

ORG

IDEAS

Mini-disc with mega-memory

By Simson L. Garfinkel

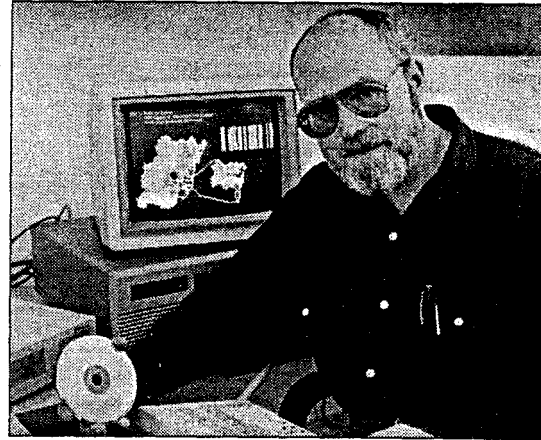
IMAGINE holding the entire maintenance manual for a Boeing 757 aircraft — 7 feet of heavy books, weighing 140 pounds in total — in one hand. Now imagine being able to find every paragraph in the manual's 13,600 pages that contains the words "auto pilot" and "flaps." Imagine finding the paragraphs in less than a minute. High-speed access to massive amounts of information is

150,000 to 250,000 pages of information, depending on how it is arranged. That's 1,500 times as much as a conventional floppy disk, enough space to store the complete Oxford English Dictionary, 12 English-to-foreign-language dictionaries, or the 300 phone books listing everyone living in New York and New England.

CD-ROMs containing these data bases, as well as many others, were on display last month at the second CD-ROM Expo in Chicago. Nearly 1,400 people gathered here to discuss the growing uses of this new technology. While 1,400 people may not seem like a lot, it's four times last year's attendance of 316.

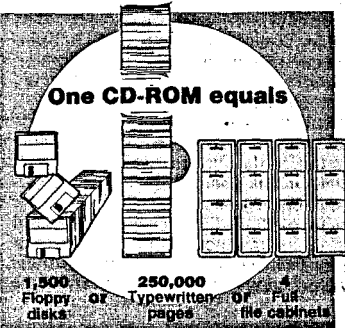
The United States market for CD-ROM goods and services is growing nearly as fast. It is expected to reach \$197.3 million this year, up from \$83.3 million in 1987, according to Link Resources, a New York-based research and consulting firm.

Next to business, libraries and education have been the largest CD-ROM markets. "Six hundred megabytes is a vast amount of material to supplement textbooks and address the needs of advanced students," says Carolyn J. Kuhn,



Jack Massey of Space-Time Research holds a CD-ROM; computer has plotted map from data on a compact disc

MARKET COMMUNICATION ASSOCIATION



SHIRLEY HORN - STAFF

what the CD-ROM (compact-disc read-only memory) is all about. Compact discs, used mostly for music today, are beginning to be used to store information for computers. The entire 757 manual fits comfortably on one CD-ROM, with room to spare for another four copies.

One 4.7-inch disc can store

president of the Software Mart, an Austin, Texas-based producer of educational CD-ROM products for major publishers.

"That can all reside on a desktop. You don't need to have access to huge university libraries or forums of experts on a subject," she says.

One high school that has made CD-ROMs available to its students is the Illinois Mathematics and Science Academy, a state-sponsored boarding school for 510 of the state's "gifted" sophomores, juniors, and seniors.

Students "use [CD-ROM] a lot for searching academic indexes," says Martha C. Guarin, the school's head librarian. Using a CD-ROM journal index, a student can locate in seconds all of the articles published in recent years on any topic in science, medicine, art, or general interest.

Students use the CD-ROMs "because its so quick," Ms. Guarin says. "Nobody's

search lasts more than five minutes. The kids love it, they lap it up. It's easy to learn, and it's so fast that if they make a mistake they can just ask again."

"The faculty use Books in Print for figuring out what to buy," she adds, referring to a CD-ROM version of the standard directory of all available books. With it, a teacher can type a few words and pull up a list of every book that has those words in its title.

CD-ROM players, which are normally used in conjunction with a personal computer, are popping up in libraries, universities, and businesses across the country. There are some 50,000 players in the US today. Nine hundred sixty CD-ROM titles were published in 1987 and 195,000 discs were replicated, according to Link Resources, which estimates that the market will reach 10,500 titles, 35 million discs, and \$2.25 billion by 1992.

Please see CD-ROM next page

A narrow track of 552 million letters

How does a CD-ROM (compact-disc read-only memory) hold so much?

CD-ROMs store information the same way musical CDs do: information is converted to a stream of 1's and 0's, which is then converted to a series of pits and flat spots on a reflective surface inside the disc. The pits are very small: 0.6 microns in width, less than a quarter-millionth of an inch. Indeed, the pits are only slightly larger than the rays of light used to scan them.

The pits on a CD-ROM are arranged in one narrow, spiraling track. There are 16,000 tracks per inch on a CD-ROM, compared with 96 tracks per inch on a magnetic floppy disk. If the CD-ROM track could be unwound, it would be more than 3.5 miles long.

The disc spins at 200 to 600 revolutions per minute, spinning more slowly on the outside. The CD-ROM drive follows the track with a laser beam. When the laser hits a flat spot, the beam is reflected back and counted as a 1. When the laser hits a pit, it is scattered away and counted as a 0.

In total, the disc holds 552 million letters — enough to allow Northern Telecom to use one 4.7-inch disc to replace 40 feet of manuals for its DMS-100 and SL-100 telephone switches.

Saving paper saves money: Northern Telecom sells the paper version of its manuals for \$21,000, but the CD-ROM version costs only \$4,000, according to Edward J. Deveau, the company's director of strategic marketing for customer information services.

CD-ROMs also save trees. — S. G.

ROBERT C. COWEN

Start now to identify and qualify for a career in space

WITH the space shuttle flying again and the international agreement to build the space station Freedom signed, you won't have to work for a government agency to be an astronaut in the 1990s. Aspiring space travelers can follow the precedent set by McDonnell Douglas engineer Charles D. Walker. He flew three shuttle missions to tend his company's electrophoresis protein purification experiment on orbit.

"I see a merging of the career astronaut and the career scientist-engineer," says Christopher J. Podsiadly, who heads the 3M Company Science Research Laboratories. His group has flown several experiments that were activated by NASA astronauts on shuttle missions, including the recent Discovery flight.

Clarke Covington, manager of the Space Station Projects Office at the Johnson Space Center, agrees. He explains: "If you're going to be in the 30 year up [age group] — maybe in your late 20s — in the late 1990s, you're probably just about right . . . to be a candidate to fly. And you don't have to work for NASA to do it, either. Working for a company that's going to make something in space, you've got a good chance of at least being eligible."

It will, of course, be a grand adventure for those who do qualify for space travel. But Podsiadly and Covington aren't talking about an "exotic" job. They are talking about a normal career for research scientists and engineers whose laboratory happens, sometimes, to be in space.

Speaking of his own group's type of work, Podsiadly says he has no doubt that "microgravity materials processing is the wave of the future." But, he adds, as this develops, the space station "will just be another spot where we do our work."

The key that unlocks the door to such a space-oriented career is "the right educational background and experience," Covington notes. That means a solid, normal education in the scientific or engineering profession to be pursued in space.

Podsiadly says that people who want to fly with experiments on the shuttle or work on Freedom should be acquiring that necessary background now. This is true whether they will be working with United States companies and universities or with institutions in space-station partner countries — Canada, Japan, and

members of the European Space Agency.

NASA will use its own professional astronauts as it returns the shuttle system to full operation over the next few years. But the agency has already organized a task force to help work out its policy for allowing other astronauts to fly in the 1990s.

It's too soon to know when NASA might resume its aborted teacher-in-space and journalist-in-space programs. But in the next century — less than a dozen years away — such ventures should become commonplace.

Young people planning their education and careers may wonder how much of a gamble they would take in aiming for astronaut status. They have seen one accident derail the United States space program for 2½ years. They see the space station program slowed down by underfunding and lack of strong political leadership.

"I don't think it's a gamble at all," says Covington. He adds: "It's going to happen. And [Freedom station] is going to be there."

So if you're interested in working in space, it's worth your while to start preparing now.

RESEARCH NOTEBOOK

Some laboratories will just happen to be in space.

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*Indicates that child care is available during the lecture.
†Please contact the sponsoring church for complete details.

UNITED STATES

ARKANSAS

Heber Springs: Oct 16, Sun, 3pm†. "Do You Think Prayer Is Doing Nothing?" (Carolyn E. Holte) Church, Hwy 110, W (4 miles W on Main St)

CALIFORNIA

Carmel: Oct 22, Sat, 11am†. "How Our Spiritual Innocence Sets Us Free" (John A. Grant) Sunset Center, San Carlos and 9th
Paradise: Oct 16, Sun, 3pm† (William C. Breen) Church, 6970 Clark rd

Sonoma: Oct 22, Sat, 2pm†. "Making Law Effective in Your Life—Through Prayer" (Ann C. Stewart) Masonic Hall, 16 S Washington st
CONNECTICUT



Bridgeport: Oct 16, Sun, 11.30am, "The Ring of Truth" (Harvey W. Wood) WUBC, Channel 30

FLORIDA

Coral Gables: Oct 22, Sat, 12 noon (Kay R. Olson) Miracle Theater, 280 Miracle Mile



Ocala (First, Inverness): Oct 16, Sun, 10.30am, "The Ring of Truth" (Harvey W. Wood) WOGX, Channel 51

INDIANA

Indianapolis (Fifth): Oct 18, Tues, 7.30pm, "Help Wanted: Shepherd" (Lona Ingwerson) Radisson Hotel, Keystone at the Crossing

IOWA

Mason City (joint lecture): Oct 22, Sat, 11am†. "Christian Healing for the Body" (Marion Sheldon Pierpont) Church, 219 N Washington at 3d st, NW

KANSAS

Salina: Oct 16, Sun, 3pm, "Christian Healing for the Body" (Marion Sheldon Pierpont) Church, 256 S 8th

LOUISIANA

Shreveport: Oct 16, Sun, 3pm (Olga M. Chaffee) Theatre on Line, 3323 Line av Please note * at church

MARYLAND

Easton: Oct 18, Tues, 8pm, "Trust in God and Live!" (Bettie B. Thompson) Talbot County Free Library, 100 W Dover st

MASSACHUSETTS

Andover: Oct 20, Thurs, 8pm†. "Can Reliance on God Bring Healing?" (Michael A. West) Church, 279 N Main st

MICHIGAN

Detroit (Highland Park) (Society): Oct 22, Sat, 11am, "Healing the Heavy Heart" (Gordon R. Clarke) McGregor Public Library, 12244 Woodward av

Midland: Oct 16, Sun, 3.30pm†. "Healing the Heavy Heart" (Gordon R. Clarke)

Saginaw: Oct 17, Mon, 8pm†. "Healing the Heavy Heart" (Gordon R. Clarke) Delta College Theatre

NEW HAMPSHIRE

Lancaster (joint lecture): Oct 22, Sat, 3pm, "Spiritual Healing Through Accepting God's Presence" (Bernice Burlock Doane) Congregational Church, 142 Main st

NEW JERSEY

Ocean City: Oct 16, Sun, 3pm†. "Help Wanted: Shepherd" (Lona Ingwerson) Church, 8th st and Asbury av

NEW MEXICO

Farmington: Oct 16, Sun, 2pm†. "Preserving the Integrity of Home" (Arno Freiler) San Juan College, 4601 College blv

NEW YORK

Huntington: Oct 16, Sun, 3pm†. "The Truth About Christian Science and Its Discoveries" (Horacio Omar Rivas) Church, 449 Main st
Millerton: Oct 16, Sun, 3pm†. "Life Without Age" (Nancy S. Pihl) Millerton Grange Hall, Rte 22

OKLAHOMA

Oklahoma City (First): Oct 22, Sat, 3pm†. "Christian Science: Its Healing Theology" (James Spencer) The Warr Acres Community Center, 4301 N Ann Arbor

OREGON

Corvallis: Oct 21, Fri, 8pm†. "What It Is and What It Isn't: An Informative Lecture on Christian Science" (Bruce Fitzwater) The LaSells Stewart Center, 875 SW 26th st

Grants Pass: Oct 22, Sat, 11am† (Bruce Fitzwater) Church, 845 NE 10th st

PENNSYLVANIA

Bethlehem: Oct 16, Sun, 3pm†. "Prayer: The Last Resort or the First?" (Nola A. Cook) Church, 1400 Main st

Stroudsburg: Oct 22, Sat, 2pm† (Bettie B. Thompson) Christian Science Reading Room—Sunday School Bldg, 760 Main st

VIRGINIA

Charlottesville: Oct 20, Thurs, 8pm†. "Spiritual Healing: What It Means, What It Requires" (Margaret M. Rennie) General District Court, 501 E Jefferson, Court Square

WASHINGTON

Bainbridge Island: Oct 16, Sun, 3pm†. "A Special Christian Science Lecture for Young People" (Ann O. Spaulding) Auditorium, Bainbridge Island High School, High School rd

WEST VIRGINIA

Wheeling: Oct 16, Sun, 3pm†. "A Practical Spiritual Solution to Our Problems? Come and See." (William Howard Frake) Stone Bldg, Wheeling Park

CD-ROM

Scientists are using CD-ROMs to replace magnetic tapes for distributing geophysical data. The US Geological Survey is distributing sonar pictures of the sea floor on CD-ROM, as well as the last seven years of world seismic data from the National Earthquake Information Center, says Jerry McFaul, a computer scientist with the bureau. Each CD-ROM replaces 20 to 40 computer tapes: They're faster to read and cheaper to mail.

Because CD-ROMs hold so much information that was too expensive to distribute just a few years ago is now becoming available. Space-Time Research, an Australian firm, has produced five CD-ROMs containing census data from the United States, Australia, New Zealand, Hong Kong, and Sweden.

"You can use it to produce maps" containing information from the census, says Samantha Harvey, a consul-

tant with the company. "A table of numbers is really difficult to read, especially for people in an educational setting."

One of Space-Time's discs is being used at the John Gardiner High School in Hawthorn, Australia, by students who produce maps for businesses and government departments.

"Someone comes to them and he wants to know where his potential clients are located," Ms. Harvey says, giving the example of a news distributor who is interested in carrying an Italian-language newspaper and wants to know where Italian-speaking residents are. Using the CD-ROM, students can make the businessman a map showing the concentration of Italian-speakers, accurate to within 200 households.

"When I was in school, if we wanted to do this we had to ring up the Bureau of Statistics. They would give us a whole stack of data. We had to sit with our calculators and do everything by hand, then we had to draw the map manually," she says. The computer, by contrast, automatically draws the map after reading the disc.

"You can spend more time actually analyzing the data rather than putting it together in the first place," she adds.

CD-ROM applications can combine information with CD-quality sound for exciting possibilities. There can be, for example, "several language versions of the same material on the same disc," Kuhn says.

"You can have multilingual materials and particularly sound. Not synthesized sound - digitized sound," that sounds just as good as music off the very best CDs. Kuhn says sound is important, "because inflection and pronunciation are critical to understanding and conveying meanings in foreign language."

Nevertheless, CD-ROM comes a high price tag. Most discs cost more than \$500 - the NYNEX phone book costs \$10,000 a year - and the players cost between \$600 and \$1,000. Because of this, the largest number of CD-ROM users today are businesses.

Nearly one-quarter of all CD-ROM revenues generated last year came from one product, Lotus One Source, a data base of current financial information that features new discs weekly shipped via Federal Express at a price of \$7,000 to \$60,000 a year, depending on the number of data bases subscribed to.

Large corporations are using the discs internally to distribute large data bases such as phone books, customer lists, or parts catalogs to branches. CD-ROMs let companies "start providing access to information they couldn't get to before because of the cost" of distributing the data, says John C. Ryan, who manages CD-ROM sales for Discovery Systems, a CD-ROM manufacturer.

"I don't think it's ready for the masses," says Barry Cinnamon, president of the Bureau of Electronic Publishing, which markets CD-ROMs and applications to consumers. "But we're getting there. The Constitution Papers and the Bible together cost \$80. But [consumers] still have to spend \$600 on the drive" required to read the discs.

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