. Officials were concerned about this mounting and almost unmanageable volume. Microfilming, while it seemed to provide a way out, was resisted because of its relative newness.

Then, in 1935, a fire broke out in the area containing the 1890 census documents, all of which were destroyed. This hard lesson prompted frantic efforts to protect the remaining irreplaceable historical records. The census bureau began microfilming the documents, starting with the 1930 census and proceeding backward through each decennial census to 1840 (with the exception, of course, of the burned 1890 records). The condition of the forms for the national tallies before 1840 were so delicate that those that could be located were photostated and then filmed.

But, as happens so often, it took tragedy to spur action.

In addition to the security protection of the census documents, it has been estimated that savings of some 10 million dollars were realized in the 1970 census by using modern microfilming techniques instead of punched cards.

When Hurricane Agnes struck the eastern part of the United States in the summer of 1972, it also taught a grim lesson. As it whirled its way up the coast, it devastated the records sections of many businesses large and small.

Again, as in Rapid City, many companies were put out of business.

Those firms, however, that employed microfilmed records systems suffered little loss and had to go only through a few days of waiting before their records were cleaned and returned to them in perfect condition.

Although firms and institutions using microfilm records systems suffer relatively little loss or delay in the savage onslaughts of floods and hurricanes, microfilm experts recommend storage in fireproof, air conditioned vaults, elevated above ground level. For maximum protection, it is advisable to maintain a duplicate microfilm record stored safely in another city or site removed from the main facility. Microfilm storage vaults are available today at underground sites throughout the country to provide security for precious files and documents in microfilm form.

In addition to the demonstrable advantages of cost savings, space savings and instant information retrieval, microfilm is making it possible for businesses and institutions actually to continue in existence when natural or man-made disasters strike.

19

Micropublishing: Growing Rapidly

Even today, when you talk about micropublishing and its future, you bump up against varied opinions.

There is a confusion of terms, which is a hindrance. Some persons sternly make a division between micropublishing and microrepublishing. They contend, certainly with word logic on their side, that micropublishing involves putting original material, never before printed or published in any form whatsoever, on a microform. Microrepublishing, then, means converting to microform any material that has previously, or even simultaneously, been put into printed form.

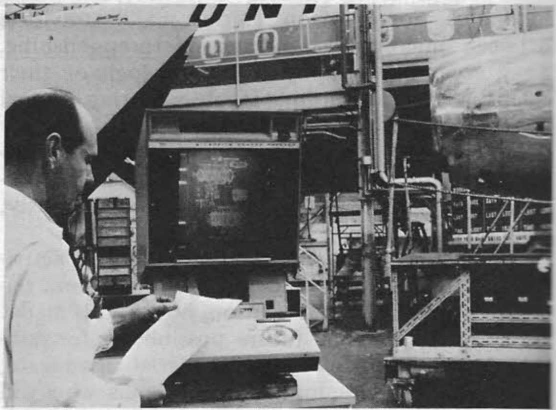
We shall take the liberty of grouping all activities in this fascinating area into one definition: micropublishing. This admonition, however, is made: do not sell short the future possibilities for publishing in microform original material to educate, elevate and inspire millions of persons who will wonder why anyone ever was so taken up with bulky, cumbersome, expensive "books."

Micropublishing is with us today, and it is growing on an accelerating curve. Major manufacturers and retailing organizations have decided that parts lists and product lists and other essential information for their field and dealer organizations simply cannot be handled in traditional paper form.

Consider the fact that for an aircraft manufacturer or an automobile manufacturer or a manufacturer of farm or heavy road equipment, the parts list can run into hundreds of thousands of items. And these are changing, because design departments are periodically producing improvements and refinements. And although new models come out with great regularity, parts for older models must be actively maintained.

These parts lists, in the case of manufacturers, must be kept rigidly up to date in scores, and often hundreds, of dealer or distributor organizations or other points of customer contact and service.

So what happens if you handle — or try to handle — this mass of material with paper? As one ma-



Many airlines around the world have reduced tons of maintenance data to microfilm. Reader-printers on the shop floor simplify the mechanic's task of locating in seconds and making enlarged copies of any page in the complex manuals and parts catalogs. Micropublishing is answering equipment and parts manufacturers' problems of maintaining up-to-date lists of hundreds of thousands of items.

jor equipment manufacturer put it, with wry truth, "The figures are so nearly incomprehensible that they are almost funny."

Micropublishing is an effective answer, and it has stood up to the stern tests of accuracy, time and cost.

A catalogue of hundreds of pages can be compressed into one 4 by 6-inch fiche. And indexing, with the flexibility of micrographics, can be simple and easy to use.

One of the early users of micropublishing to update service and parts manuals was Sears Roebuck. Another was its big competitor in the mass merchandising field, Montgomery Ward.

But it is like reading Fortune's 500 today to scan the list of companies using the techniques of micropublishing to bring some degree of sanity and order to their handling of parts catalogues, maintenance information and other voluminous and changing material: General Motors, Ford, IBM, International Harvester, most of the major airlines, and the list could go on and on.

In effect, what such companies do in micropublishing is to produce master negatives in order to prepare as many microforms as needed, instead of paper copies — and to prepare them at little cost, with virtually no space requirements and with the advantages of almost instant retrieval. The savings in postage alone, apart from all of the other benefits, are enough to warm the hearts of cost-conscious executives.

The U.S. government, the biggest printer of documents in the world, has entered the field of micropublishing, and its goliath impact will be felt more and more in the industry. The Social Security administration, as is well known, has been a pioneer in the use of microforms.

Other large-scale examples have received much news space. One of the more ambitious ventures was the publication, under the auspices of Encyclopedia Britannica, of 20,000 volumes of the Library of American Civilization on microfiche. In hard copy, these volumes require 2,000 feet of shelf space. In microfiche, they fit neatly into two files about the size of shoe boxes.

What about the micropublishing of original material, completely bypassing the conventional printed form by offering microforms to the public?

Not much . . . yet.

Perhaps the art of the book, the feel of the book, are too much a part of our ingrained culture to be easily thrust aside by a strip of film and a machine, however sophisticated and easy to use they may be.

Even such industry protagonists as D. W. "Scotty" McArthur of 3M are cautious about predicting any early widespread applications of microforms for general public consumption. The medium is a strange one for the average person accustomed to ink on paper. Although ideal for government, business and industry, microfilm images still are not sharp and clear enough for prolonged pleasant reading of, for example, a novel.

But events are crowding in from many directions on conventional publishing techniques — time and labor costs, most notably. And postage, a killing factor, as publishers of now-defunct mass circulation magazines have come to learn. By contrast, an entire issue of a magazine could be mailed on microfiche at the cost of a first-class letter.

And when one conjectures on where micropublishing in its purest form may go in a decade or so, he must take an appraising look at COM.

The information printed in a typical book of some 300 pages adds up to approximately 2 million characters. Think of the speed with which some existing COM systems could transfer those

characters from a computer to microfilm: it would require about 1 1/2 minutes!

Nobody wants to see the book, in its beloved and traditional form, languish and die. Something would go out of the lives of all of us.

But in assessing the value of microforms in making massive amounts of knowledge more accessible and useful to all of us, think about the implications of the following exercise in space mathematics:

The complete run of The New York Times from 1851 to today takes up some 1,900 running feet of shelf space. On 35mm microfilm, that same amount of material that mirrors more than 120 years of history can be stored in three standard 10-drawer film storage cabinets.

20

The Place of Service Organizations

Why doesn't every user have an in-house system of one sort or another to reap the proven benefits and demonstrable savings that micrographics provide?

It is not always necessary, or feasible, or economical.

For many users, specially-tailored microfilm systems and procedures must be developed through long study, analysis and informed experimentation. Helter-skelter trial and error in a vacuum of knowledge can be highly costly. And expensive failures understandably turn people off.

Special service organizations often can be the answer for these users. Microfilm service bureaus began appearing in the 30's. However, they were most often one-man organizations with severe limitations due to the state of the art, the lack of good hardware, and the absence of standards and specifications. But there were pioneers in those early days of the microfilm service bureaus — men who operated under almost unbelievable limitations and yet were able to develop soundly designed systems that served well, even when measured against today's advanced technology and superior hardware.

There are no magic answers, in microfilming or anything else, to an individual company's specific needs. The right answer for one may be disastrous

for another. Systematic information management is complex.

Manufacturers of microfilming supplies and equipment today provide outstanding systems analyses to current and potential users of microfilm. Their staffs contain authorities in every area of information management. It is to their hard financial advantage to steer a customer right so that he does not become disgruntled, at best; or openly hostile and completely anti-microfilming, at worst.

The individual considering new or expanded systems may be bewildered by a confusing variety of formats, equipment and technologies available — all presented to him in glowing terms, all seeming to offer dramatic, tangible benefits in his information management situation. But, it may well be that this user, or potential user, is not ready yet for a complete, expensive in-house system. Perhaps his needs are not that great or that persistent. Perhaps he doesn't have critical turnaround problems or security fears. Or perhaps, at the moment, he needs only a smaller system for workaday needs, and can profitably enlist the facilities of the outside service organizations for other information management purposes.

In such instances, and they exist frequently, he may be well served by calling for the help of a microfilm service bureau or independent consultant who can come in and make a complete survey of his requirements, then come up with recommendations that most efficiently and economically serve his needs.

The growth of computer-output-microfilm has carved out a new place of importance for the service bureaus, and they have moved in to occupy that place in increasing numbers. In many instances they are performing with notable distinction.

In working with a bureau, you are advised to

Above is an example of the incredible space problems that conventional paper filing systems can create. A team of specialists examined data in this department, converted a large share of it to microfilm, and eliminated more than 100 cabinets from the filing area.

consider the following: besides such questions as price and turnaround, consider carefully the equipment and facilities of the service bureau, its demonstrated reliability, its reputation for professionalism, its operating philosophy and flexibility when special circumstances arise — as they invariably do.

So far as the need for in-house COM is concerned, some admittedly artificial criteria have been discussed in the industry. They probably make a good deal of sense today, but new equipment could alter their validity.

It is said, with truth, that any medium to large-size processor of data is a logical prospect for COM, that he can buy it and use it efficiently and economically. The example is cited of 100,000 pages of data a month. It is suggested that an out-

put of less than that should make a user opt for the service bureau. Then, too, there is a gray area where individual circumstances may require varying solutions to the information handling load.

But when that data handling figure spurts to 200,000 pages and more a month, then the user would save money by using in-house COM, and manufacturers are happily prepared to prove the validity of that statement.

A CASE IN POINT

How, specifically, does a COM service bureau serve the varying needs of its clients?

The answer depends more on the data processing and records requirements of the client than it does on such factors as size, type of business or any other measurement. Most service bureaus are capable of coming up with a nice assortment of answers.

Take the example of a COM service bureau headquartered in Atlanta, Ga., with service facilities in several American cities and with ambitious plans in motion to open in Canada and in other countries overseas. The name of this company is Computer Microfilm International Corporation (CMIC). It was founded in 1968 and entered into a joint venture agreement with 3M Company in April, 1973. Its clients range widely in size and sophistication.

Take the case of one customer, which is typical of many. It is a medium-sized manufacturing firm that has its own computer and a growing volume of paper print-out. The cost of the paper is climbing, as is the cost of storing it, duplicating it and mailing it. CMIC provided an attractive answer to these problems. A courier from the service bureau picks up the firm's magnetic tape at any time of the day or night. The tape is taken to CMIC's facilities and the data is put on microfilm.

The process is simple, highly-organized and virtually foolproof.

The client's tape is loaded into the COM system, and a punched paper tape with specific instructions is fed into the computer terminal. CMIC keeps a book containing the specific paper tape instructions for the client, thus greatly reducing the chance for error that might occur if a machine operator had to manually key in instructions each time.

In the recorder portion of the system, the taped data is written on 16mm film. It could also be written on 35mm or 105mm microfilm.

The finished film emerges from the system and goes to a processor. In zip time, films, copies and tape are transported to a pickup station, ready for delivery to the client.

The customer can receive either positive or negative film, depending upon his needs. A job control log follows each step of the process so that the exact location and status of the customer film is known at all times.

Other clients of CMIC prefer the microfilming to be done on their own premises. The facility management service of the bureau fills this requirement by providing all of the software and staff needed at the customer location. The work proceeds in much the same manner, and the clients enjoy the advantages of an in-house operation minus the costs involved in paying for additional equipment, and hiring and training operators.

But there are other requirements to be satisfied, too, at the busy Atlanta facility and at its branch locations.

A medium-sized retailer, for example, has little need for computerized data. Obviously, he is not going to invest in a computer and support its cost in idleness. The retailer, however, is becoming overwhelmed by paper and files that are cumbersome to manage. For this customer, CMIC pro-

Microfilm service organizations assist potential microfilm users in determining their needs. These organizations microfilm documents for the customer, or aid him in setting up an in-house operation. Here, a worker mounts microfilm chips onto aperture cards for a customer firm.

vides source-document filming. It is an economical solution to a widespread problem.

Another customer — in fact, a state welfare department — was baffled by its mounting overall records problems. The first step was for CMIC to do an exhaustive systems study. The service bureau experts looked into every nook and cranny of the problem and came up with a detailed proposal. In this case, very large amounts of paper were being generated, and they had to be referred to constantly by welfare department investigators and other staff members.

The complete systems study resulted in the recommendation that many of the files be converted to 16mm rolls of film for economical storage and easy accessibility. The proposal was accepted.

Another client's needs took a different tack. The problem was the maintenance of bulky technical manuals. This customer, a parts house, made profitable use of CMIC's micropublishing services, which usually involves the filming of reference works.

Thus, CMIC, like many other service bureaus, offers these services: computer-output-microfilming from a customer's magnetic tape, a principal source of business; microfilming of original records; facility management at a client's place of business; systems studies, in which a customer contracts with CMIC to analyze its records problems and come up with solutions; and micropublishing.

Throughout the country, more and more business firms and institutions are making daily use of the tailored-to-order services and facilities of the bureaus, which are making the benefits of COM and microfilming available to anyone, regardless of size or problem.

21

Associations: Advancing the Cause of Microfilm

As the story of microfilm was unfolded in this book, it became obvious that numerous problems in technology and communications had to be faced and solved. And it can be expected that, as microfilm applications expand, new problems will have to be tackled.

The task of keeping tabs on all of these developments, broadcasting news of industry activity across a wide spectrum of listeners, and fostering a growing use of microfilm are some of the key responsibilities of two important organizations: the National Microfilm Association (recently renamed National Micrographics Association) and the International Micrographic Congress.

NATIONAL MICROGRAPHICS ASSOCIATION

Silver Spring, Md., is a frantic commuter's drive from Washington, D.C. In a glittering, modern building across a wide boulevard from a glittering, modern motel is the home of the National Microfilm Association. Its members include manufacturers of microfilm and peripheral equipment — about 20 per cent of the membership — and users of the industry's products.

Like so many associations that ably and conscientiously serve special interests, it has grown tremendously in service and function. It promotes the usages of microfilm; it is an educational body;

it serves as a forum for the display and demonstration of the industry's growing output; it fosters and establishes standards to bring order and discipline to the industry; it is a conscience.

At one time the NMA was housed in a basement on Prince George Street in Annapolis, Md. It is still there in spirit, perhaps, for Vern Tate, who for many years was the moving force in the organization, still presides over the archives of the association in the Annapolis location. A gentle, pipe-puffing man, who is given to wearing a beret in his present archival duties, he is a repository of microfilm information. He is a vigorous, friendly man, who remembers when the entire office staff consisted of himself and his wife on a part-time basis.

As the microfilm industry has grown, so has its central organization. Today, the NMA has more than a dozen full-time people, with an executive staff consisting of people highly trained in association work and in technical competence.

The organization has 5,000 professional members who are microfilm users in every possible application in business, government and industry. Well over 200 companies in the business of manufacturing microfilm and equipment are sustaining members. The association has a sizable annual budget, and publishes both a bulletin and a scholarly, in-depth monthly journal.

One of the most active fronts on which the NMA has been operating is in the effort to promote the metric system as an expression of measurement. It is felt in most areas today that this is the direction the United States must take to achieve conformity with most of the world. It is widely felt that our measurement system is an anachronism today and puts us out of step in international commerce.

Each year the association summons the industry to an annual conference that includes a trade

show of the latest products as well as an educational gathering at which manufacturers and users can exchange information that aids the expansion of microfilm services and applications for everyone.

INTERNATIONAL MICROGRAPHICS

We began our journey into micrographics in France a century ago with pigeons over Paris. And although many microfilm developments and breakthroughs have been attributed to American ingenuity, many other nations have been keeping pace. For example, in Latin America it is expected that microfilm growth will proceed at a faster rate than in the United States over the next few years. The same can be said for Europe.

Some countries, notably Germany and England, have developed highly sophisticated systems on their own. Many other nations are presently reliant to a large degree on imports. That fact holds out a handsome promise of expanded foreign business for U.S. manufacturers.

A vital force in the growth of micrographics world-wide is the International Micrographic Congress. It was founded in the United States in 1964 and consists of microfilm users, manufacturers, service companies and dealers. Its membership structure is generally patterned after the National Microfilm Association.

Although the IMC is a viable organization, it is not a "super" body with control over the organizations and efforts of individual countries. It was founded on the sound premise that micrographics transcends national boundaries and national needs. Naturally, it has had its problems with different languages and long distances, but the IMC has become more and more active on many fronts. Today some 36 nations have microfilm organizations of some kind, with absolute equality in IMC on the basis of one vote per member nation.

What does IMC do? Its objectives are clearly stated in Article III of its Constitution and By-Laws:

1. To promote understanding and cooperation among the organizations that are engaged in furthering the progress and application of micrographic science, technology and systems.

2. To stimulate research and the development of new methods and devices that will aid in the micrographic field.

3. To provide an international clearing house for information and advancement in systems and technology.

4. To promote facilities for the exchange of publications and papers among the member organizations.

5. To encourage and assist the establishment and use of international standards.

6. To encourage exchange of delegations.

7. To provide an organizational framework for international product exhibitions and conventions.

8. To aid and stimulate the establishment of national organizations in countries where they do not exist.

Admirable objectives. And the IMC is working diligently in specific areas to implement them.

The organization's members from all over the world met in London in May, 1973, for a well-attended, highly-successful convention. It featured seminars and workshops on almost every microfilm application and technology, from scholarly dissertations to practical how-to-do-it workshop sessions. The convention exhibition area glittered with a display of latest products and systems. The fruitful London meeting followed other worldwide get-togethers held in Tokyo in 1965 and in Frankfurt, Germany, in 1969.

Sao Paulo, Brazil, was the site of the 1974 International Micrographic Congress during which 3M introduced the "Microdisc" storage and retrieval system to that market.

IMC's 1974 convention was held in Sao Paulo, Brazil, and was attended by representatives from Peru, Argentina, Mexico, Venezuela, Colombia and other countries, as well as from Australia. 3M was one of several major companies participating in the conference, and the event marked the introduction of the LBR and Microdisc microfilm retrieval system in South America.

The IMC's 1975 conference will be held in Sidney, Australia; the following year's session in Stockholm, Sweden.

As Scotty McArthur of 3M pointed out recently, "Not all of the brains in the world are sitting here in America."

International conventions represent only one phase of IMC's activity. The organization publishes – presently on a quarterly basis – the "IMC Journal," which serves as a forum for the exchange of ideas in all areas of microfilming.

A brief look at what is happening in micrographics in a few selected nations will help fill in a picture of real growth:

In Australia, sales of micrographics equipment and supplies more than doubled between 1968 and 1971. A 5-year forecast envisions the tripling of sales to some $4.5 million in 1976. Australia depends on imports for the great bulk of its needs. U.S. manufacturers provide about two-thirds of the imports. Government is the largest user, but commercial organizations are showing healthy growth, particularly banks and finance houses. Products that the Australian market will show a growing appetite for the next five years or so — with a big share of the equipment to be shipped from the United States — include cameras of all kinds, roll film and microfiche readers and reader-printers, and automatic retrieval devices. Active interest also is being shown in COM.

Sweden, a highly-industrialized nation with one of the highest per capita incomes in the world, is busily modernizing its information handling systems. The trend accelerated in the late 60's, increasing by 60 per cent in micrographics sales from 1968 to 1971. Like Australia, a tripling of sales is projected between 1972 and 1976, to an annual volume of almost $11 million. No U.S. manufacturers share more than 50 per cent of the Swedish micrographics market. COM units are expected to enjoy a big spurt in Sweden over the next few years. In 1972 there were only six installations in the country, but a 500 per cent increase in COM units seems to be in store by 1976.

Another smaller country that is showing markedly growing interest in micrographics is Spain. Here, too, the economy is growing at a robust rate in the drive to modernize commerce and industry. Sales of equipment and supplies were $600,000 in

1968, but sales of $4.7 million are expected annually by 1976. United States firms supply about 75 per cent of the market, and this share of the business is not expected to diminish. Spanish industry manufactures little or no micrographics equipment of its own.

So, internationally, microfilming is on a sharp increase almost wherever you look. Management of growing piles of information has become a global problem. Australia, Spain, Sweden — and add France, where sales in micrographics are expected to total 50 million dollars from 1973 through 1976 — represent only a few examples.

Go to Russia and its satellites, and the same trend emerges. Then add to the growing list Brazil, Israel, Republic of South Africa, Korea, Panama, Uruguay. There is impressive evidence of growth everywhere. The future augurs well, not only for the business possibilities in export opened to United States manufacturers, but for growing industrial expansion in all of the nations showing enthusiasm for the benefits that microfilming techniques provide.

Man's world is getting smaller in many ways.

22

The Paperless Society

We Americans are a conjectural people (which probably doesn't distinguish us from any other society), and we like to play with absolutes. The thought of intelligent life in the outer universe and in far distant galaxies intrigues and excites us, and the term, "flying saucers," can perk up many a desultory conversation.

Among our diversions in the last few years has been the notion of a paperless society. We speculate on our advancing technologies and the information explosion and wonder if that old friend of ours, paper, is on its way out of our lives. Social and economics theorists like to ponder the possibilities — and, in some areas, the inevitability — of a paperless society. It is a harmless divertissement. It doesn't take much of an exercise in logic to conclude that we are going through an evolutionary process regarding our use of and reliance upon paper.

But not even the most avid protagonist of microfilm will suggest that this medium ever will eliminate paper from our society.

It still is a paper world, but the microfilm industry and developers of other sophisticated technologies are positioning themselves with astonishing speed with regard to paper. They seek to complement the use of paper where necessary; to foster its reduced use, if required; and to replace it

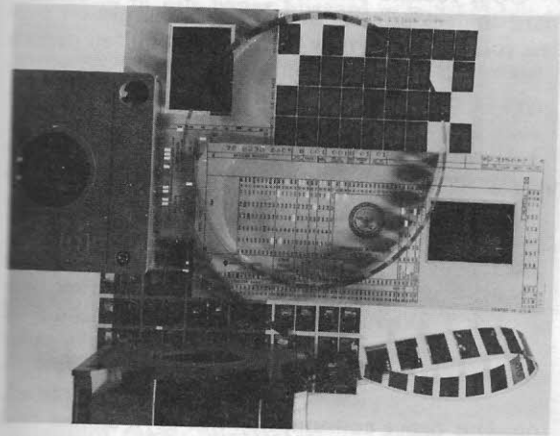
entirely where such a step is needed to insure more efficient flow of information or conserve vitally needed space.

The paper industry does not suffer from malnutrition. It rings up more than 21 billion dollars a year in business, and few persons would sell short its prospects for the future.

There is nothing quite like a piece of paper or a book to hold, to fondle and review, and to distribute for the examination and evaluation of others.

And when it is so easy to press a button and get all of the copies you need of an image on a CRT screen, you probably are going to do just that: press a button for hard copies.

But paper — used by itself — can glut an operation. In one very large firm, it was found that iden-



Although paper will never be eliminated from our society, microforms — cartridges, microfiche, aperture cards, etc. — are increasingly complementing its use and replacing it where efficient flow of information and space savings are imperative.

tical personnel information was repeated within the labyrinth of its corridors as much as 600 times. A few of the areas included the payroll office, labor or time department, medical office, recreation club, library, public relations office, mailing and service areas — and the list could go on and on. All of that information detailed and repeated on pieces of paper.

Yet all of that information can be made instantly available to any department on microfilm retrieval at the push of a button. And sweep out a monumental pile of paperwork.

It has been pointed out many times that a single 16mm microfilm cartridge contains the material that it takes 40 pounds of paper to present. That tiny cartridge replaces the information that formerly occupied an entire office file drawer.

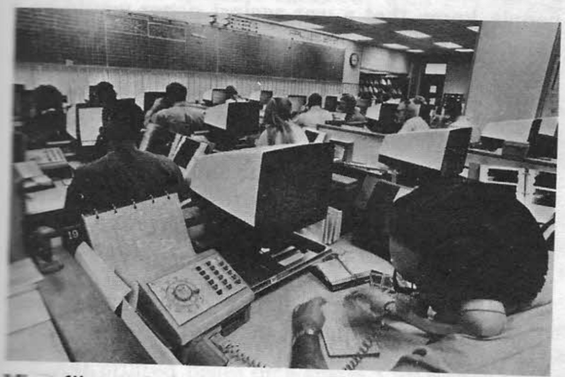
COM focuses attention on paper. With a standard impact printer, the computer gorges on endless rolls of paper, now rising to 300 billion pages a year in this country. But despite all of its advantages in space and cost savings, COM still only occupies about 4 per cent of the print-out market. That percentage is bound to grow as COM proves itself in more and more applications, but the ratio shows that the death knell of paper, even in computer use, has not been sounded.

There is a place, and there likely always will be a place, for both microfilm and paper in the handling of data. It is not likely that man's habit of relying on paper records over a span of 3,500 years will be broken completely. Yet severe paper shortages are developing, and this will have its impact, too. Our paper consumption has been almost 560 pounds per person per year in the United States.

Of course, many of paper's values are aesthetic and cultural, deeply ingrained in the human race. A world without books, for example, would be a dismal one. But the fact remains that paper is expensive, cumbersome to handle, very costly to distribute and prodigal in its demands on space. And it is fragile. Moreover, you can do things on microfilm you cannot do on paper.

The first practical commercial use of microfilm was in the recording of bank checks in the 20's. Microfilm was not intended to replace checks, but rather to provide an ideal means for record storage of financial transactions.

Probably few persons could have foreseen a half century ago that, today, Americans would be scribbling out checks by hand, machine or computer at the rate of 22 billion a year. Magnetic ink and computerization, of course, are employed by even smaller banks today to handle this flood, but it is estimated that each check is transferred 10 times. This is placing an intolerable burden on our banking system, and the annual cost of handling checks — in our paper blizzard — is 3 1/2 billion dollars.



Microfilm reader-printers are used extensively at many installations for instant retrieval of facts and statistics and, ultimately, for the fast, efficient handling of problems, requests or information processing.

The conclusion is almost inescapable in examining this aspect of the paperless society question: the check as the major means of debt settlement has to go — not in five years or ten years, perhaps, but probably before the end of this century. We have the available technology to revamp our monetary society in electronic data processing, microelectronics and instant information retrieval and communications systems.

The microfilm industry is doing a good job today portraying many of the lesser known benefits of its products as against paper. One is its graphics capability. Harried business executives like to see facts reduced to diagrams, charts and other grasp-at-a-glance graphics devices. Paper print-out cannot really provide graphics. Other advantages include greater image quality from microfilm, and type versatility — being able to use italics, bold face and other interesting varieties.

The brief is an impressive one, but microfilm people know that a war against paper would be a useless pursuit. They have a highly useful tool to present, but one that they recognize should be shown in a balanced perspective; in relation to where it fits best in the information processing cycle.

Another interesting fact: microfilm manufacturers have found that very few customers switch back to paper once they have converted to film and experienced its money-saving, space-saving, quick retrieval benefits.

These customers will not completely discontinue their use of paper; that would be preposterous to consider. But they will use film where film serves best. There, and in most other applications, the two mediums will continue to coexist in the foreseeable future.

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A (Small) Wrapup

In the 1970's, as Women's Liberation took hold across the land, a cigarette company sought to get on the bandwagon by proclaiming, "You've come a long way, Baby!"

So it has been with microfilm.

The seige of Paris. The intrigue of wartime espionage. An enterprising bank worker in New York with a gadget. Film, File and Forget. The OSS. Crude aperture cards cut with a razor blade. Film 'N File, and a swat at the growing piles of paper. Bulky engineering drawings made manageable. Filmsort. The first practical reader-printer — a tremendous achievement. Automation and fast processing and speedy retrieval. Dry-Silver technology. Microfiche. The acronyms: COM, EBR, LBR.

Who would have predicted a decade or so ago that such exotica as Electron Beams and Laser Beams would be used to transfer mountains of computer data directly to film?

Of equal wonder, who would have suggested that some day you would be able to put more than 3,000 printed pages on a single 4 by 6-inch card of film?

Or to be able to bring up in seconds an image from among hundreds of thousands or millions?

So, the prescience to suggest what the future holds for this still-developing, still-young industry is not a gift possessed by this writer.

But this can be said absolutely:

Microfilm technology will continue its steady growth and development. Its benefits will impact every area of our lives. That has been its past, and that will be its future.

(END)

APPENDIX: A Survey of Microforms

The following pages are reprinted with permission of the National Micrographics Association. They are taken from the excellent 28-page publication, "Introduction to Micrographics," published by the Association.

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MICROFORMS

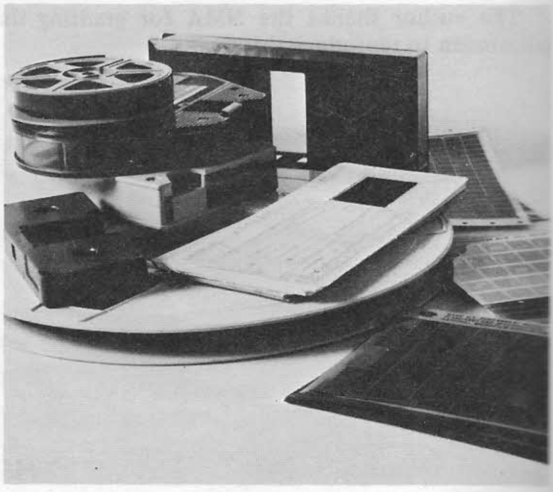
The wide variety of user needs and applications has given rise to a number of different *forms* in which microfilm is made, stored and used. Some of the familiar microforms are shown and described in detail on the following pages.

Each has a range of applications designed to fulfill certain specific user requirements, and the most important planning consideration is to *select the form to match the need.*

Primary factors to consider in selecting the appropriate form of microfilm include type of input, the nature of the information to be stored, and how it is to be used.

There are additional factors. For example:

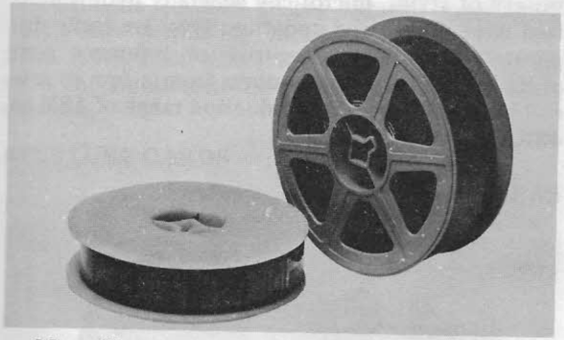
- Overall system cost;
- Speed and ease of document retrieval;
- Accessibility of information at any desired number of locations;
- Capability and cost of making duplicates, either in large or small quantities and whether they're to be on microfilm or in hard copy blowback form;



- Frequency with which the file is changed or updated;
- Need for file integrity (i.e., the assurance that no document is ever lost or misfiled);
- Storage density;
- Anticipated means of reading and duplication, both at central and/or remote locations;
- Compatibility with other information systems, such as data processing.

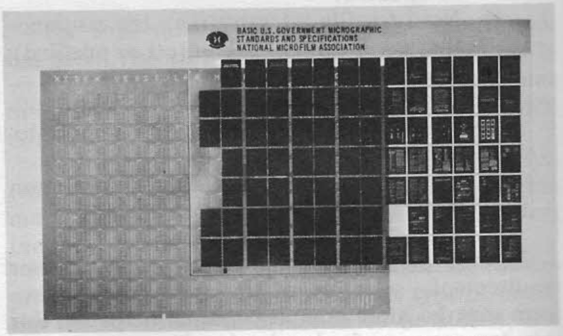
Because of the wide variety of individual user requirements, selection of the appropriate microform may be more complex than anticipated. For this reason, a professional microfilm systems expert can provide valuable assistance.

REELS, 16MM & 35MM



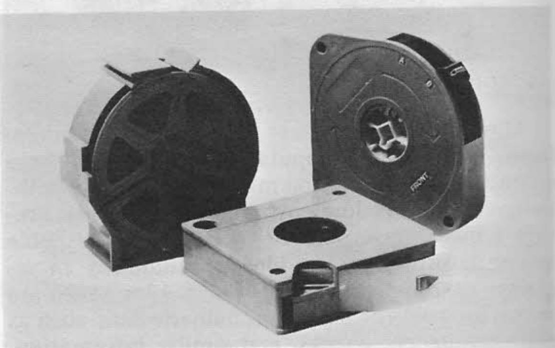
Microfilm on reels was one of the first microforms. It is still a popular choice because large quantities of information may be stored in very little space, at very low cost. Microfilm on reels provide a high measure of file integrity, are desirable where information is added continuously in sequence and updating is infrequent. 16mm reels are primarily used for alpha and numeric data, such as correspondence, checks, and similar information. 35mm reels are used for graphics and large documents such as engineering drawings, x-rays, newspapers, and maps.

MICROFICHE



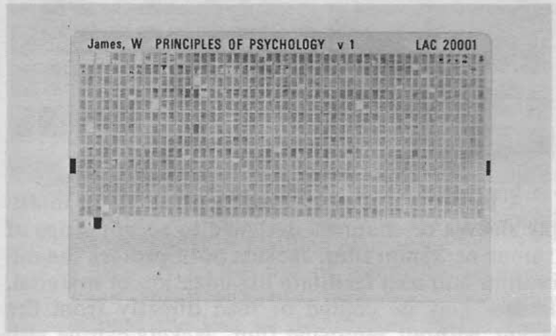
A microfiche, or "fiche," is a sheet of film containing multiple microimages in a grid pattern. It usually contains identification information which can be read without magnification. Available in a variety of styles, microfiche generally permit unitized data storage and updating. They are easily duplicated for mailing, security or reference purposes. Microfiche may contain from a few to several hundred images in a reduction range of 18X to 48X.

CARTRIDGES



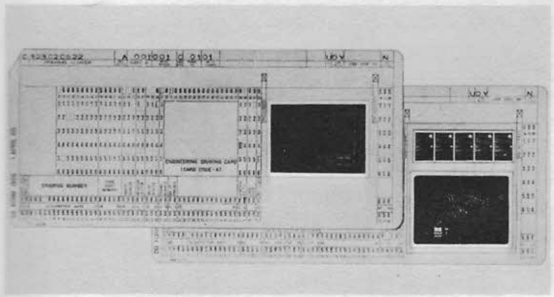
Microfilm cartridges function as "convenience packaging" for rolls of microfilm. Unlike microfilm on reels, which require threading, cartridges can be self threading. Microfilm in cartridges is well protected, and not subject to fingerprints and other possible sources of damage.

ULTRAFICHE



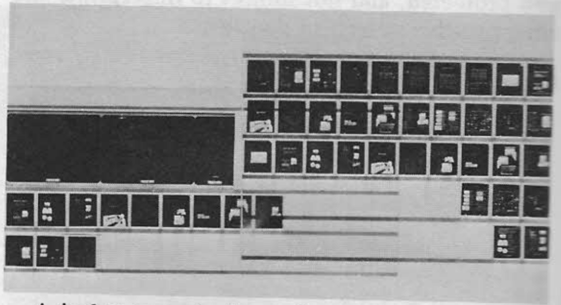
Ultrafiche contain images reduced more than 90X, thus permitting thousands of images per fiche. Ultrafiche offers the advantage of storing more information in less space than a standard microfiche.

APERTURE CARDS



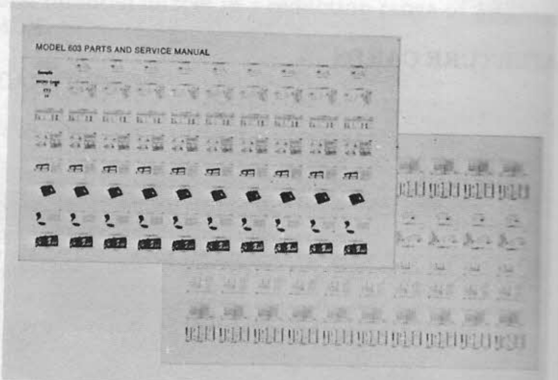
Available in many sizes — with the tab size (82.5mm by 187.25mm or 3 1/4 inches by 7 3/8 inches) most commonly used — they combine key punched data and access information with microfilm. Aperture cards may contain a single image, or up to eight page-size images on one 35mm frame.

JACKETS



A jacket is a plastic carrier with single or multiple sleeves or channels designed to accept strips of 16mm or 35mm film. Jackets both protect the microfilm and also facilitate organization of material. Images may be copied or read directly from the jacket without removing film. Jackets can be visibly titled for quick, easy file reference.

MICRO-OPAQUES



Similar to microfiche in configuration, micro-opaques are, as their name implies, images on opaque stock. Therefore, images may be stored on both sides. Unlike microfiche where transmitted light is used for blowback, opaques use reflected light.

ROLL MICROFILM

Microfilm — regardless of its ultimate format for storage — is, in almost all cases, first produced as roll film on a reel. Roll film is the least expensive form in which microfilm can be produced and duplicated.

File Integrity and Security

In addition to its low cost, roll film offers other advantages. Among them:

File integrity — the ability to retrieve and reproduce a document without the chance of its being lost or misfiled after use.

File security — the use of microfilm to duplicate irreplaceable records as assurance against the loss or destruction of the originals.

Choice of Format Determined by User Need

Documents may be recorded and reproduced on roll film in many formats and styles, depending on the nature of the material and how it is to be

Roll microfilm is available in reels, cartridges, and cassettes.

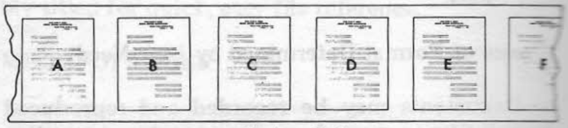
used. The standard roll film formats are shown on these two pages.

Some users require a microfilm system that can reproduce documents within a wide range of sizes — from large engineering drawings to a small file card. Some, like banks and law firms, need a system that can reproduce both front and back of a document (a cancelled check or a notarized deed) side by side. Some require capability for automated or computerized document retrieval. Whatever the requirement, there is a roll microfilm format to accommodate it.

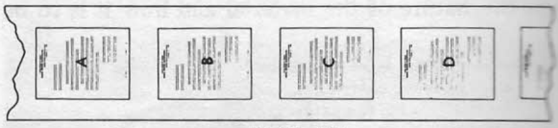
SIMPLEX, DUO & DUPLEX

These terms refer to the arrangement of the documents contained on the microfilm.

SIMPLEX FORMAT



Simplex – Comic



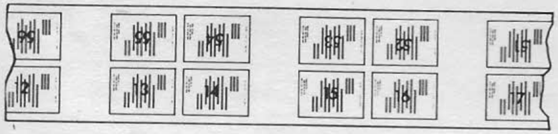
Simplex – Cine

Film is run through the camera once, and a single row of images is photographed. Documents of various widths and lengths are accommodated. Image orientation can be *comic*, with information right reading from edge to edge of the film, or *cine*, with information right reading along the length of the film.

DUPLEX FORMAT

Both the front and back of a document, both sides of a check for example, are photographed simultaneously side by side on the film, across the width.

DUO-FORMAT



Film is run through the camera twice and a row of images is photographed along one half of the film width during each passage. Documents of various widths and lengths are accommodated, in either cine or comic mode.