



Triad's William Stevens (foreground) with employees after a recent weekly company breakfast: Trying to keep communications lines open while sales grow 85% and earnings 96% a year

responsibility to managers. All too often, an entrepreneur stifles growth by creating a "crisis of centralization," by trying to do everything himself, according to Steven Brandt, lecturer in small business management at Stanford University. The solution, says Brandt, is to break down the work into manageable units, adding at least one layer of management as products and markets become more complex. "That releases the entrepreneurial spirit again," Brandt says, "and lets management get closer to the customer level."

At Electro-Biology Inc., which makes a medical device that electro-magnetically treats bone fractures, management has learned to departmentalize staff and communication flows as business has grown from sales of \$118,000 in 1977 to more than \$5.9 million in the first six months of 1981. Rather than going directly to the source of every problem, as these entrepreneurs used to do, says Vice-President Richard H. Reisner, the Fairfield, N.J.-based company's founders have learned to deal with middle managers. "In the beginning we could get by with sergeants," he says. "But now there are times when you just have to delegate the responsibility to lieutenants."

Similarly, Archive Corp. has hired three vice-presidents after only one full

LARRY ENGLISH



ROLM founders Robert Maxfield (l.) and Walter Lowenstern at the employee dining terrace: "You can catch up on hiring, but building takes a two-year lead time," says Maxfield. The company is now expanding by recruiting outside of Silicon Valley



Jim Patterson halted his production line for three weeks to iron out quality problems. Now Quantum is back on line and expects to report \$15 million in sales this year

year of production. But, says Howard Lewis, president, with 55 employees to manage and plans for sales to grow from \$1.5 million for the year ended Sept. 30 to \$70 million within three years, his problem is not one of letting go of the reins as much as it is of biting the expensive bullet of experienced management.

The tendency of many companies is to stay lean for as long as possible—sometimes too long for the sake of control. "We have to conduct ourselves like a \$50 million company today," Lewis says. "You don't want to spend the money for lots of necessities, but you've got to belly up to the bar and do it."

Another expensive support, both in time and money, is proper training at all levels. Many individuals have to be trained for *dual* jobs—their own and their boss's, which they'll be expected to take over, sometimes within months. But when the growth pace accelerates, training is one of the details that too often slips through the cracks.

James Bochnowski, now a general partner in Technology Venture Investors, a Menlo Park, Calif., venture capital firm, was president of Shugart Associates in Sunnyvale, Calif., a leading maker of floppy disk drives, while it grew from 300 to 3,000 employees and from sales of \$13 million to \$134 million between 1976 and 1979. His chief concern, like that of most other managers of rapid-growth companies, was getting enough quality workers when he needed them. To compete with other Silicon Valley firms, Shugart did anything and everything: posted job notices on shopping center kiosks, flew planes over sports stadiums trailing a line of advertising for attention, held periodic open houses where qualified people were hired on the spot, and even advertised for employees on local television.

The essential enticement fast-growing companies use to lure employees, particularly management talent in high-technology companies, is stock. On top of that come other fringes such as bonuses (often tied directly to performance). Also important is the environment in a small company. But take away that equity and quality managers have little reason to leave secure positions and hefty salaries in larger corporations.

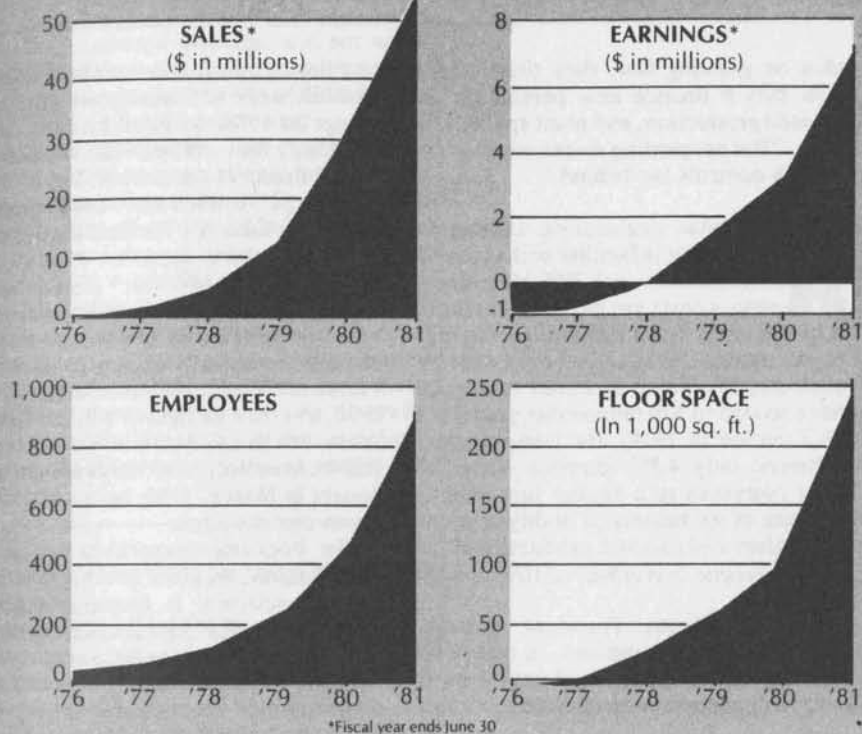
Equity kickers for employees—provided through the familiar employee stock option plan (ESOP)—can have obvious motivating benefits for top-notch recruitment candidates. But eventually the effect can be quite different. After an ESOP became too successful at Triad Systems Corp., it backfired. At Sunnyvale-based Triad, where profits have increased at a compounded annual rate of 96% over the last five years, the ESOP

Rick Browne

Lane Ethells

How Employees and Space Must Keep Pace with Sales Growth

NBI Inc.'s Remarkable Fast-Track Growth



made fortunes for some key employees. As soon as a few cashed in their chips they wanted either to retire or start their own companies.

(Tax laws regarding employee stock options have recently been liberalized. For a more comprehensive explanation, see columnist Gerald Hunter's tax column, p. 14.)

At NBI Inc., staff will almost double next year to 1,700 from the current payroll of 900, up from only 490 last year. The manufacturer of word processing systems uses videotapes for some indoctrination training and most instruction on engineering systems for new employees. When new products come out, the information is relayed by top corporate management—on tape—to field offices around the country. But new employees don't rely on video tape to meet managers, says NBI CEO Kavanagh. "We're still committed to one-on-one employee-to-manager meetings, too. There's no substitute for that."

Stanford's Brandt, who sits on the boards of several electronics firms, insists that involvement with top management and feedback on performance are essential. "You can't expect the quill-and-pen approach of memos and manuals to instill the same level of understanding and excitement as the entrepreneur. And

With poor accounting controls, cash can disappear, and growth has to be financed on lower profit margins

you find it's not cost-effective when you soon end up with high turnover."

As young Quantum Corp. enters a critical growth stage, hiring 20 new employees a month, Jim Patterson looks for people who are overqualified now for immediate job vacancies but who will soon take on more responsibility. Sometimes finding a manager for a three-person department can be difficult when the job requires the experience of managing a 50-person division. "We sell the opportunity of growth," Patterson says. Others try the same approach but warn of misleading the interviewee. Says the president of one company: "We try to avoid selling the excitement too much. There's still a lot of drudgery to be done."

Triad Systems, a marketer of computer systems for automobile parts whole-

salers, has chosen from the start to hire most of its marketing and technical people directly out of college. The initial cost of keeping less experienced employees is higher, because of added training cost and a longer wait until they produce. But the approach builds loyalty, and that helps to stave off personnel pirating from other companies. And because all marketing personnel start out in sales or customer-training positions, they are forced to learn the real backbone of the business—customer service.

Hiring engineers continues to be a problem for high-tech companies in Silicon Valley but a potentially more pressing concern is planning for expanded plant and facilities. For example, ROLM Corp., the telecommunications and military computer firm with 1981 sales of \$295 million, may be planning now for its continuing expansion, but the company learned from past mistakes. In its early years in the mid-1970s, ROLM took options on 42 acres in Santa Clara for expansion. But the company had to take temporary quarters when it accelerated its building plan. During that time, the telecommunications division alone, which grew from \$20 million in sales and 300 workers in 1977 to \$160 million in sales and 2,000 employees in 1980, was scattered in nine different buildings in far-ranging ends of the valley. "We got way behind on our building plans," says Robert Maxfield, executive vice-president and one of the four founders. "You can catch up on hiring, but building takes at least a two-year lead time. There's never enough temporary space nearby."

No one knows better the tribulations of having to quickly adapt to space availability and market nuances than the operators of the numerous fast-track airlines since deregulation in 1978. Beyond jockeying for additional takeoff and landing times and terminal and ticket counter space, Gordon Linkon, president of Chicago-based Midway Airlines, had to provide for additional airplanes. When he found a sister ship for his fleet of eight DC-9s, he bought it even though it wouldn't be used for another three months. "You don't find planes every day that are compatible with the fleet you already have," Linkon says.

As the Midway fleet has grown from five jets to nine, and monthly operating revenues from less than \$1 million in 1979 to \$8 million this year, Linkon has planned to expand his Chicago maintenance facilities at least one year in advance. He expects the facilities to be adequate to service the fleet, which is set to nearly double by late 1982 to 17. "But," Linkon assures, "we don't put more on our plate than we can chew and digest."

As products and markets become more complex, an area often overlooked is managing the flow of information—from tracking inventory and receivables to budgeting and planning. So important is information management to companies such as Synapse, that the tiny startup is already planning ways to absorb the flood of paperwork which it expects will start rolling in next year. From its first day of incorporation, Synapse has been on a computerized payroll system. Its engineering group uses an in-house computer, but manufacturing and accounting systems only recently were computerized using a time-sharing service bureau. After 12 to 18 months of leasing a software package for integrated manufacturing, materials planning, and accounting, President Mark Leslie intends to buy those software programs for use on the in-house computer. "We'll pay more now in time and effort to build an automated inventory and manufacturing system," he acknowledges. "But the systems will make the transition easier."

Donald Briggs, a partner in the accounting firm of Peat, Marwick, Mitchell & Co. in San Francisco, attributes the failure of many fast-growing companies to their inadequate capacities for processing information. "Most entrepreneurs are engineers or marketers, so when they

The elements to prepare for are the same in any company—people, facilities, materials. But toss in speed, and challenges intensify

plan on growing fast, they think about how they'll finance new personnel, increased production, and plant space," he says. "But accounting systems and information controls lag behind."

A particular engineering consulting firm Briggs is familiar with is a case in point. Although 70% of the company's costs are payroll, that function has never been integrated with that of job costing, he says. As a result of an exploding workload and staff (revenues have soared to \$20 million this year from \$6.5 million in 1979), the company has achieved only 4.5% after-tax earnings. That compares to a similar firm which, because of its automated ability to manage orders and execute products and invoices on time, has achieved 10% returns after taxes.

In San Diego, President Konrad Boekamp of Boekamp Inc., a maker of quartz space heaters, found out the hard way how important immediate access to

accounting information can be. While operations were still headquartered in his garage in 1978, he hired an outside accounting firm to provide end-of-the-month financial statements. But by 1979, sales hit \$1.5 million and were \$20 million just a year later. By the time the accounting firm's work came in, he says, "I hardly had time to react." Similar delays caused problems with sales forecasts, which were practically obsolete as soon as they were made. Boekamp finally invested in a Digital Equipment Corp. PDP-II 70, a system he figures will last for five years. But that \$200,000 investment came this summer only after the first system he bought in March, 1980, became obsolete seven months later.

The Boekamp scenario is not an uncommon one. In many cases, the way to solve a problem is literally to throw money at it—for data processing equipment, experienced management, capital equipment, and research and development on future products. However, while many entrepreneurs prefer to secure financing in a lump sum well in advance of production, others prefer to do it step by step, finance one stage of development at a time. But, advises Sanford Robertson, partner in the San Francisco investment banking firm of Robertson, Colman, Stephens & Woodman, "The smart manager will get his capital well ahead of time. It usually produces a stronger balance sheet, more opportunity to meet changing markets, and the ability to raise money more easily later on." Besides, most managers of booming firms find they have enough to do without looking for money too. Robertson recommends that entrepreneurs opt for adequate equity financing early on at the expense of giving up some of their ownership. "The time to get the money is when you're growing fast and have high multiples," says Robertson.

Once the foundation for growth is in place and profits start rolling in, however, previously cost-conscious entrepreneurs sometimes become spend-thrifts, frittering away profits on excessive travel, personnel, even plush offices, and fancy cars. To counteract this tendency, many growing companies spread budgetary responsibility among many people. More than 400 out of 4,000 workers at ROLM have some input into the budget.

At Staodynamics Inc., a Longmont,

The Thorniest Problem: Pacing Production

Production is perhaps the single area in a company which is most susceptible to downside risk. If there are internal problems, particularly quality problems, this is the first cog in the wheel to grind to a halt. And likewise, if there are external problems, such as a slackening of demand, the production line and staff are the first casualties. To protect against being caught with too much plant or too big a payroll, companies sometimes prefer to subcontract.

At Sunnyvale, Calif.-based Triad Systems Corp., for example, subcontracting all assembly work on its specialized computer systems has helped to keep down the work force that otherwise might be a third larger than its current staff of 1,100 employees.

But subcontracting isn't always the answer. Once, Staodynamics Inc., maker of electric nerve stimulators in Longmont, Colo., tried subcontracting some injection molding work. But when the subcontractor got in a bigger order, Staodynamics's job was delayed. If the practice had persisted it could have put the young company out of business. Instead, using \$190,000 raised publicly at the firm's birth, Thomas H. Thomson, president,

built his own injection molding department, as well as tool-making and other operations likely to be jobbed out at other companies.

But when it comes to building up production, quality above all else must be maintained for the sake of the fast-growing company's credibility. When Quantum Corp., San Jose, found that customers were returning as many as a quarter of its Winchester-type disk drive units earlier this year, Jim Patterson, president, realized that more was at stake than shipping product out the back door. So he shut down production for three weeks to analyze the problem. All the employees knew the cost impact of shutting down, Patterson says, and by privately talking about quality and personal initiative with each employee, Quantum's standards were quickly set back on track. After the shutdown, the return of products dropped dramatically.

The problem of quality control becomes especially acute when a company has a constant stream of new employees. "So you have to stay on top of attitude," Patterson says. "We had problems, and now we realize how essential quality is to our growth." —J.L.

Colo., maker of electric nerve stimulators, budget forecasts for people, space, and equipment are limited to a percentage of the last quarter's earnings. "That way we're only spending money that's already earned," says Thomas H. Thomson, president. "We make sure that money's always available and not withdrawn at the end of the quarter," he adds. Staodynamics had profits of \$250,000 on sales of \$4.8 million this year.

Other profitable, fast-growth companies tend to jump at new markets and products before their staffs and budgets can really afford the added complexity. Quantum Corp., the computer disk drive company, would like to take advantage of the booming market in add-on memories for small business computers. But Jim Patterson realizes he's limited by what he can produce. "All you can do is keep beating down the tendency to diversify too quickly," he says, "or sooner or later you end up compromising on people and plans."

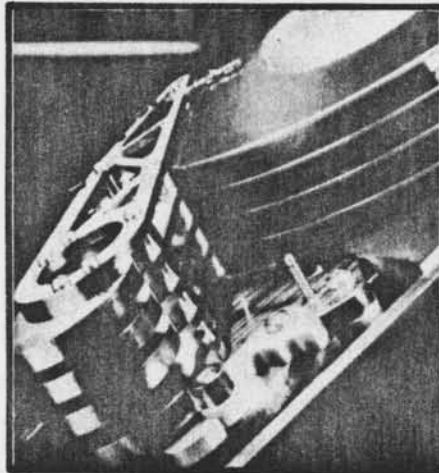
Many employees train for dual jobs—their own and their boss's, which they'll take over within months

Triad Systems is a good example of how over-ambition can be avoided. Rather than jumping into tempting military computer operations and other markets distant from its experience with the auto parts and hardware industries, Triad expanded vertically. New products include systems for auto parts warehouses and independent tire dealers—areas close to the company's main line.

"We want to accomplish three things," says Stevens: "To make a 20% pretax profit, to keep employees excited, and to keep customers satisfied. If we meet at least that last goal, we'll make a profit. Once customers aren't serviced adequately, you're in trouble."

The problems that come with fast growth may not seem any different from those faced by companies in more moderately paced tracks. It's just that they all seem to come at the same time, and therein lies the challenge. One founder likens the job of steering his company through fast growth to watching a slide show on an automatic projector: The frames keep flipping, whether you're ready or not. "The key," he says, "is to be disciplined enough to solve each crisis before you go on to the next." ■

DESIGN OF A LOW COST EIGHT INCH FIXED DISK DRIVE



By Joel N. Harrison

QUANTUM CORPORATION

1981 AND 1982 CHRISTMAS PARTY INVITATIONS

*You are cordially invited
to attend
Quantum Corporation's
Christmas Dinner Dance
to be held on
Friday, December 11, 1981
at
Rickey's Hyatt House
4219 El Camino Real
Palo Alto, California
7:00 P.M. to 1:00 A.M.
\$5.00 per couple*

*You are cordially invited
to attend
Quantum Corporation's
Christmas Dinner Dance
to be held on
Saturday, December 18, 1982
at
Santa Clara Marriott Hotel
Great America Parkway
Santa Clara, California
7:00 P.M. to 1:00 A.M.
\$5.00 per couple*

IT IS UNLAWFUL TO CONSUMMATE A SALE OR TRANSFER OF THIS SECURITY, OR ANY INTEREST THEREIN, TO ANY PERSON WHO IS KNOWN TO BE A STOCKHOLDER OF THE COMPANY, WITHOUT THE WRITTEN CONSENT OF THE COMMISSIONER OF CORPORATIONS OF THE STATE OF CALIFORNIA, EXCEPT AS PERMITTED IN THE COMMISSIONER'S RULES.

THE SHARES REPRESENTED BY THIS CERTIFICATE HAVE BEEN ACQUIRED FOR INVESTMENT AND NOT WITH A VIEW TO, OR IN CONNECTION WITH, THE SALE OR DISTRIBUTION THEREOF. NO SUCH SALE OR DISPOSITION MAY BE EFFECTED WITHOUT THE WRITTEN CONSENT OF THE COMMISSIONER OF CORPORATIONS OF THE STATE OF CALIFORNIA. IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND SEAL OF OFFICE THIS _____ DAY OF _____, 19____. REGISTERED OFFICER OF THE STATE OF CALIFORNIA. BY _____, SECRETARY OF THE STATE OF CALIFORNIA. IN OPINION OF COUNSEL FOR THE COMPANY THAT SUCH REGISTRATION IS NOT REQUIRED UNDER THE SECURITIES ACT OF 1933.

INCORPORATED UNDER THE LAWS OF THE STATE OF CALIFORNIA

Number 228

Shares 10

QUANTUM CORPORATION

CAPITAL STOCK 5,000,000 SHARES

Preferred Stock 2,000,000 Shares

Common Stock 3,000,000 Shares

This Certifies that KEITH A. ROSHEIM is the record holder of TEN Shares of the Common Stock of

QUANTUM CORPORATION

transferable only on the share register of said Corporation, in person or by duly authorized Attorney, upon surrender of this Certificate properly endorsed or assigned.

This Certificate and the shares represented hereby are issued and shall be held subject to all the provisions of the Articles of Incorporation of ~~Quantum~~ ^{Quantum} ~~Corporation~~ ^{Corporation} and any amendments thereof, to all of which the holder of this Certificate, by acceptance hereof, assents.

A statement of the rights, preferences, privileges and restrictions granted to or imposed upon the respective classes of shares of stock of the Corporation and upon the holders thereof may be obtained by any stockholder, upon request and without charge, at the principal office of the Corporation.

Witness the Seal of the Corporation and the signatures of its duly authorized officers this

21st day of December, A.D., 1981


SECRETARY


PRESIDENT

Capital for Quantum

Quantum Corp. said yesterday it raised more than 90 million dollars in new capital in its third round of financing. Since the Milpitas firm was founded two years ago, it has raised \$12 million.

Quantum Corp. has moved its manufacturing facilities and its corporate headquarters to a 46,500 sq ft structure at 1804 McCarthy Blvd., Milpitas, Cal. 95035.

Quantum Names Manager Of Int'l Winchester Sales
MILPITAS, Calif. — Quantum Corp. has named former Quantum manager of international sales, a new position.

Mr. Malmel, who reports to Quantum sales director Bob Teal, will be responsible for international sales of Quantum's Q2000 family of 8-inch Winchester disk drives.

Quantum Gears Up for 8-In. Winchester Demand

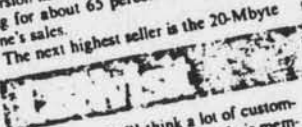
Market Soars Beyond Manufacturing Rate

By John Gritzner
CEN Staff
MILPITAS, Calif. — Quantum Corp., a year-old supplier of 8-in. Winchesters, is now cranking out 50 units per day while industry-leading Shugart Associates is only pushing out a reported 150 units per day, meaning the Winchester market will be limited by production capability for at least another six months, maybe longer.

This conclusion was offered recently by James I. Patterson, president and co-founder of Quantum. His firm has become one of the leading names in 8-in. low-end Winchesters, targeting the same small business computer and word processor market that Shugart's popular SA1000 has set its sights on. "It's very difficult for anyone to tell exactly how big the market is," Patterson said. "Our customers are selling into explosive markets of their own and I don't think even they can really tell at this point how big those markets will be." Quantum intends to hit the 200-units-per-day mark sometime in the spring of 1982. "Right now," Patterson said, "we

cannot produce enough drives to meet the demand. I think the market will be limited by production for at least another six months." The product that has launched Quantum into the fray in just one year is the Q2000 series of drives which come in capacities of 10-, 20-, 30- and 40 Mbytes. According to Patterson the 40-Mbyte version has been the best seller, accounting for about 65 percent of the product line's sales.

The next highest seller is the 20-Mbyte



version, he said. "I think a lot of customers think in terms of doubling their memory capacities. We haven't sold a lot of 30-Mbyte drives, which surprised us somewhat." Another development that surprised Quantum officials a bit was the fact that users weren't "co-mingling" Quantum drives with Shugart SA1000s in second-source type arrangements, even though Quantum designed its drive to be fully compatible with the Shugart model. "The customers seem to want to stick with one vendor," probably because of the commitment that a customer must

make to learn about a product and about the vendor, Patterson said. In addition to small business and word processor manufacturers such as Vector Graphic Inc. and Altos Computer Systems Inc., Quantum sells products to controller firms that add their own controllers to the drives and sell the combined units as subsystems. "That has been a significant portion of our sales so far," Patterson said, "but I think in the long run it will be one of our smaller markets, compared to the small

business computer field." Controller firms, smaller than computer companies, often can move more quickly when new products are introduced. When Quantum introduced its drive, controller companies "jumped on it" very quickly and therefore were among the first customers for the product, Patterson noted. However, the word processing and business computer market should overtake the controller house market before too long, he said. Quantum's competitors, other than Shugart, include Scagate Technology, Tandon Corp. and Control Data Corp.

(CDC), "although CDC has a different kind of orientation than we do," Patterson said.

The other major competitors to be reckoned with are the Japanese disk drive firms, led by Fujitsu Ltd. "Our goal at Quantum has always been in manufacturing technology, rather than in engineering. We want to produce the world's best manufactured drive, available in large quantities with good reliability. That's been our goal from the start," Patterson said.

"The Japanese are probably the best in the world at that strategy," he noted. The firm is working on higher capacity drives to take it beyond the 40-Mbyte range. Nearly all of the founding members of Quantum worked at Shugart, including vice-president of engineering David A. Brown, vice-president of manufacturing Harold C. Medley, manager of electrical engineering Donald V. Daniels, manager of mechanical engineering Joel N. Harrison and sales director Robert G. Teal. Patterson formerly was vice-president of engineering in the development and support of Systems Industries Inc.'s memory subsystems product line. Quantum Corp., 1804 McCarthy Blvd., Milpitas, Calif. 95035, (408) 262-1100.

Quantum II & III SAN JOSE, CALIF. — Quantum Corp. has named Richard C. Cowden to the newly created post of quality assurance manager.

Cowden had been senior director of general engineering at Mohawk Data Sciences Corp. He is now responsible for maintenance of quality standards throughout production and distribution of the company's disk drives. These responsibilities previously were handled by manufacturing vice-president Harold Medley, to whom Cowden reports.

Quantum Gets \$7M Financing

MILPITAS, Calif. — Quantum Corp. has received \$7 million in second-round financing from a combination of venture capitalists and the Bank of America. Quantum received \$2.5 million in second-round equity financing from Mayfield Fund II, Kleiner-Perkins Caufield Fund II, Sutter Hill Ventures and Byers II, Continental Illinois Venture Capital I, Continente Technology Venture Capital I, participated in Quantum's first-round venture funding of \$3 million in early 1980. An additional \$4 million has been made available to Quantum as a line of credit from Bank of America, which also has awarded Quantum a \$500,000, 5-year loan for capital equipment purchase. The company has announced plans to move to a new facility in Milpitas later this month.

Quantum Gets \$6M Venture Funding

MILPITAS, Calif. — Quantum Corp., a Winchester disk drive manufacturer, has received a third round of equity financing of more than \$6 million from a group of venture capital sources.

Formed in 1980 by a group of former Shugart Associates employees, Quantum makes 8-inch Winchester drives aimed at the low-cost end of the marketplace.

Winchester it was purchasing from Micropolis Corp. Since then, Micropolis has cleaned up those problems, but Vector instead will be using Quantum Corp.'s 40-Mbyte drive in the 3030, having just inked a multimillion-dollar 18-month OEM deal. Some of the Quantum drives are in systems in beta test sites at this time, and Vector is looking to get the 3030 rolling full force later this year.

Quantum Corp. successful in 2nd round of financing

QUANTUM CORP., Milpitas, said it has secured \$7 million in its second round of financing through venture capital and bank credit. It said that of the \$7 million, \$2.5 million is cash in return for equity; \$4 million is a line of credit secured through the Bank of America, and \$500,000 is a five-year term loan for the purchase of capital equipment. Second-round investors are: Technology Venture Investors; Mayfield Fund II; Kleiner, Perkins, Caufield & Byers II; Sutter Hill Ventures; Merrill Pickard I; and Continental Illinois Venture Capital Corp. All but Technology Venture Investors participated in Quantum's initial round of financing in 1980, which resulted in more than \$3 million for start-up operations. The company was founded in March 1980 to manufacture low-cost disk drives.

Quantum Creates Disk Drive Quality Post

SAN JOSE, CALIF. — Quantum Corp. has brought in Richard C. Cowden as quality assurance manager, a newly created post.

Mr. Cowden takes on responsibility or maintaining the company's quality standards throughout the production and distribution of its line of Shugart-compatible 8-inch Winchester disk drives.

Mr. Cowden comes to Quantum

from Mohawk Data Sciences Corp. where his most recent post was senior director of general engineering. He also served as manager of product engineering/reliability and serviceability at MDS.

Prior to joining MDS, Mr. Cowden was at Memorex Corp., where he held the posts of product assurance director and programmed systems and systems technology director.

Quantum Corp., a San Jose disk drive manufacturer, has moved to new facilities at 1804 McCarthy Blvd., Milpitas. The firm also has secured \$7 million in its second round of financing with venture capitalists and the Bank of America.

Intel Corp., the Santa Clara semiconductor maker, has reached an agreement in principle with Miltope Corp., a Plainview, N.Y., manufacturer of digital computer peripheral equipment, for a technology exchange and cross-licensing agreement to design and make military "bubble" memory cassette systems.

Names in the News

by Chuck Baker

Norm Petermeier was named VP of engineering for Telecommunications Technology, Sunnyvale... At OCLI, Thomas F. Rosenkranz was named manager of market development... Gates Energy named William A. O'Brien as West Coast district manager. He'll headquarter in Ramona, CA... Analog West, Mountain View, named Lawrence J. Dean to VP of finance... ZyMOS Corp. picked Cortani/Brown/Rigoli as agency of record for PR... In Milpitas, Quantum named Stephen M. Berkley as VP of marketing... TII pegged Neil Carlson as VP of marketing... Atari has been busy. The new VP of planning there is F. Rosenthal, who will center on the Home Computer Division.

Ex-MDS Director Named QA Manager at Quantum

SAN JOSE, Calif. — Quantum Corp. has named former Mohawk Data Sciences Corp. senior director of general engineering Richard C. Cowden to the new position of manager of quality assurance.

Mr. Cowden reports to Quantum vice-president of manufacturing Harold Medley.

Mr. Cowden had been responsible for facilities, equipment and staff planning for the start-up of Mohawk's advanced development center in Los Gatos, Calif. He had been manager of product engineering and reliability at the MDS Berkimer, N.Y., operations.

WHO'S GETTING THE BUSINESS?

The bottom line for success in the rigid disk drive business is to land OEM contracts. The more contracts a company signs and the bigger their value, the better chance a manufacturer has for success in the marketplace, because of resultant economics of scale. The following list of major OEM contracts signed during the past two years was compiled by CSN and is believed to accurately portray who's really getting the business. Of course, the list is subject to change at a moment's notice in this volatile market. (Note: some OEMs are listed with more than one supplier because of alternate sourcing or for different products.)

8-INCH WINCHESTERS		5-1/4-INCH WINCHESTERS	
VENDORS	CUSTOMERS	VENDORS	CUSTOMERS
Shugart	Wang Labs, Altos Computer Systems, Convergent Technologies, Tandy Corp.	Seagate	DEC, Hewlett-Packard, Apple, Vector Graphic, Altos Computer Systems, North Star Computers, Lanier Business Products, Convergent Technologies, TI, Rair.
Quantum	Nixdorf Computer Corp., Wang Labs, Altos Computer Systems, Vector Graphic, Convergent Technologies.	Tandon	Commodore Business Machines, Tandy Corp., TeleVideo Systems.
Control Data	Point 4 Data, Modular Computer Systems.	RMS	Durango.
Memorex	Zenith Data Systems.	IMI	Corvus.
IMI	Hewlett-Packard, Corvus.	Computer Memories	Intel, Dynabyte, Convergent Technologies.
Micropolis	ICL, Tektronix, Dynabyte, Milcom.	Irwin	Olivetti, Intertec.
Priam	NBI, Ultimate Corp., Alpha Micro Systems, Intel Corp.	MiniScribe	Xcomp.
Fujitsu America	Plexus Computers.		
BASF	Zilog Inc., Point 4 Data Corp., Xylogics Inc.		
SLI	Texas Instruments.		
NEC	Plexus Computers.		

Quantum moves to Milpitas

Quantum Corp., a one-year-old electronics firm, moved its headquarters from San Jose to Milpitas.

Quantum also said Thursday it secured \$7 million in its second round of financing in the last year.

President James Patterson said Quantum moved partly to capitalize on the availability of nearby housing opportunities for employees in Milpitas.

The move to a 46,000-square-foot headquarters and manufacturing facilities also permits Quantum to consolidate its operations.

Prior to the move, Quantum leased three buildings in San Jose.

The firm, which makes instruments to retrieve and store computer data on discs, said it plans to exercise "almost immediately" its two-year option to buy an adjacent four-acre parcel in Milpitas.

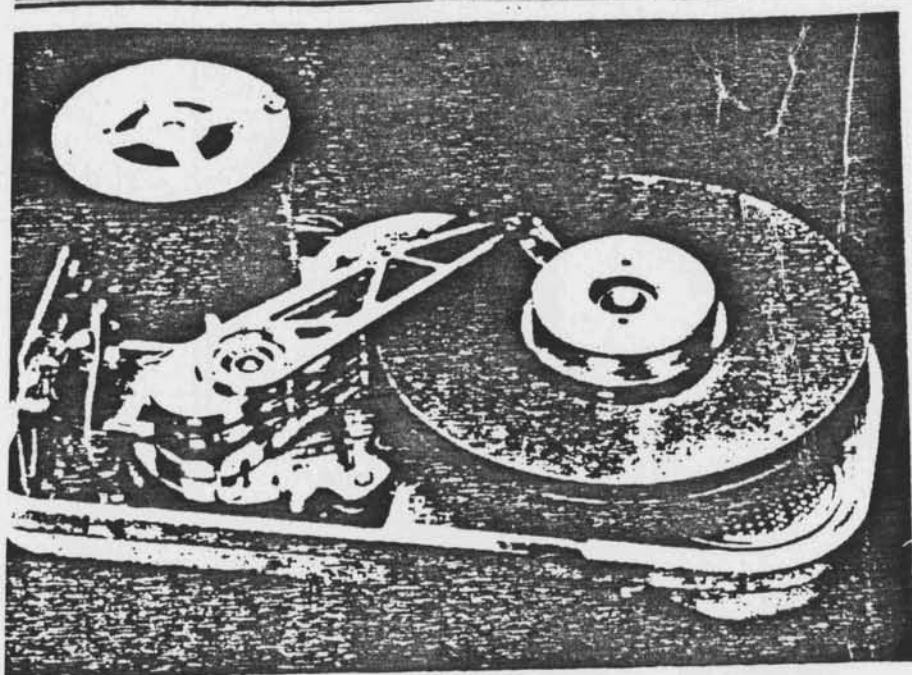
Quantum, which employs 85 people, said it expects to hire 115 additional personnel by March.

Quantum's sales figures are not yet available because the firm began selling its product just last January.

Of the \$7 million Quantum raised, \$2.5 million came from venture capitalists.

Quantum also secured a \$4 million line of credit from Bank of America and a \$500,000 five-year loan for the purchase of equipment from the bank.

Quantum raised more than \$3 million last year from the venture capitalists.



8-inch fixed disk drives

The Quantum 2000 series is a family of 10-, 20-, 30- and 40-megabyte 8-inch fixed disk drives in an 8 inch floppy-size package. These Winchester drives provide OEMs with an upgrade of floppy disk and lower capac-

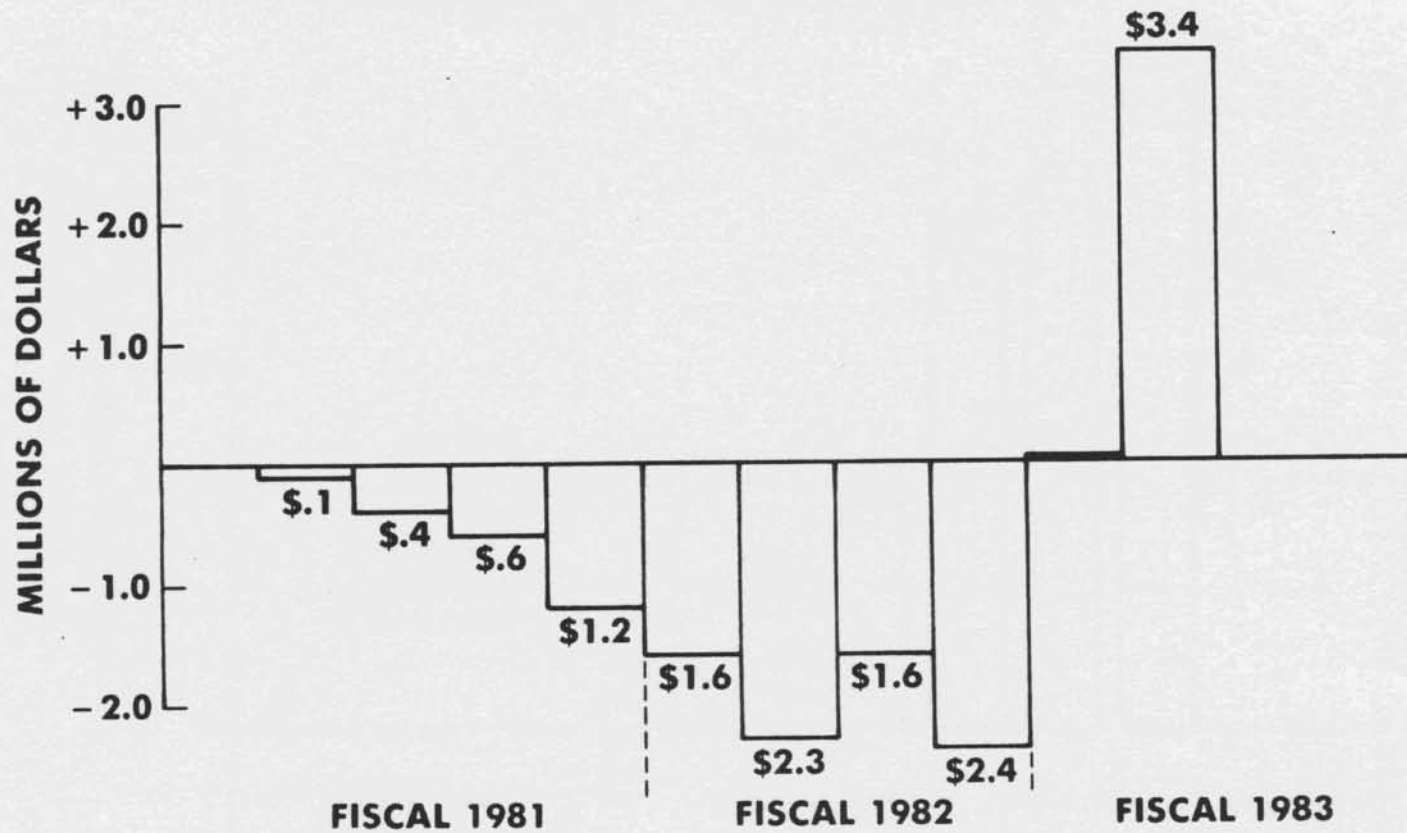
ity Winchester-based systems. Q2000 drives are fully compatible with the current industry-standard 8-inch Winchester drives.

Power supply and mounting requirements are fully compatible with industry-standard 8-inch floppy

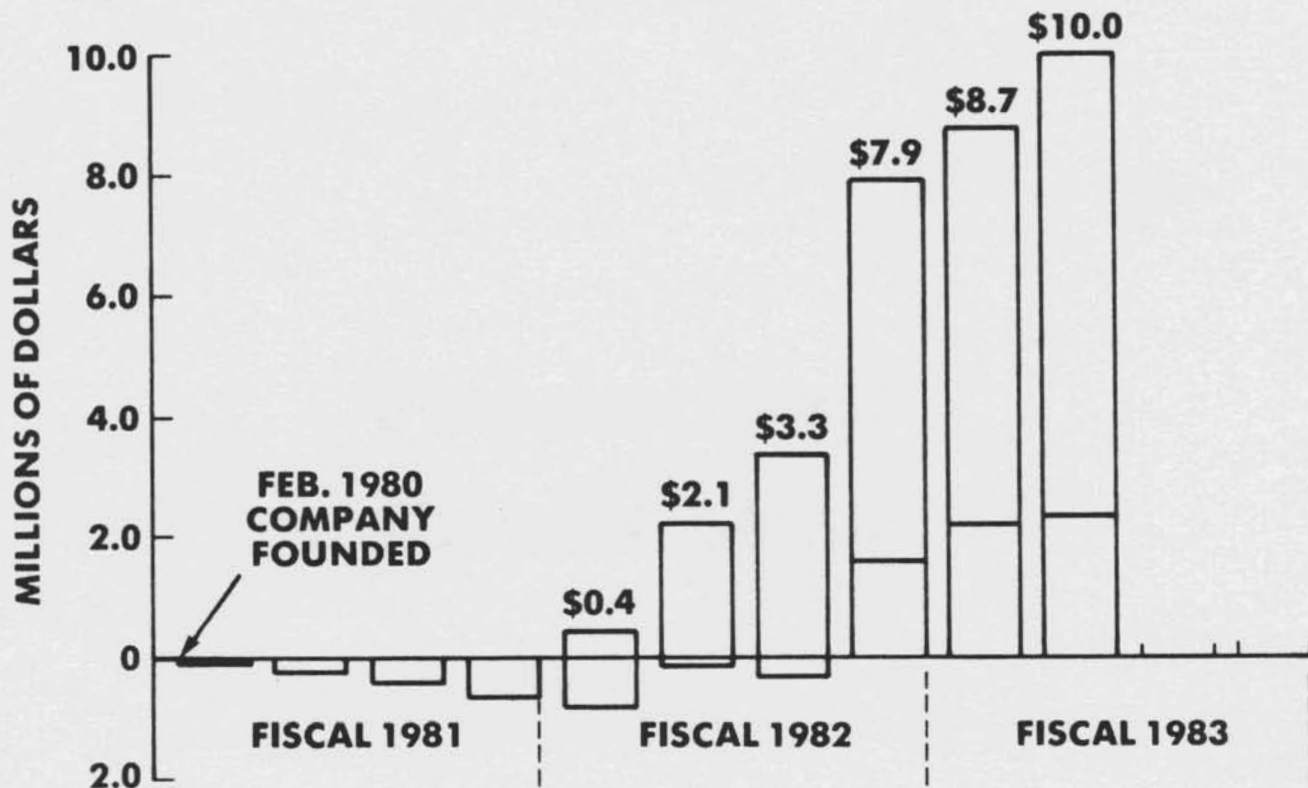
drives. Drive control and data signals use the same pin assignments as compatible floppy drives, allowing daisy-chaining of fixed and floppy drives.

Quantum/Thema.
440 on enquiry card

Cash Flow From Operations



Sales and Income Before Taxes



Production Challenges

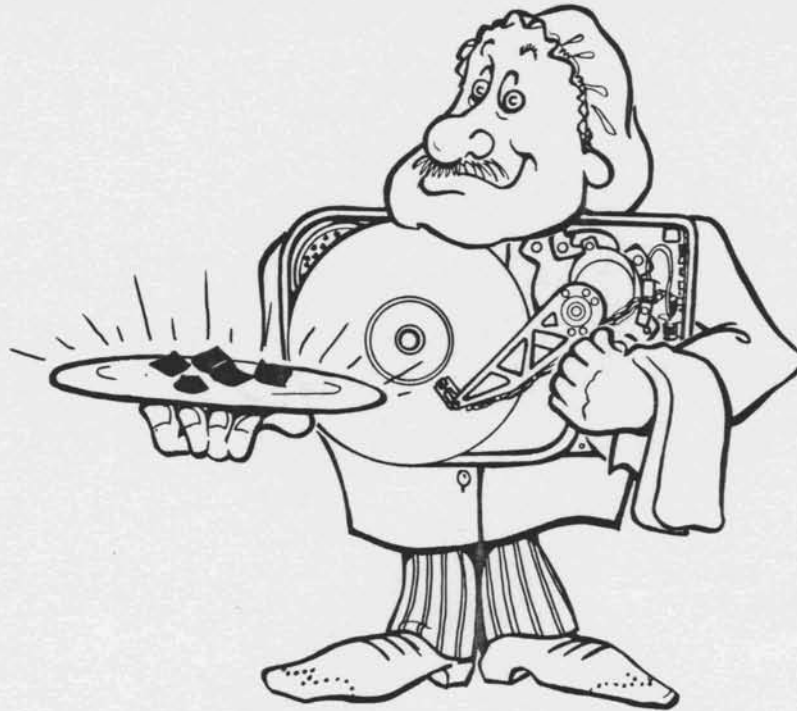
May 1981

**Shake & Bake
Began**



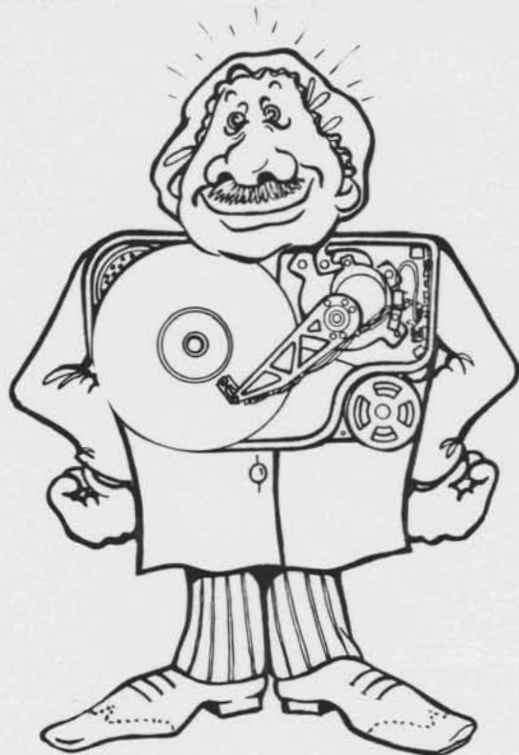
January 1982

Quantum Encoders Passed Shake and Bake



January 1982

Encoder Problem Solved



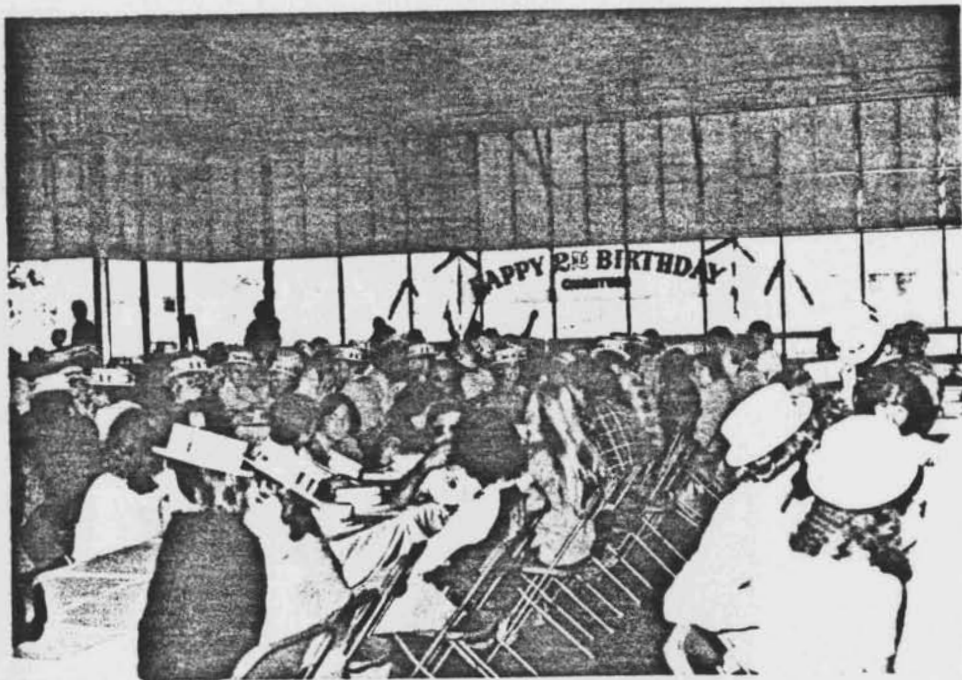
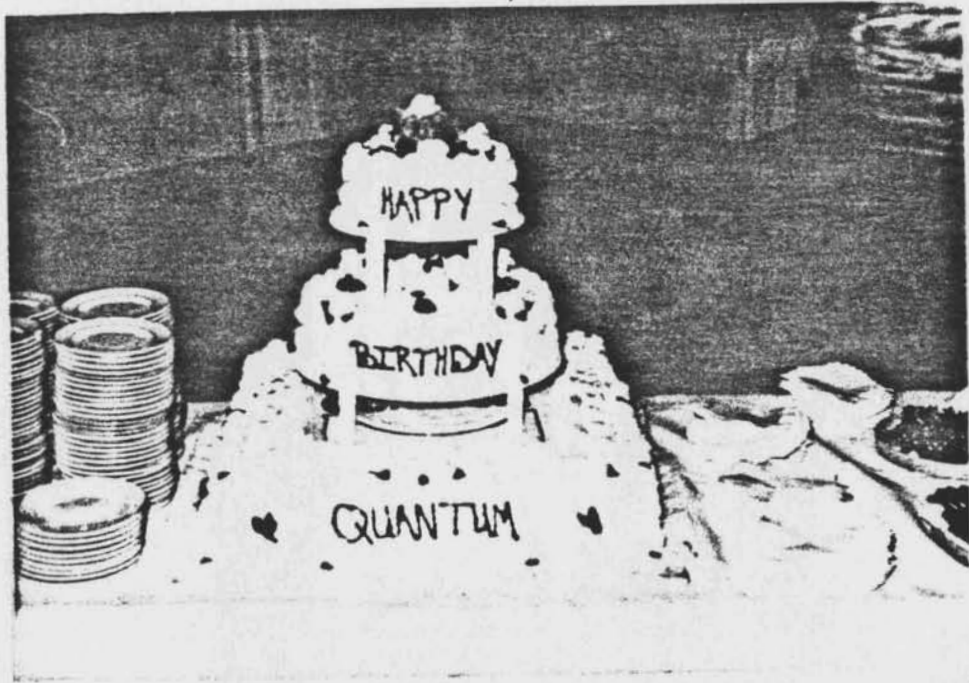
1982

JANUARY, 1982
BONUS PROGRAM



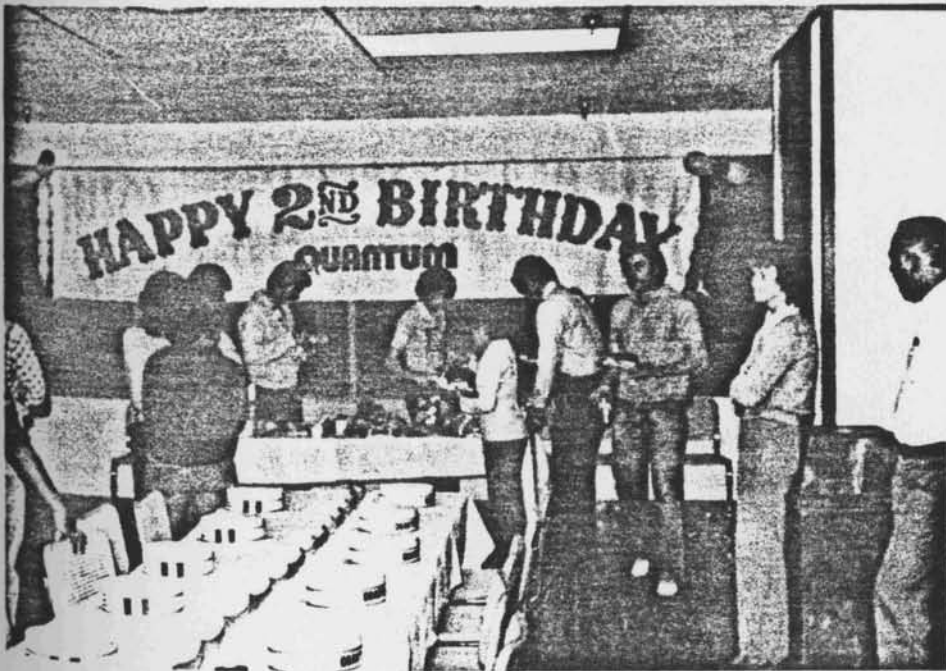
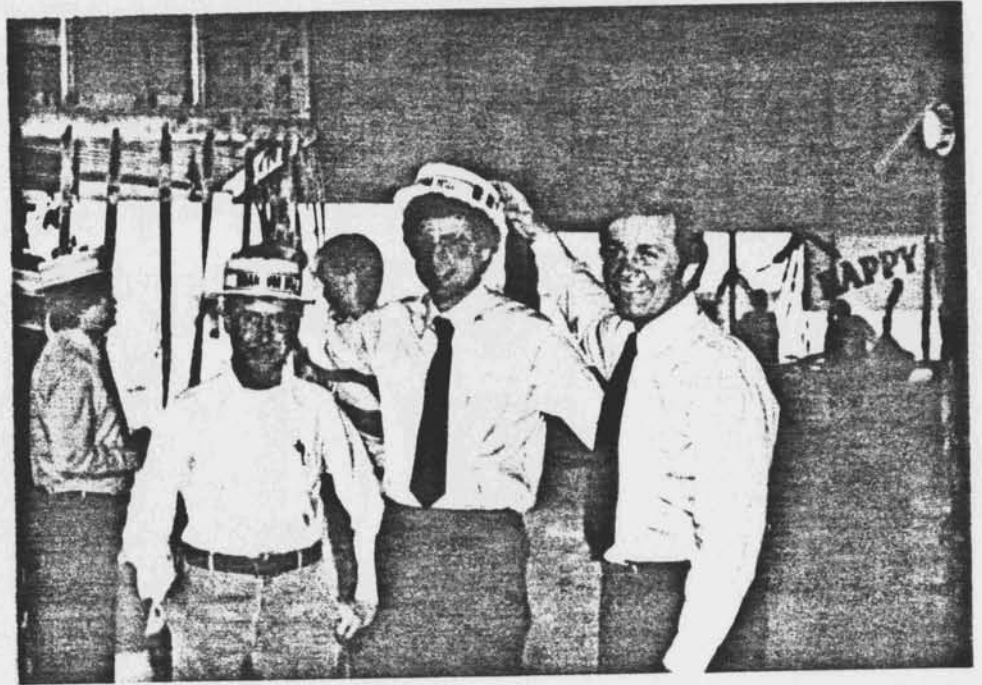
QUANTUM'S 2ND BIRTHDAY PARTY

FEBRUARY, 1982



QUANTUM'S 2ND BIRTHDAY PARTY

FEBRUARY, 1982



QUANTUM'S 2ND BIRTHDAY PARTY

FEBRUARY, 1982



Rigid disks: the new small systems alternative

JAMES N. PORTER, DiskTrend, Inc.

New sizes, prices and capacities make Winchesterst viable floppy-disk-drive substitutes

Disk-drive manufacturers are chasing the μ c market even more zealously than they chased the minicomputer market in the early 1970s, and their rapid product innovations are being matched by rapid market acceptance. By historical standards, the 5¼-in. Winchester-disk drive has been an instant success, and a major portion of all drives produced by 1984 will be 5¼- and 8-in. models. The international disk-drive market is worth \$7 billion. It will reach \$14 billion by 1984.

In addition to this continual downward swing in physical size, these trends characterize the disk-drive business:

- Capacities of 5¼-in. Winchesterst will soar past the conventional 6M bytes this year and may reach 40M bytes.
- Very-high-capacity drives in the 8-in. range will be introduced this year.
- Drive vendors are making it possible for users accustomed to 14-in. removable disk cartridges to have them in smaller dimensions.

Floppy drives set the stage for small Winchesterst

In 1973, International Business Machines Corp. introduced the 3340, which was developed under the internal IBM code name "Winchester." This drive provided higher densities and better reliability by using low-mass heads and lubricated disks in an environment sealed against outside contamination. The industry has borrowed the term Winchester, and now generally uses the name to describe any disk drive using similar technology, regardless of capacity or disk size.

Also in 1973, IBM introduced the 8-in. floppy-disk-drive format, which immediately set a worldwide

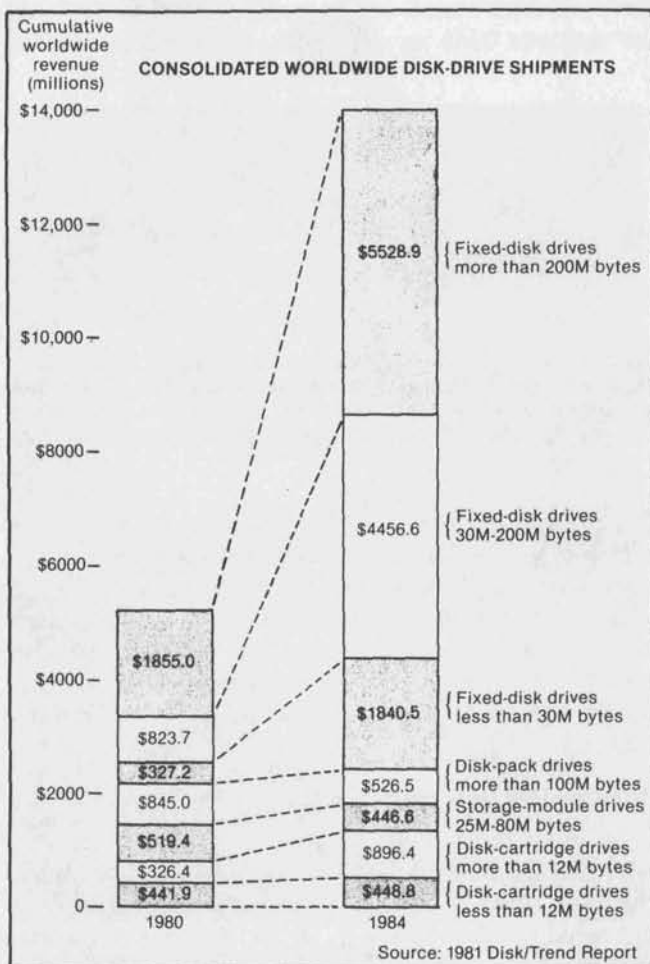


Fig. 1. Disk-drive revenues will grow at least 29 percent annually through 1984. Strongest growth will occur in the fixed-disk markets, with lower capacity Winchesterst drives leading the way.

Depending on the number of work stations per system, demand for disk capacity and access time may vary from modest to relatively high levels.

standard. The floppy became the preferred interchange standard for minicomputers and small-business systems within a few years. IBM's 8-in. floppy format was followed in 1976 by Shugart Associates' 5¼-in. version, which was better suited to desk-top computer systems.

The packaging of Winchester technology into the physical dimensions established for floppy-disk drives has been driven by the sharp growth in floppy-disk-drive shipments for small-computers, especially small-business systems. Almost half of the 4.8 million

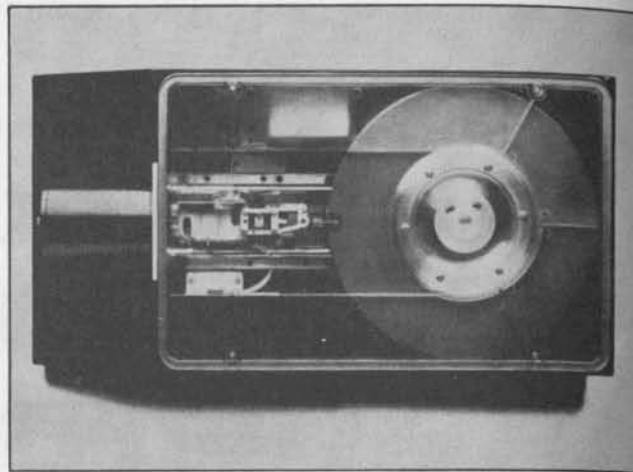


Fig. 3. Multi-platter, fixed, 8-in. drives such as this 6170 series unit from BASF boast large capacities. The unit above stores 40M bytes on three platters and uses a linear actuator to achieve 27-msec. average head-positioning times. The 6170 is driven by a DC motor, has a 10,000-hour MTBF and does not require scheduled maintenance.

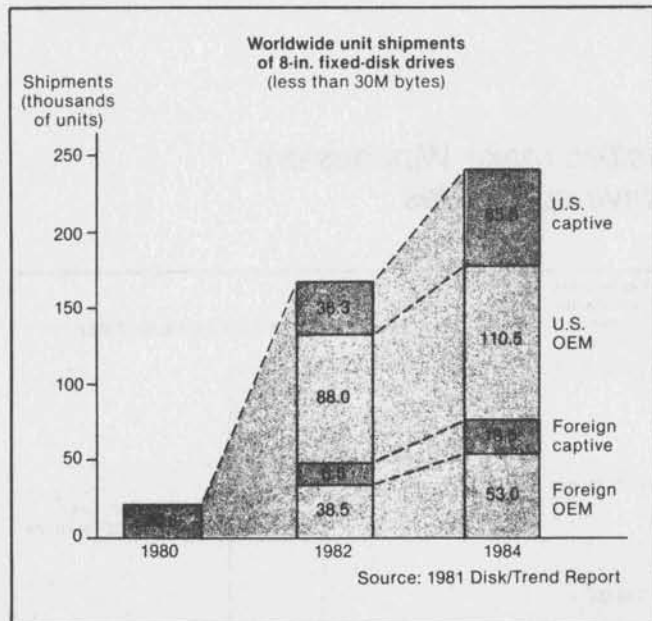


Fig. 2. Worldwide shipments of less-than-30M-byte 8-in. Winchesters will grow 39 percent annually from 1981 to 1984. Captive and foreign units will command an increasing share of future shipments.

floppy-disk drives expected to be shipped worldwide this year will be used with small-business systems, and most users of these systems develop voracious appetites for increased storage capacity. System manufacturers have shown they are ready to upgrade to higher capacity Winchesters that fit the same system slot as a floppy-disk drive, to capitalize on this appetite for capacity.

Winchesters are young, but already changing

At about the same time IBM was delivering its first 8-in. Piccolo drives in early 1979, International Memories, Inc. (now a division of Dorado Micro Systems), delivered the first OEM 8-in. drive. Shugart Associates with its SA 1000 drives soon joined IMI in this market, and the two firms continue to lead the industry in 8-in. Winchester shipments, most of which store 10M bytes

of data. Although several other announced manufacturers suffered extended production delays caused by a lack of Winchester manufacturing experience, an estimated 93,000 8-in. drives with less than 30M bytes of capacity were shipped worldwide in 1981 (Fig. 2).

The growth period for low-end 8-in. Winchesters in the 10M-byte range is severely limited by the emergence of 5¼-in. Winchesters in the same capacity range. The future for 8-in. fixed-disk drives is in applications requiring higher capacities and faster access. Numerous system manufacturers are offering

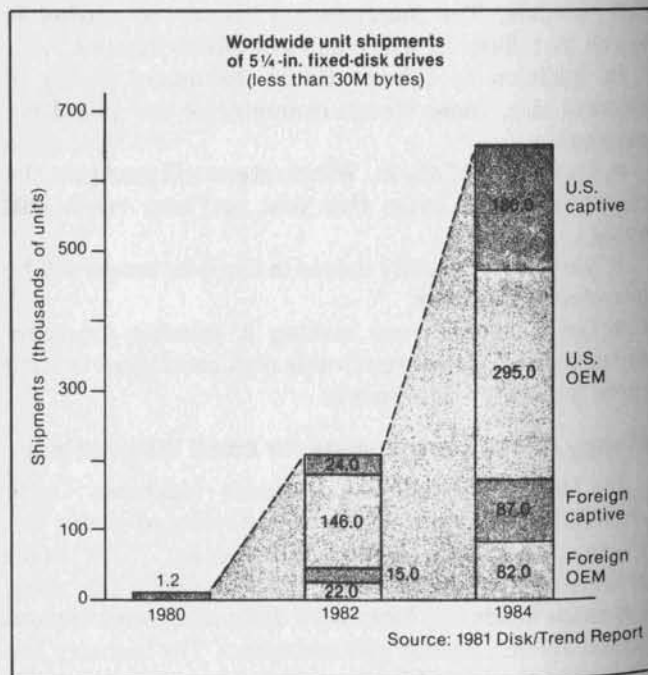


Fig. 4. Worldwide shipments of 5¼-in. Winchesters should grow at 117 percent annually from 1981 to 1984. Foreign vendors lag behind their U.S. competitors but will ship one-fourth of all 5¼-in. drives in 1984. Captive manufacturers are expected to jump on the 5¼-in. bandwagon and eventually account for nearly half of 1984 shipments.

Most 60M-byte and larger drives offer the standard SMD interface used with most of today's high-performance 14-in. OEM disk drives, plus a few unique interfaces and the ANSI interface proposed by the ANSI X3T9.3 technical subcommittee.

distributed-data and/or word-processing systems using clusters of work stations that share higher performance disk drives.

Depending on the number of work stations per system, demand for disk capacity and access time may vary from modest to relatively high levels. A 20M-byte disk capacity and a 70-msec. average-access time might be adequate for a three-terminal cluster, for example, but 25 terminals might require 80M bytes and 25-msec. average-access times.

To take advantage of the growing market for small-disk drives for distributed-processing systems, disk-drive manufacturers provide drives with new design features. Several manufacturers ship 8-in. drives with as much as 40M bytes of capacity and 35 to 65-msec. average-access times (Fig. 3). Shugart Associates' SA1000 interface is the standard for drives in this

group introduced by Quantum Corp. and by Shugart itself, but several firms, including IMI, Micropolis Corp., Control Data Corp. and Fujitsu Ltd., offer additional interfaces, including intelligent versions.

Deliveries of another group of fixed Winchester 8-in. drives is just beginning. These drives emphasize more capacity and faster access, and come from manufacturers known for higher-performance disk-storage technology. The drives range from 60M to 84M bytes with average-access times from 20 to 42 msec. Companies offering these drives include Ampex Corp., Fujitsu, Priam Corp., 3M Co., SLI Industries and IBM, and others are expected.

Further development of high-capacity, fixed-disk drives in the 8-in. range is expected. Drives with capacities of 160M bytes should be introduced in mid-1982. Those drives will use recording technologies available to most manufacturers. Higher density recording will be feasible with the thin-film heads and thin-film media being developed.

Most 60M-byte and larger drives offer the standard SMD interface used with most of today's high-performance 14-in. OEM disk drives, plus a few unique interfaces and the ANSI interface proposed by the ANSI X3T9.3 technical subcommittee. Future intelligent interfaces should make deep inroads in the share held by the SMD standard. Some of the smart interfaces will include a buffering capability so that systems can

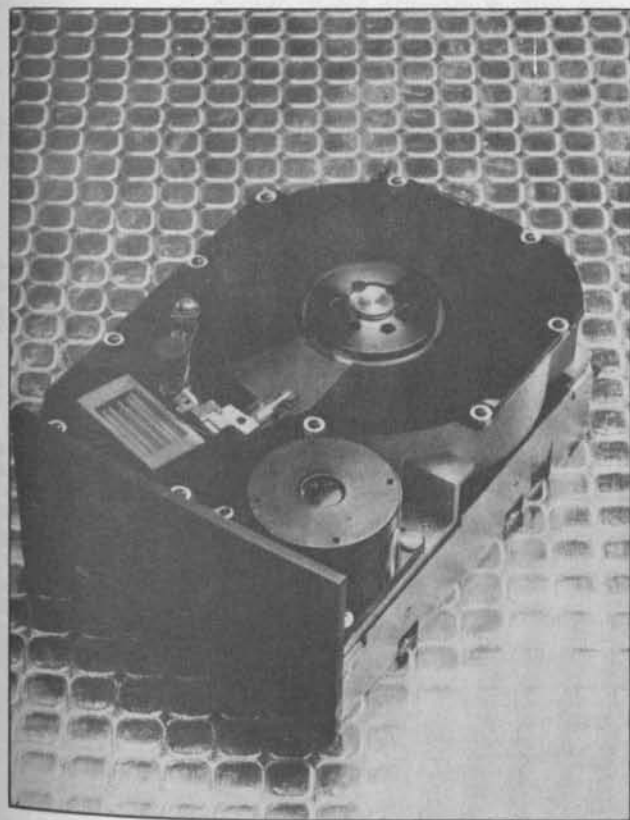


Fig. 5. Rising 5 1/4-in. disk capacities are exemplified by this 19.14M-byte unit from Computer Memories, Inc. Recording almost 5M bytes on each of its four platters, the model CM 5000 features Winchester technology, industry-standard mounting dimensions and optional transfer rate for 8-in. Winchester compatibility.

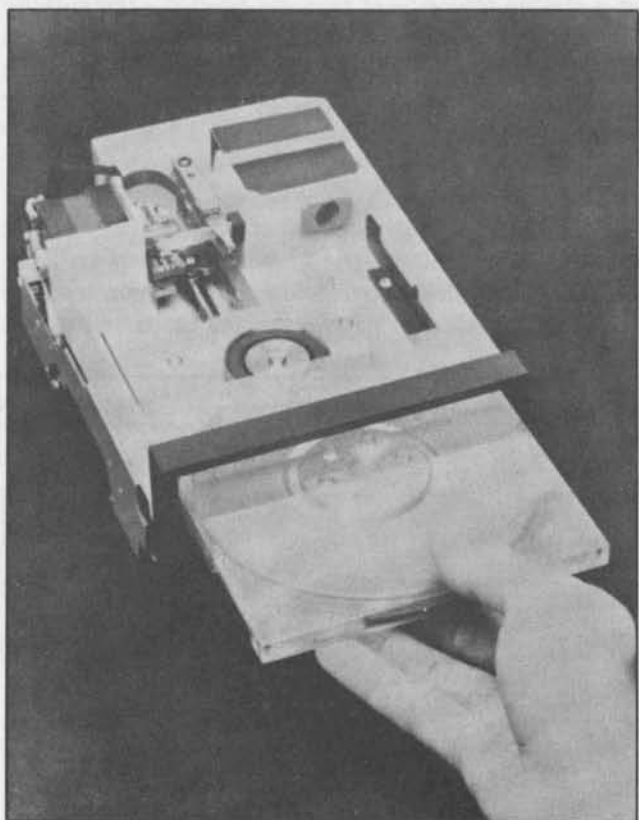


Fig. 6. Seagate Technology's ST-706, a 5 1/4-in. cartridge-disk drive, stores 6.38M bytes (unformatted). The drive uses thin-film heads and is intended for backup applications with multitasking, multi-user, 16- and 32-bit systems.

Drive manufacturers saw that the largest and most receptive market for high-capacity 5¼-in. floppies was the small-business-systems market.

accept data streams at acceptable rates, despite the higher transfer rates made necessary by tomorrow's extremely high recording densities.

Winchesters dominate floppy-upgrade market

Almost 2 million 5¼-in. floppy-disk drives were shipped worldwide in 1981, including both single- and double-sided models. By 1984, the total is expected to exceed 5 million drives. The original single-sided 5¼-in. floppy, introduced in 1976, was conceived as a disk for personal computers and word processors with only 110K-byte capacity. However, several developments changed this outlook. Double linear-recording density, double-track density and double-sided recording increased unformatted capacity for the 5¼-in. floppy-disk format to 1M byte. Drive manufacturers saw that the largest and most receptive market for high-capacity 5¼-in. floppies was the small-business-system market.

By 1979, 1M-byte, 5¼-in. floppy-disk drives seemed adequate for most desk-top small-business systems—but a sizable minority of systems needed substantially more disk capacity because desk-top units started to compete for applications previously handled by much larger systems. It was not then practical to push floppy recording technology to the densities needed to satisfy these system requirements, and even today, 5¼-in. floppies storing more than 2M bytes are not imminent.

Sensing the market potential of a 5¼-in. drive using Winchester technology, the founders of Seagate Technology moved quickly to develop one. Seagate used the technology at conservative densities to ensure a fast

startup, held packaging to the standard SA 400 dimensions to fit existing system enclosures and designed an interface similar to the SA 1000 8-in. Winchester drives to take advantage of available controllers. Seagate deliveries started in July, 1980, and touched off a stampede as existing and new disk-drive manufacturers tried to bring competitive 5¼-in. Winchester-disk drives into production.

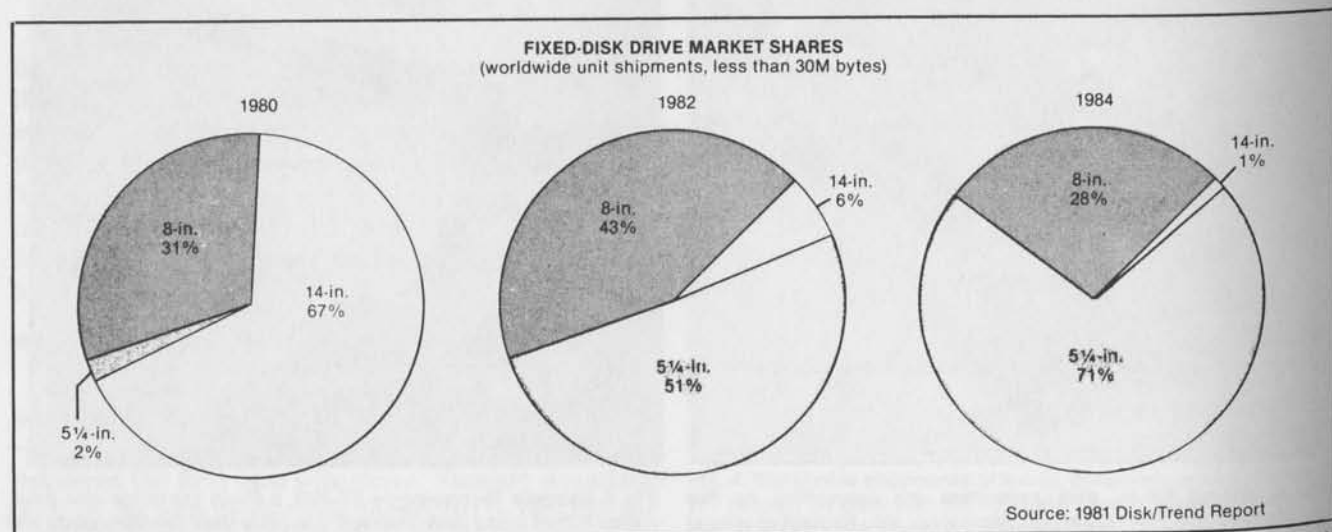
Only 1200 5¼-in. Winchesters were delivered in 1980, all by Seagate, but worldwide shipments grew to an estimated total of 63,000 drives in 1981 (Fig. 4). The *Disk/Trend* forecast of worldwide shipments of 5¼-in. fixed-disk drives storing less than 30M bytes in 1984 is 644,000 drives. More than 20 additional disk-drive manufacturers have followed Seagate into the field.

Most 5¼-in. Winchesters shipped in 1981 were 6M-byte drives. Seagate and most of its competitors have also announced 12M-byte drives, and some product lines planned for early 1982 feature capacities as high as 19M bytes (Fig. 5). At least one manufacturer offers a 50-percent bonus in capacity through a run-length-limited encoding scheme.

Most 6M- and 12M-byte, 5¼-in. Winchesters will probably be used with single-work-station systems. However, 5¼-in. fixed drives in the 30M- to 50M-byte range are expected by 1983, and these drives will compete in a different arena. Just as 5¼-in. Winchesters are becoming the choice of system designers over 8-in. Winchesters for single-user small-business systems, higher capacity 5¼-in. Winchesters are expected to open a new market with multi-user systems. The industry is fast reaching the stage at which a master work station in a five- to 15-terminal cluster need be no larger physically than the individual satellites. And the high-capacity, fast-access 5¼-in. fixed disks necessary for this development will soon be here.

Cartridge-disk dimensions are shrinking, too

A generation of minicomputer and small-business-system users have grown up using 14-in. removable



Fixed-disk drive market shares for less-than-30M-byte units are split by disk size. Winchester technology is used in 14-, 8- and 5¼-in. drives, but larger drives are losing popularity as a result of soaring 5¼-in. capacities that reach 38M bytes.

OEM RIGID-DISK DRIVES

This list includes drives offered for sale in the U.S. to the OEM market, regardless of whether manufactured in the U.S. or elsewhere. Drives made by major data-processing system vendors for sale to their captive end users are excluded, as are subsystems assembled by resellers. Also omitted are 14-in. drives of all capacities in order to concentrate on the newer generation of smaller disks.

Manufacturer Model	Unformatted capacity (M bytes)	Number of data surfaces	Bytes per track	Average access time including latency (msec.)	Transfer rate (K bytes/sec.)	Actuator type	Interface type
8- AND 10½-IN. FIXED DISKS							
Ampex Corp.							
Scorpio 48	49.7	3	20,160	40.3	1209	linear, voice coil	SMD
Scorpio 80	82.9	5	20,160	40.3	1209	linear, voice coil	SMD
BASF Systems							
8171	8	1	13,344	35.3	800	linear, voice coil	BASF SMD, ANSI
8172	24	3	13,344	35.3	800	linear, voice coil	BASF SMD, ANSI
8173	40	5	13,344	35.3	800	linear, voice coil	BASF SMD, ANSI
Cii-Honeywell Bull							
Cynthia D 160/4, D162/4	60.2 (formatted)	4	12,800	48.3	920	linear, voice coil	Cynthia
Cynthia D160/6, D162/6	90.31 (formatted)	6	12,800	48.3	920	linear, voice coil	Cynthia
Cynthia D160/8, D162/8	120.42 (formatted)	8	12,800	48.3	920	linear, voice coil	Cynthia
Control Data Corp.							
9410-8 Finch	3.13	1	13,440	58.3	806	Rotary, voice coil	modified floppy-disk type
9410-24 Finch	24.39	3	13,440	58.3	806	Rotary, voice coil	modified floppy-disk type
9410-32 Finch	32.5	4	13,440	58.3	806	Rotary, voice coil	modified floppy-disk type
Data Peripherals							
DP 100	46.4	4	13,440	68.3	875	linear, voice coil	modified SA1000
Puma DP 400	46.4	4	13,440	68.3	875	linear, voice coil	modified SA1000
Fujitsu America, Inc.							
M2301B/K	11.712	4	12,000	80.1	593	band, stepping motor	Model B:SA4000; Model K: bidirectional
M2302B/K	23.424	8	12,000	80.1	593	band, stepping motor	Model B:SA4000; Model K: bidirectional
M2311K	48.250	4	20,480	28.3	1229	rotary, voice coil	SMD
M2312K	84.439	7	20,480	28.3	1229	rotary, voice coil	SMD
Hitachi America, Ltd.							
DK801-1	6.9	2	13,300	78.5	889	rotary, stepping motor	Modified SMD
DK801-2	13.9	4	13,300	78.5	889	rotary, stepping motor	Modified SMD
DK811-2	24	3	12,800	33.5	904	rotary, voice coil	Modified SMD
DK811-4	48	6	12,800	33.5	904	rotary, voice coil	Modified SMD
Hokushin Electric Works							
CD-8010P	11.5	4	15,151	81.3	900	band, stepping motor	Priam
IBM Corp.							
680	64.5 (formatted)	11	16,384 (formatted)	36.6	1031	rotary, voice coil	IBM
International Memories, Inc.							
7710	11.12	3	10,800	43.3	648	linear, voice coil	IMI
7720	20.5	5	10,800	43.3	648	linear, voice coil	IMI
7740	40	5	10,800	58.3	648	linear, voice coil	IMI
Kennedy Co.							
7300	41.4	5	20,160	38.3	967	rotary, voice coil	SMD, Kennedy, ANSI
Memorex Corp.							
101	11.7	4	12,000	80.1	593	band, stepping motor	SA4000
102	23.4	8	12,000	80.1	593	band, stepping motor	SA4000
Micropolis							
1221-I, 1201-I	8.911	1	15,364	50.3	922	rotary, voice coil	Micropolis, ANSI
1222-I, 1202-I	26.73	3	15,364	50.3	922	rotary, voice coil	Micropolis, ANSI
1223-I, 1203-I	44.56	5	15,364	50.3	922	rotary, voice coil	Micropolis, ANSI
Mitsubishi Electric Corp.							
M2860-1	21.73	3	13,440	43.3	806	linear, voice coil	Trident, SMD, SA1000
M2860-2	50.71	7	13,440	43.3	806	linear, voice coil	Trident, SMD, SA1000
New World Computer							
Mikro-Disk VIII-I	1.8	1	11,300	26.6	675	stepping motor	ST-506, SA1000
Mikro-Disk VIII-ITF	5	1	16,500	36.6	988	stepping motor	ST-506, SA1000

Nippon Electric Co.								
D2220	25.49	3	20,480	38.55	1198	rotary, voice coil	SMD	
D2230	42.49	5	20,480	38.55	1198	rotary, voice coil	SMD	
Nippon Peripherals								
NP30-40	36.6	5	19,800	36.6	1031	rotary, voice coil	SMD	
NP30-80	80.6	11	19,800	36.6	1031	rotary, voice coil	SMD	
NP30-120	120.9	11	19,800	36.6	1031	rotary, voice coil	SMD	
Olivetti OPE								
HD 830/1	34.75	3	17,850	48.3	800	linear, voice coil	bidirectional, ANSI	
HD 830/2	57.92	5	17,850	48.3	800	linear, voice coil	bidirectional, ANSI X3T9.3	
Priam Corp.								
Diskos 1070	10.8	4	15,151	81.4	900	band, stepping motor	Priam	
Diskos 3450	35.28	5	13,440	50.3	800	linear, voice coil	Priam, SMD	
Diskos 7050	70.49	5	13,440	50.3	800	linear, voice coil	Priam, SMD	
Quantum Corp.								
Q2010	10.66	2	10,400	60	543	rotary, torque motor	SA1000	
Q2020	21.33	4	10,400	65	543	rotary, torque motor	SA1000	
Q2030	32.0	6	10,400	70	543	rotary, torque motor	SA1000	
Q2040	42.66	8	10,400	75	543	rotary, torque motor	SA1000	
Shugart Associates								
SA1002	5.33	2	10,400	79.6	542.5	band, stepping motor	SA1000	
SA1004	10.67	4	10,400	79.6	542.5	band, stepping motor	SA1000	
SA1104	20.3	3	10,400	34.6	542.5	rotary, voice coil	SA1000	
SA1106	33.9	5	10,400	34.6	542.5	rotary, voice coil	SA1000	
SLI Industries								
Cheyenne 7.44	7.44	1	11,340	48.3	602	rotary, voice coil	SMD, SA1000, ANSI	
Cheyenne 22.3	22.3	3	11,340	48.3	602	rotary, voice coil	SMD, SA1000, ANSI	
Cheyenne 37.2	37.2	5	11,340	48.3	602	rotary, voice coil	SMD, SA1000, ANSI	
Cheyenne 52.07	52.07	7	11,340	48.3	602	rotary, voice coil	SMD, SA1000, ANSI	
Cheyenne 83.0	83.0	5	20,160	48.3	1200	rotary, voice coil	SMD, SA1000	
Cheyenne 116.14	116.14	7	20,160	48.3	1200	rotary, voice coil	SMD, SA1000, ANSI X3T9.3	
3M Co.								
8431	10.03	2	17,920	74.6	933.3	rotary, stepping motor	ANSI	
8432	20.07	4	17,920	74.6	933.3	rotary, stepping motor	ANSI	
8533	60	4	17,920	38.6	933.3	rotary, voice coil	ANSI	
Toshiba Corp.								
MK80F-10	15.32	2	20,160	48.3	1210	rotary, voice coil	SMD	
MK80F-20	22.98	3	20,160	48.3	1210	rotary, voice coil	SMD	
MK80F-30	38.3	5	20,160	48.3	1210	rotary, voice coil	SMD	
5/4-IN. FIXED DISKS								
Ampex Corp.								
Pyxis 4	4	2	10,417	93.3	625	rotary, stepping motor	ST-506	
Pyxis 8	8	4	10,417	93.3	625	rotary, stepping motor	ST-506	
Pyxis 12	12	6	10,417	93.3	625	rotary, stepping motor	ST-506	
Pyxis 16	16	8	10,417	93.3	625	rotary, stepping motor	ST-506	
BASF Systems								
6181	3.19	2	10,416	123.3	625	band, stepping motor	ST-506	
6182	6.38	4	10,416	123.3	625	band, stepping motor	ST-506	
6183	9.57	6	10,416	123.3	625	band, stepping motor	ST-506	
Computer Memories, Inc.								
CM5206	6.38	2	10,400	138.3	625	rotary, stepping motor	ST-506	
CM5412	12.76	4	10,400	138.3	625	rotary, stepping motor	ST-506	
CM5619	19.14	6	10,400	138.3	625	rotary, stepping motor	ST-506	
International Memories, Inc.								
5007	6.72	4	12,000	171.25	960	band, stepping motor	IMI	
5006H	6.38	2	10,416	168.3	625	band, stepping motor	ST-506	
5012H	12.76	4	10,416	168.3	625	band, stepping motor	ST-506	

5018H	19.14	6	10,416	168.3	625	band, stepping motor	ST-506
Irwin International, Inc. 510	12.3	2	10,080	33.32	675	rotary, voice coil	Irwin
Micro Peripherals, Inc. 10	12.06	4	8,900	34.5	625	rotary, stepping motor	SA1000
Miniscribe 1-006	6.4	2	10,417	202.3	625	rack and pinion, stepping motor	ST-506
1-012	12.8	4	10,417	202.3	625	rack and pinion, stepping motor	ST-506
Mitsubishi Electric Corp. M4863-1	3.33	2	10,417	83.3	625	rotary, stepping motor	ST-506
M4863-2	6.66	4	10,417	83.3	625	rotary, stepping motor	ST-506
M4863-3	10.0	6	10,417	83.3	625	rotary, stepping motor	ST-506
New World Computer Mikro Disc V 2/0	2	1	13,000	36.6	782	stepping motor	ST-506, SA1000
Mikro Disc V 4/0	4	2	13,000	36.6	782	stepping motor	ST-506, SA1000
Nippon Peripherals, Ltd. NP05-6	6.66	4	10,400	98.3	625	band, stepping motor	ST-506
NP05-10	10	6	10,400	98.3	625	band, stepping motor	ST-506
Olivetti OPE HD 513	12.3	2	10,080	33.32	675	rotary, voice coil	special
HD 561/1	3.75	2	10,417	94.3	625	band, stepping motor	ST-506
HD 561/2	7.50	4	10,417	94.3	625	band, stepping motor	ST-506
HD 561/3	11.25	6	10,417	94.3	625	band, stepping motor	ST-506
HD 512/1	13	3	10,080	38.3	690	linear, voice coil	bidirectional
HD 512/2	21.7	5	10,080	38.3	690	linear, voice coil	bidirectional
Rodime RO 101	4	2	10,416	93.3	625	rotary, stepping motor	ST-506
RO 102	8	4	10,416	93.3	625	rotary, stepping motor	ST-506
RO 103	12	6	10,416	93.3	625	rotary, stepping motor	ST-506
RO 104	16	8	10,416	93.3	625	rotary, stepping motor	ST-506
Rotating Memory Systems RMS 504	4.5	2	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 509	9	4	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 513	13.5	6	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 504	4.5	2	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 509	9.0	4	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 513	13.5	6	10,417	91.3	625	rotary, stepping motor	ST-506
RMS 518	18.0	8	10,417	91.3	625	rotary, stepping motor	ST-506
Seagate Technology ST-506	6.38	4	10,417	178.3	625	band, stepping motor	ST-506
ST-412	12.76	4	10,417	178.3	625	band, stepping motor	ST-506
ST-538	38.25	6	10,416		625	band, stepping motor	ST-506
Shugart Associates SA602	3.33	2	10,400	84.6	542.5	band, stepping motor	SA1000
SA604	6.66	4	10,400	84.6	542.5	band, stepping motor	SA1000
SA606	10	6	10,400	84.6	542.5	band, stepping motor	SA100 type
Tandon Magnetics 602	6.38	4	10,400	176.3	625	rotary, stepping motor	SA1000, ST-506
602E	9.6	4	10,400	233.3	625	rotary, stepping motor	SA1000, ST-506
603	9.57	6	10,400	176.3	625	rotary, stepping motor	SA100, ST-506
603E	14.3	6	10,400	233.3	625	rotary, stepping motor	SA1000, ST-506

Only 1200 5¼-in. Winchesters were delivered in 1980, all by Seagate, but worldwide shipments grew to an estimated total of 63,000 drives in 1981.

disk-cartridge drives. These users are very receptive to the idea of staying with the same concept of file organization and data backup, as systems become physically smaller.

A group of disk-drive manufacturers is enabling system manufacturers to stay with disk cartridges as they cut system size. In the 8-in. disk area, CDC introduced the Lark, a drive with 8M bytes fixed and 8M bytes removable capacity, and a double-density version is expected this year. Data Peripherals, a new firm, started shipping an 11M-byte removable-only disk cartridge drive in 1981. Other 8-in. cartridge drives are expected from several manufacturers, including Digital Equipment Corp., with an 8-in. cartridge drive equivalent to the widely used RL101 and RL102 family of 14-in. drives. Cartridge drives in the 5¼-in. size have also arrived on the scene. DMA Systems, another new company, is shipping a 5M-byte fixed, 5M-byte removable drive that meets the height and width standards for 5¼-in. drives.

Seagate has announced a removable-only 6M-byte drive using the same physical cartridge (Fig. 6).

Texas Instruments Inc.								
525/61	6.38	2	10,417	123.3	625	band, stepping motor	SA1000, ST-506	
525/122	12.75	4	10,417	123.3	625	band, stepping motor	SA1000, ST-506	
525/62	6.38	4	10,417	178.3	625	band, stepping motor	SA1000, ST-506	
CARTRIDGE DISKS								
Cii-Honeywell Bull								
Cynthia D120, D122	10 (formatted) removable	2	12,800	73.3	920	linear, voice coil	Cynthia	
Cynthia D135, D137	5 fixed, 5 removable, (formatted)	2	12,800	108.3	920	linear, voice coil	Cynthia	
Cynthia D140, D142	10 fixed, 10 removable (formatted)	4	12,800	73.3	920	linear, voice coil	Cynthia	
Control Data Corp.								
9455 Lark I	8.35 fixed, 8.35 removable	4	20,160	58.55	1209	linear, voice coil	SMD	
Data Peripherals, Inc.								
DP100	11.02 removable	2	13,440	68.3	874	linear, voice coil	modified SA1000	
DMA Systems								
Micro-Magnum 5/5	5 fixed, 5 removable	4	10,890	58.7	625	linear, voice coil	modified SA1000	
New World Computer								
Mikro Disc V 2/2	2 fixed, 2 removable	2	13,000	36.6	782	stepping motor	ST-506, SA1000	
Mikro Disc V 4/2	4 fixed, 2 removable	3	13,000	36.6	782	stepping motor	ST-506, SA1000	
Mikro Disc V 4/4	4 fixed, 4 removable	4	13,000	36.6	782	stepping motor	ST-506, SA1000	
Seagate Technology								
ST-706	6.38	2	10,416		625	band, stepping motor	ST-506	

RIGID DISK-DRIVE MANUFACTURERS
(by location of home office)

	U.S.	Japan	Europe
Disk-cartridge drives (less than 12M bytes)	12	3	4
Disk-cartridge drives (more than 12M bytes)	10	4	3
Storage-module drives (25M-80M bytes)	8	1	1
Disk-pack drives (more than 100M bytes)	9	5	2
Fixed-disk drives (less than 30M bytes)	29	8	7
Fixed-disk drives (30M-200M bytes)	20	8	4
Fixed-disk drives (more than 200M bytes)	8	4	1

Source: 1981 Disk/Trend Report

Both 8- and 5¼-in. cartridge-disk drives will find a ready market among certain types of system manufacturers. Floppies must be used with fixed-Winchester drives when systems needing Winchesters must rely on software published on floppy disks or when lowest possible hardware cost is essential. And tape-cartridge streamers make more sense if convenient end-of-day backup is the prime reason for removable media in a system. But disk cartridges continue to excel for data-processing systems with a heavy save/restore requirement—when applications are frequently moved on and off the system.

10,000th DISK DRIVE

March 30, 1982

SCANNER #10

MODEL NUMBER: Q2040 110 V 60 HZ
 SERIAL NUMBER: TEN THOUSAND

THRESHOLDS	2F		1F	2F/1F	OVERWRITE	MOD
	AMPLITUDE	(TAA)				
	30%			65%	10%	

CYLINDER	HEAD					
511	0	48%	62%	79%	0%	N
511	1	54%	67%	81%	0%	N
511	2	47%	60%	79%	0%	N
511	3	43%	57%	75%	0%	N
511	4	45%	56%	80%	0%	N
511	5	53%	67%	79%	0%	N
511	6	48%	61%	79%	0%	N
511	7	52%	65%	79%	0%	N

INDEX-TO-INDEX TIME: 20.34 MS
 AVERAGE SEEK TIME: 62.06 MS
 SINGLE TRACK SEEK TIME: 13.76 MS
 FULL STROKE SEEK TIME: 101.71 MS

CYLINDER	HEAD	ERROR	ERROR	BIT	DROP	DROP	ERROR
		OFFSET	LENGTH	OVFL	OUT	IN	OVFL
250	4	3864	1			H	
251	2	1929	4			S	
251	2	2611	2			S	
251	2	2706	10			S	
251	2	2711	1			S	
251	2	2718	4			S	
251	2	2990	9			S	
251	2	5711	3			S	
251	2	5715	4			S	
251	2	5719	3			S	
251	2	5770	3			S	
251	2	5808	7			S	
261	2	4473	2			S	
261	2	4490	1			S	
261	2	4493	1			S	
261	2	4596	3			S	
261	2	4603	3			S	
261	2	4653	1			S	
261	2	5100	2			S	

...cerpts relating to Quantum
...om CSN Special Report,
...dated April 12, 1982.

COMPUTER SYSTEMS NEWS

Rigid Disk Drives

Somewhere, over the rainbow...there really is a pot of gold, and OEM rigid disk drive vendors are scrambling to find it. Those that are smart enough or lucky enough to discover the key to getting over the rainbow will learn that the pot of gold, for disk drive vendors at least, is actually a thriving, bountiful marketplace expected to approach \$2 billion by 1985.

While large amounts of time, energy and money will be spent formulating plans to reach the pot of gold, the secret to success is not really a secret. Successful companies do three seemingly simple things: they achieve volume manufacturing; they keep their costs under control; and they maintain the reliability of their products.

Obviously, however, things are not as simple as they seem. Most companies will go through at least a few rainstorms in trying to attract experienced personnel, iron out manufacturing problems and round up funding, before nearing the rainbow.

Some companies, such as Control Data Corp. and Shugart Associates, have found their pots of gold. Others, such as Seagate Technology and Quantum Corp., appear to be on their way. Many other suppliers, however, will never get to see the brilliant colors of the rainbow, let alone share in the pot of gold.

This section examines the myriad opportunities for disk drive vendors in the various market segments and attempts to give potential OEM customers a glimpse of what to expect in terms of products, technology and vendor strategies. Additionally, it looks at the new roads manufacturers are taking to go beyond the rainbow in search of that elusive pot of gold. —Mike Perkowski



And as the market segmentation and technology have changed, so has the competitive picture. Shugart still is highly successful in the low end, but Memorex has suffered through numerous problems, IMI has devoted a great deal of its resources to meeting the needs of its related companies and Kennedy dropped its original products and unveiled a high-end drive. Shugart now competes with Quantum, a Shugart spin-off that became a market force almost overnight in 1981.

In the high end, Micropolis was one of the only companies to land OEM contracts until recently, although Priam and Fujitsu have come on in the past year. BASF is selling its rigid disk drive operation, and PCC has scrapped its original product for a complete new line of drives. And a number of newer players, including Ampex Corp., NEC Information Systems and 3M, have come into the market and are vying for market share.

Achieving market share in the face of formidable competition, however, will be a difficult task. Most market followers expect at least four suppliers to emerge as certain winners when all the smoke has cleared a year from now: Shugart Associates, Quantum, Control Data Corp. and Fujitsu America.

For the remainder, being a winner in the 8-inch Winchester game will depend totally upon achieving volume manufacturing of a reliable product. Just which companies will be able to do that is still unclear, and although the market certainly will support a wide number of competitors, the battle for market share promises to be an intense one.

Financial muscle, although a key ingredient to success, is no guarantee that a company will reach its goals, as evidenced by the plights of Memorex and BASF. By the same token, relatively small and young companies such as Quantum can attain market share if they can produce the product reliably.

establish a cost-effective product with enough market share to pay the bills," he said. "The bottom line is that if you're not enjoying at least a 15 percent share of your segment of the 8-inch market, you're probably looking at a somewhat doubtful future and maybe you should look for another place to invest your money."

Quantum's early strategy—to become a second source for Shugart's SA1000 line—has paid off, aided by the fact that five of the six co-founders of Quantum worked on the SA1000 project at Shugart. Observers note that Quantum has been extremely successful at its game plan, and actually has gone beyond being just a Shugart second source to become an outstanding supplier in its own right.

Marketing vice-president Steve Berkley said Quantum currently is on a ramp that will take the company to \$50 million in annual revenue within its first two years of shipments.

"Although the 5-1/4-inch Winchester got all the attention and generated the excitement, what was lost during the past year was that the 8-inch market has finally expanded rapidly," he said. "Quantum and Shugart are quietly shipping away, and we're both finding an acceleration of demand."

"The result of this demand is that we're increasing our production capabilities from 30,000 square feet of space to 80,000 over the next three months. For companies like Quantum and Shugart, the demand for lower-cost peripherals is pushing the

increased orders."

Berkley said Quantum probably will continue to rely on proven technology in future products, rather than look to expand capacities through more advanced techniques.

"We are a manufacturing-driven company, not an engineering-driven company," he explained. "Large OEMs require a couple of things. One is a high level of confidence in the ability of a manufacturer to produce a product. Our strategy is not to push the state of the art and to keep the margins in the manufacturing process."

"The world didn't need another 8-inch Winchester disk drive when we came out with our products in 1980, but it did need a product that could be manufactured in volume and done reliably in a cost-effective manner. We use simple technology and are tooled for very high volumes, because the large OEMs can't afford to compromise their businesses with a disk drive that takes chances on technology."

Berkley declined to discuss Quantum's future products, but knowledgeable sources said the company has been privately discussing an 80-Mbyte drive with key accounts. Such a product would allow it to compete with high-end manufacturers as well.

WHO'S GETTING THE BUSINESS?

The bottom line for success in the rigid disk drive business is to land OEM contracts. The more contracts a company signs and the bigger their value, the better chance a manufacturer has for success in the marketplace, because of resultant economics of scale. The following list of major OEM contracts signed during the past two years was compiled by CSN and is believed to accurately portray who's really getting the business. Of course, the list is subject to change at a moment's notice in this volatile market. (Note: some OEMs are listed with more than one supplier because of alternate sourcing or for different products.)

8-INCH WINCHESTERS

VENDORS	CUSTOMERS
Shugart	Wang Labs, Altos Computer Systems, Convergent Technologies, Tandy Corp.
Quantum	Nixdorf Computer Corp., Wang Labs, Altos Computer Systems, Vector Graphic, Convergent Technologies.
Control Data	Point 4 Data, Modular Computer Systems.
Memorex	Zenith Data Systems.
IMI	Hewlett-Packard, Corvus.
Micropolis	ICL, Tektronix, Dynabyte, Micom.
Priam	NBI, Ultimate Corp., Alpha Micro Systems, Intel Corp.
Fujitsu America	Plexus Computers.
BASF	Zilog Inc., Point 4 Data Corp., Xylogics Inc.
SLI	Texas Instruments.
NEC	Plexus Computers.

5-1/4-INCH WINCHESTERS

VENDORS	CUSTOMERS
Seagate	DEC, Hewlett-Packard, Apple, Vector Graphic, Altos Computer Systems, North Star Computers, Lanier Business Products, Convergent Technologies, TI, Rair.
Tandon	Commodore Business Machines, Tandy Corp., TeleVideo Systems.
RMS	Durango.
IMI	Corvus.
Computer Memories	Intel, Dynabyte, Convergent Technologies.
Irvine	Olivetti, Intertec.
MiniScribe	Xcomp.

10/11/82

Quantum Unveils Its High-End 8-Inch Winchester

MILPITAS, CALIF. — Quantum Corp. has taken the wraps off the long-awaited high-end addition to its current line of 8-inch Winchester disk drives.

The new Q2080, as previously anticipated (CSN, Sept. 27), has an unformatted capacity of 85.45 Mbytes. It complements Quantum's existing family of 8-inch Winchesters in capacities of 10 to 40 Mbytes.

Quantum began shipping its products early last year and quickly established itself as the second-leading volume supplier of 8-inch Winchester disk drives behind Shugart Associates. In recent months, however, Shugart has faltered with its follow-on SA1100 8-inch Winchesters, and observers believe Quantum can capture the leadership position in the 8-inch market with the new 85-Mbyte drive if it can duplicate its earlier marketing and manufacturing success.

The Q2080 is said to be fully compatible with Quantum's lower-capacity drives, employing the same form factor, inter-

face, and closed-loop servo as the earlier drives. Quantum expects the new drive to be utilized primarily in multiuser, multifunction computer systems.

The drive also features an improved average access time over the earlier products—40 milliseconds, compared to the 65-millisecond access time offered with the 40-Mbyte drive. Available in either AC or DC power versions, the drive features track density of 783 tpi and recording density of 6600 bpi. Transfer rate is 4.34 Mbits per second.

Pricing of the product has not yet been determined, although the company said it expects to sell the drive for less than \$2500 in quantity 500.

Initial shipments of evaluation units are expected to take place later this year, with volume production scheduled for the first quarter of next year.

Quantum believes that it will be able to build its manufacturing ramp quickly because the new drive achieves approximately 80 percent parts

commonality with the existing drives.

With the new drive, Quantum now is going up against a number of new competitors.

Whereas in the low-end 8-inch market, Quantum most found itself competing with Shugart and International Memories Inc., the company now is expected to encounter opposition from such vendors as Priam Corp., Micropolis Corp., 3M Corp., NEC Information Systems Inc., Ampex Corp., Control Data Corp., Per-tec Computer Corp., Kennedy Co., Disctron Inc., and SLI Industries Inc.

Quantum, a privately held company that posted revenue of about \$13 million for its first year of operation, expects to boost that figure to more than \$40 million during the next year.

Among its chief OEM customers are Wang Laboratories Inc., Nixdorf Computer Corp., Convergent Technologies Inc., Altos Computer Systems Inc., and Vector Graphic Inc.

Circle Reader Service No. 137

marketing organiza-
ip. Obviously we don't
or on Data General's
vendors.
these alleged actions
on a national level. We
an isolated event that
with Japan."
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research house, said:
are in the business of
among our best custom-
ers with whom we are
information. They will
us to obtain it through

that would countenance
aining information from
e allegations are not in
anxious to get informa-
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on U.S. relations with
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try, but very uncommon
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gave a wish list to a guy
ormal. But if they paid
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what strange."

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we are not in a position
s are true, anyone in or
situation deplorable."
ompanies were very reti-
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allegations and would not

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said he thinks industrial
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only those involved.

Corp., said, "If it's true,
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ve at first issued a state-
was not rare and that last
between U.S. and Japa-
case probably has drawn
ese companies, and not
companies. However, he
drawn.

were stolen. We informed the
FBI, and IBM has cooperated
fully with the investigation."

Sources said IBM went along
with the FBI's sting operation
and turned over certain docu-
ments primarily for one rea-
son: the documents supplied
through the FBI to the Japanese
were not so crucially sensitive in
their nature that the company
could be severely damaged by
turning them over to the Japa-
nese.

When the Japanese asked for
more sensitive information,
IBM decided against providing
the documents, prompting the
FBI to end its operation and be-
gin arresting people. It has yet
to be determined on what those
requests centered.

IBM also said it intends to
make every effort to retrieve all
materials already turned over to
the Japanese businessmen and,
presumably, to their companies
in Japan. "We will continue to
do what is necessary to protect
company assets against those
who seek to obtain them illegal-
ly," IBM's statement said.

U.S. attorney Joseph P. Rus-
soniello, asked how IBM would
be affected by the Japanese
companies having proprietary
IBM data, said, "It really de-
pends upon the sophistication
of the company as to how much
value this information has in so
far as its competitive position in
the marketplace."

Sources speculated that while
Hitachi and Mitsubishi may
have gained some lead time on
their competitors also develop-
ing 3380-compatible disk drives,
it is unlikely the two companies
will make a dent in IBM's domi-
nant position in the market-
place.

"eager" approach of two Ameri-
cans—FBI special agent Alan Gar-
retson and an unnamed confiden-
tial FBI source.

The FBI, on the other hand,
maintained that the Hitachi offi-
cials made the initial overtures to
Garretson, seeking to pay for the
information and that the Hitachi
employees were told that the data
was being obtained by illegal

pany admitted that one of its em-
ployees had paid \$20,000 for prop-
rietary information from IBM.

News of the arrests has domi-
nated national media coverage in
Japan, and several members of
the Japanese press questioned the
arrests as a possible U.S. conspir-
acy by government and industry
against Japan. The U.S. immedi-
ately denied those charges.

DATA FLOW

Computer Syst. N.
6-28-81

(Continued from Page 6)

One of the OEM industry's two leading suppliers of 8-inch Winchester disk drives, Quantum Corp., finally has decided to take the plunge into the 5-1/4-inch Winchester disk drive marketplace, according to informed sources. Late this year the company is expected to formally announce its entry into the market, with production probably beginning early next year. Ever since Quantum was formed in 1980, rumors have been rampant about the company expanding its product line to include 5-1/4-inch drives, but Quantum has steadfastly remained on its original course to concentrate on becoming a leading supplier of 8-inch Winchesters, a goal it clearly has attained. But, apparently driven by requests by some of its larger OEM customers to expand its product line, Quantum has made an internal commitment to the 5-1/4-inch market, and development efforts have begun. There has been no definite word as to what capacities the new drives will be offered in, although knowledgeable sources indicate that Quantum will follow its game plan of supplying low-cost drives in the 20-to-40-Mbyte range. Also in the late-1982 time frame, watch for the long-expected unveiling of Quantum's 85-Mbyte 8-inch Winchester, a product that will propel the company into the thick of the battle in that market's high end.

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[Signature]

NOTE Please sign exactly as your name is shown. If the account is held jointly, all joint owners MUST sign. When signing as attorney, executor, administrator, trustee or guardian, please give your full title as such.

⑈005179924⑈ ⑆021902352⑆ 99⑈000008⑈ 0017

SUTTER HILL VENTURES
3000 EL CAMINO REAL
PALO ALTO, CALIFORNIA 94306

BANK OF AMERICA
STANFORD FINANCIAL SQUARE OFFICE
PALO ALTO, CALIFORNIA

4579 11-35/1210

April 22 1982

REGISTERED ~~RO-25868~~ 250005 dol's 00 cts

\$ 250,005.00

TO THE ORDER

QUANTUM CORPORATION

[Handwritten Signature]
[Handwritten Signature]

⑆ 121000358⑆ 01188⑈06155⑈

1103

22 April 1982

PAY TO THE ORDER OF Quantum Corporation - \$ 124,995⁰⁰/₁₀₀

One Hundred Twenty-Four Thousand Nine Hundred Ninety-Five ^{and no/100} DOLLARS

NOT VALID FOR LESS THAN \$500.00

Shawmut Bank of Boston, N.A.
Boston, Massachusetts
Present at Mutual Funds Department - FCR

FOR Robert E. Schroeder

⑆ 011000206⑆ 5003351624⑈ 701

FACTORY SECURITY SYSTEM

4356

April 22 1982

11-35
1210

PAY TO THE ORDER OF Quantum Corporation - \$ 15,000⁰⁰/₁₀₀

Fifteen thousand and no/100 DOLLARS

BANK OF AMERICA^{NSTA}
STANFORD BRANCH
383 STANFORD SHOPPING CENTER
STANFORD, CALIF. 94305

MEMO Purchase - Pfd Stock W. R. Hawley

⑆ 121000358⑆ 4356⑈05200⑈03536⑈

MICR DATA SYSTEMS, INC., NEW YORK, N.Y.

WILLIAM LYNCH
Ready Assets Trust

ROBERT R. MOMSEN

50-235
219

ACCT ID 063 27029190-9 No.

PAY TO THE ORDER OF Quantum Corporation

DATE April 21 1982

\$ 10,005.⁰⁰/₁₀₀

Ten Thousand Five and ⁰⁰/₁₀₀

DOLLARS

NOT VALID FOR LESS THAN \$500

The Bank of New York

PLEASE SIGN EXACTLY AS YOUR NAME IS SHOWN. IF THE ACCOUNT IS HELD JOINTLY, ALL JOINT OWNERS MUST SIGN.

Robert Mومن

⑈ 270291909⑈ ⑆ 021902352⑆ 99⑈000009⑈

Purch 238 "C" @ \$15.00

TVI MANAGEMENT
3000 SAND HILL RD
BLDG 4 STE 210
MENLO PARK CA 94025

36

April 22 19 82 11-4
1210

PAY TO THE ORDER OF Quantum Corporation

\$ 3,570.⁰⁰/₁₀₀

Thirty-Five Hundred Seventy and ⁰⁰/₁₀₀

DOLLARS

PAYABLE THROUGH DRAFT: NOT VALID FOR LESS THAN \$500.00

SECURITY PACIFIC NATIONAL BANK
San Mateo Office
441 S. El Camino Real
San Mateo, CA 94402
FRANKLIN MONEY FUND

Bryan J. Mumerty
J. Bochnowski

⑈ 0148955636⑈ ⑆ 121000044⑆ 928⑈ 958374⑈

Purchase 16,429 shs P/S

TECHNOLOGY VENTURE INVESTORS
3000 SAND HILL RD BLDG 4 STE 210
MENLO PARK CA 94025
1X DR W/SO

42

April 22 19 82 11-4
1210

PAY TO THE ORDER OF Quantum Corporation

\$ 246,435.⁰⁰/₁₀₀

Two Hundred Forty-Six Thousand Four Hundred Thirty-Five-DOLLARS

PAYABLE THROUGH DRAFT: NOT VALID FOR LESS THAN \$500.00

SECURITY PACIFIC NATIONAL BANK
San Mateo Office
441 S. El Camino Real
San Mateo, CA 94402
FRANKLIN MONEY FUND

Bryan J. Mumerty
J. Bochnowski

⑈ 0113248542⑈ ⑆ 121000044⑆ 928⑈ 958374⑈

Dreyfus Liquid Assets, Inc.

No: 23 219
 DATE 4-30 1982

PAY TO THE ORDER OF Quantum Corp
 AMOUNT Ten thousand and five + $\frac{00}{100}$

\$ 10,005 $\frac{00}{100}$

NOT VALID IF DRAWN FOR LESS THAN \$500 SCOTT HEDRICK
 039 00514898-6

PAYABLE AT Purchase of 667 Preferred shares
 THE BANK OF NEW YORK - MUTUAL FUNDS DIVISION
 NEW YORK, NEW YORK

Scott Hedrick

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⑈005148986⑈ ⑆021902352⑆ 99⑈000008⑈ 0023

CONTINENTAL ILLINOIS VENTURE CORPORATION
 231 S. LA SALLE ST.
 CHICAGO, ILL. 60604

 CONTINENTAL BANK
 Continental Illinois National Bank
 and Trust Company of Chicago

5574
 2-3
 710

PAY -ONE HUNDRED NINETY NINE THOUSAND NINE HUNDRED NINETY FIVE AND 00/100-

TO THE ORDER OF
 QUANTUM CORPORATION

DATE April 22, 1982 AMOUNT \$199,995.00

CONTINENTAL ILLINOIS VENTURE CORPORATION

Judith Bulba
John S. Hallegon

⑈005574⑈ ⑆071000039⑆ 72⑈54733⑈

Stanford University

823621

Bank of America
 STANFORD BRANCH
 STANFORD SHOPPING CENTER

Controiler's Office
 Stanford, California 94305

11-35
 1210

04 21 82
 NO DAY 19

PAY EXACTLY *700,005 DOLLARS 00 CENTS

*700,005.00
 DOLLARS CENTS

Stanford University
 SPECIAL DISBURSEMENT ACCOUNT

TO THE ORDER OF Quantum Corporation*



⑈00823621⑈ ⑆121000358⑆ 05206⑈00020⑈

C Carellos

INVESTECH L.P.

112

Pay to

April 22 19 82

1-23/210

the order of

Quantum Corporation

\$ 199,995.00

One Hundred Ninety-nine Thousand Nine Hundred Ninety-five and no/100 Dollars

Morgan Guaranty Trust Company
OF NEW YORK

Seymour L. Goldblatt
Carl [unclear]

Memo _____

⑆021000238⑆

143 46 512 0112

BURROUGHS-NEWPORT-B/W



Quantum Corporation Presents Our
Hospitality Suite...
SIMPLE & ELEGANT BY DESIGN

PLACE: Directors Suite
Las Vegas Hilton
DATES: Monday, November 29
Tuesday, November 30
Wednesday, December 1
TIME: 5:00 p.m. To 8:00 p.m.

Present this invitation at the Suite to receive
a complimentary Quantum wine glass

QUANTUM

QUANTUM
CORPORATION

Cordially invites you to our
Hospitality Suite for cocktails
and hors d'oeuvres at the

MGM GRAND HOTEL
3645 Las Vegas Boulevard South
Las Vegas, Nevada

DATES: Thursday, November 19
Friday, November 20
Saturday, November 21

TIME: 4:00 pm - 8:00 pm

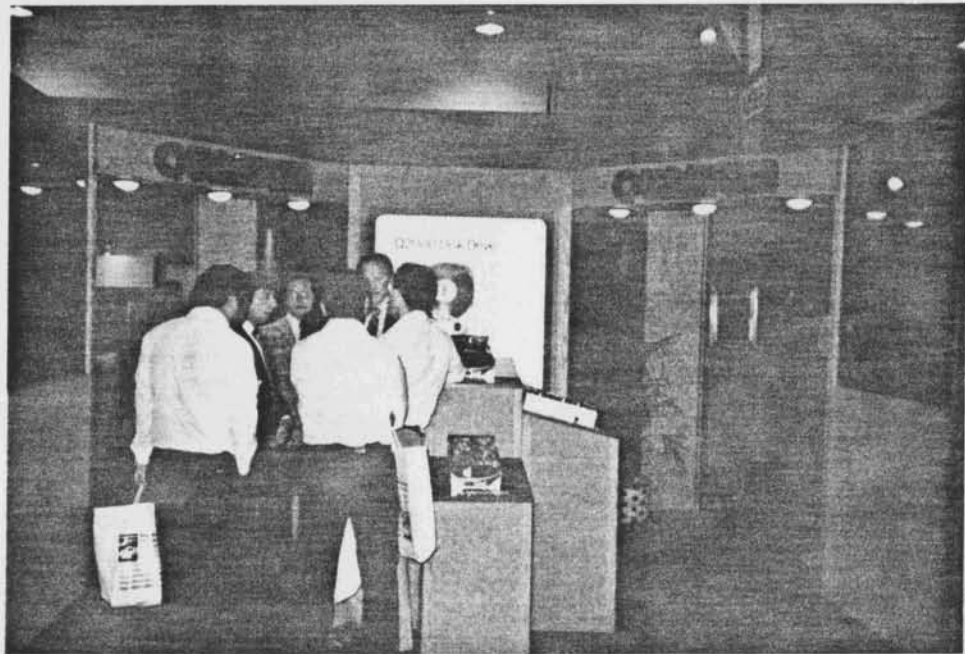
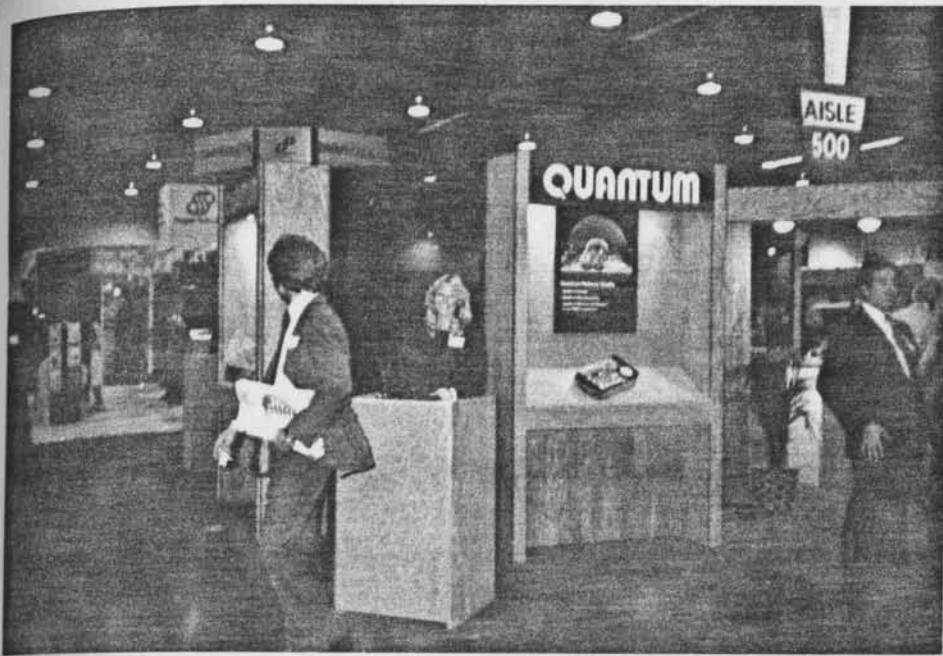
For notification of the Quantum Hospitality
Suite number, please inquire at the Hotel's
front desk.



TRADE SHOW

PESE - PERIPHERAL EQUIPMENT
AND SOFTWARE EXPO

1982
ANAHEIM, CALIFORNIA



TRADE SHOW

NORM De NARDI
1982
PALO ALTO, CALIFORNIA

