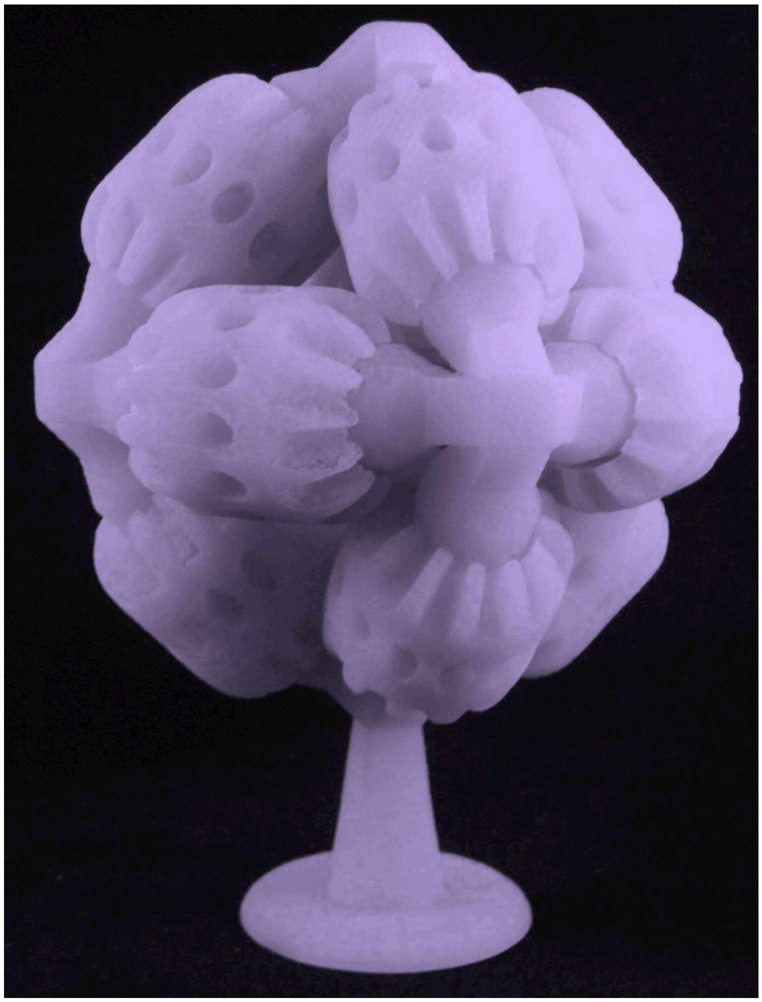
FABBERS

THE ENNEX ARCHIVE
OF 3D PRINTING RESOURCES AND ARTIFACTS



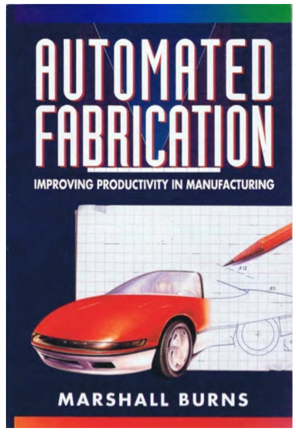
A rare and important collection of early 3D printed objects,
born-digital computer files, bound printed matter, and analog media
providing a multifaceted and historically significant overview
of emergent technologies in automated fabrication
from 1991 to 2005

FINE FOURNIER RARE

Credits

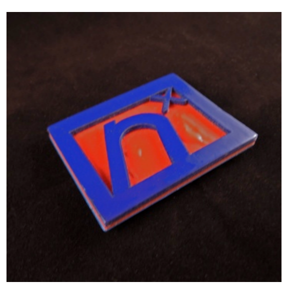
Front cover image: Gear tree, December 1991, 13.5 cm, produced by selective curing (photopolymer) on a Cubital Solider 5600 by Stature Machining, Detroit, MI. Rear cover image: "Custom-Made by Push-Button," Ennex reprint of July 27, 1993 article in *Toronto Star*.

Descriptive texts, layout and design 2016 - 2017 by Arthur Fournier Fine & Rare LLC on behalf of Ennex Corporation. All rights reserved.



Burns, Marshall. *Automated Fabrication*.
Englewood Cliffs, N.J. : PTR Prentice Hall, 1993.

CONTENTS



Ennex logo, 1994, 5.4 cm, cut-first pattern lamination (vinyl)
on a Genie fabricator by Ennex, Los Angeles, CA.

Acquisitions

Inquiries concerning the sale of the Ennex Archive may be directed to Arthur Fournier.
info@arthurfournier.com, +1 (917) 749-9431, www.arthurfournier.com.

I. OFFER SUMMARY

Fabbers: The Ennex Archive is a well-preserved and thoughtfully cataloged set of material objects, printed texts, sound and image recordings, 35 mm photographic slides, and born-digital computer files that provide a rich context for understanding the historical origins and early uses of 3D printing. At the archive's core is a collection of ninety (90) rare and important 3D printed objects made using a variety of pioneering automated fabrication technologies between 1991 and 2005. Highlights include two gear trees, specifically designed to demonstrate the advantages of automated fabrication for the construction of objects with interlinked moveable parts, and a life-size human skull modeled from CT scans, which enabled a team of doctors to better understand the challenges they would face in a complex surgery to repair cranial fractures. In complement to these fascinating artifacts, the Ennex Archive includes a comprehensive library of conference proceedings, journals, newsletters, books, and other documents related to its own business activities and the larger 3D printing industry. Together, these paper-based text materials amount to approximately twenty-three thousand (23,000) printed pages. The present offering also encompasses dozens of relevant sound and moving image recordings on a variety of audio- and videotape formats, and more than five hundred (500) photographic still images on 35 mm slides. Coupled with these rich analog media resources are more than twelve-thousand (12,000) born-digital items in a variety of formats, including CAD files, word-processing documents, e-mails, PDFs, images, and databases associated with Ennex Corporation's entrepreneurial journey in the field. The entire collection has been rigorously cataloged and annotated by Dr. Burns in an Excel database that forms the basis of a sophisticated finding aid and teaching tool of great use to students and researchers. Currently housed in approximately eleven (11) banker's boxes and similar containers (along with one hard drive) in secure storage on the West Coast, the archive is available for immediate acquisition.

II. INTRODUCTION

Marshall Burns founded the Ennex family of corporations to "take on extraordinary challenges and opportunities" in 1975 in his native Canada, after dropping out of his sophomore year at MIT to hitchhike across the US and Mexico. At the time, high-tech entrepreneurship was still an exotic – and largely unknown – field.

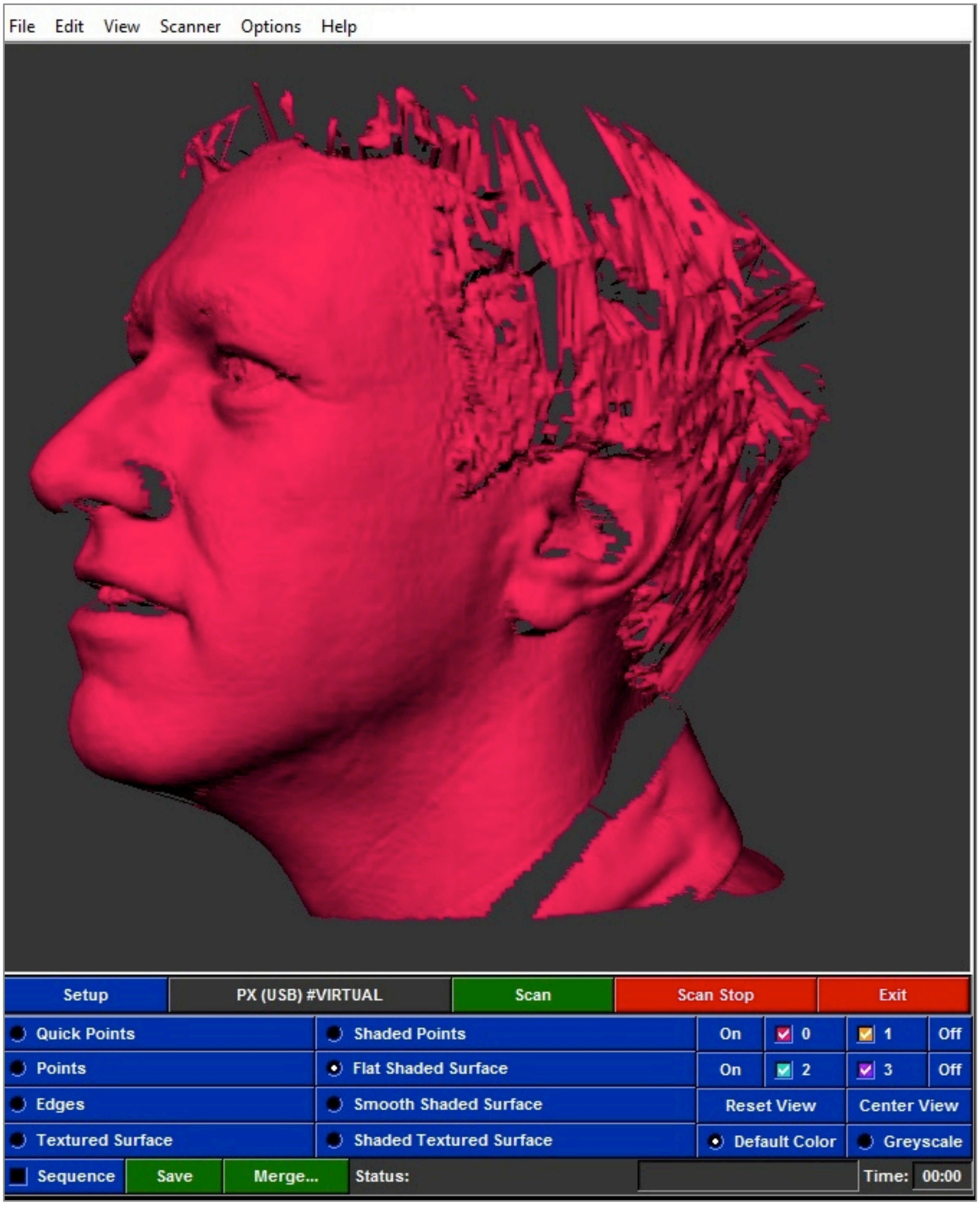
The name Ennex invokes an English-language phonetic representation of the two letters in the Roman alphabet, "n" and "x." In elementary mathematics, "n" is used to represent a known, given quantity, while "x" represents the unknown. Taken together as n to the power of x – or simply n^x – the two characters represent the infinite potential available from combining what is known with that which is not yet known. For Burns, it's shorthand for "raising knowledge to the power of imagination."

While Ennex never became a household name, it did play an important role in the development and transmission of several cutting edge computer-based technologies from the research laboratory to the consumer marketplace.

The Birth of the PC Clone

When IBM launched its model 5150 Personal Computer in August of 1981, its sophisticated design revolutionized the marketplace for home computers. Unfortunately, its high retail price placed the machine well out of reach for most consumers.

As a college graduate (B.S., MIT '79) living in Los Angeles and working in home electronics sales, Marshall Burns sensed an opportunity. Since IBM had sourced most of its components and software from third party suppliers, a little detective work and ingenuity lead him to discover that he could easily build high-quality "PC clone" devices and advertise them to consumers at a significantly reduced price.



3D scan of Marshall Burns' head, filename: "MB-Cybrw.3d," captured on October 16, 1995 by Brett Gassaway of Viewpoint Datalabs, Los Angeles, CA.

"Why Pay Retail," IBM PC clone advertisement published in *Wall Street Journal*, July, 21, 1982

In May of 1982, Marshall Burns Computer Sales of Pasadena, CA, was born. It was the first company to market and sell a generic-brand, low-cost personal computer built around the proprietary technology of the revolutionary IBM Personal Computer. Components were sourced directly from IBM and its vendors (or their equivalents), and custom assembled into complete systems on demand. Prices were kept low by direct marketing without a storefront, by maintaining low inventories, and by requiring payment C.O.D. All units underwent 24-hour quality testing before being shipped, resulting in zero returns.

When Burns moved the fledgling company to Texas later that year (renaming it Ennex Technology Marketing, Inc. along the way), direct-to-consumer PC clone sales proved strong enough for the young entrepreneur to afford a small condominium on the East Side of Austin. They also earned him enough money to meet his goal of financing a graduate school education in physics at the University of Texas.

“Eventually, other people around campus started to get the idea of what I was doing,” Burns recalls. “One of them was a college freshman who started a similar company called ‘PCs Unlimited’ in his dorm room.”

“His name was Michael Dell.”

<u>From Theoretical Physics to 3D Printers</u>

Marshall Burns left the computer marketing and sales sector in the winter of 1982 to devote himself full time to graduate studies at UT Austin, where he pursued a Ph.D. in physics.

Toward the end of his program, in October 1990, and thinking about what to do next, Burns attended a business plan workshop at the Austin Technology

Incubator. There he saw a presentation by one of its tenant companies, DTM Corporation. The name stood for "DeskTop Manufacturing" and the presentation included video footage of a machine that used laser light and plastic powder to render a computer-based design into a solid, three-dimensional object.

"In that two-minute movie clip, I saw my future, and the future of humankind, flash before my eyes," he recalls. "Suddenly, the Ph.D. I had been pursuing for eight years acquired new meaning."

After spending the next few weeks hunkered down in the library reading everything he could find on the topic, Burns learned that DTM's patented technology was only one of more than a dozen processes under investigation around the world for achieving the same objective. Another company by the name of 3D Systems had sold over a hundred of its machines to the likes of General Motors, Kodak, and Apple Computer. At the time, the technology was primarily marketed to industrial manufacturers as a solution for "rapid prototyping." But Burns recognized that it had far wider potential than that name suggested. He began to refer to the devices as *fabbers* – a moniker he still uses today, short for "automated fabricators."

"I'd spent most of the 1980s in graduate school because I believed that a new wave of technology, something more profound and more effectual than computers, was going to emerge from discoveries in modern physics," he

DESKTOP
MANUFACTURING
The next automation revolution

Logotype design for Desktop Manufacturing : The Next Revolution,
Fort Lee, NJ : Technical Insights, Inc., 1988
(Emerging Technologies Series, 37)

explains. “When I found out about automated fabrication, I felt that the technological revolution I had come to the University of Texas to prepare for was at hand.”

Burns completed his dissertation on “Nonlinear Resonance in the Hydrogen Atom” and it was approved by the faculty in April 1991. Nine days later he was in Minneapolis for his first job in his newly chosen industry, preparing the proceedings of “Desktop Manufacturing,” one of the first conferences on automated fabrication.

To get there, he embarked on a cross-country road trip. Afterwards, he spent the next four months roving the country in an effort to meet as many of the key inventors, entrepreneurs, and users of automated fabrication as he could.

Marshall Burns' driving route for first autofab research trip, May 4 to September 17, 1991

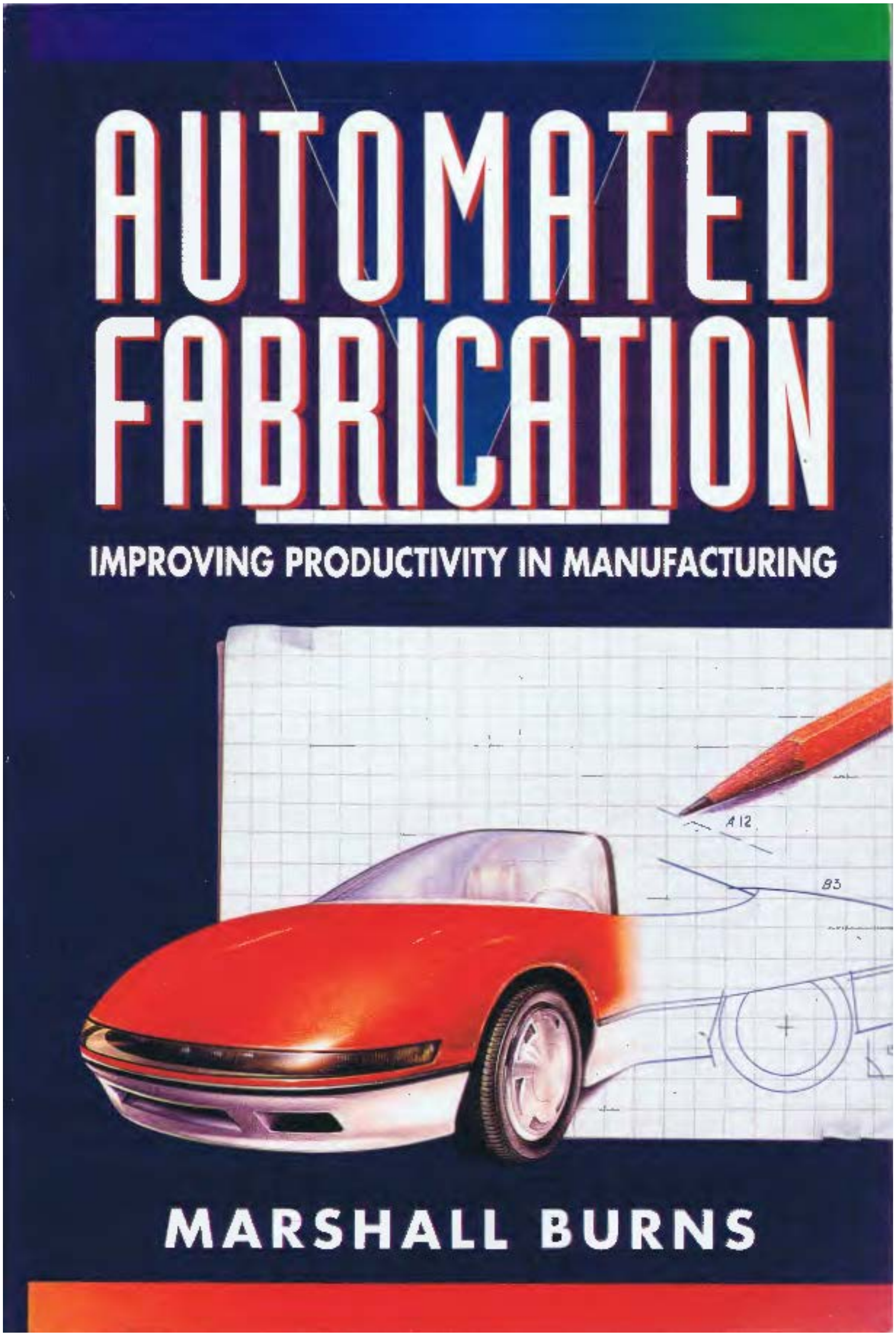
“On that trip, I met Scott Crump, the founder and CEO of Stratasys, Terry Feeley, a laser entrepreneur behind the development of the Quadrax fabber, Haim Levi, who represented Israel’s Cubital fabber in the US, Efrim Fudim of Light Sculpting, inventor of one of the highest-precision fabbers at the time, David Gore, working on one of the first ideas for fabbing in metal, and Peter Sferro, head of the stereolithography (SLA) lab at Ford Motor Company, and many others. I met Chuck Hull, founder of 3D Systems, a few months later."

For Burns, meeting Sferro was a particular high point. “In Pete’s lab at Ford, I laid eyes for the first time on a stereolithographic 3D printer. I had seen DTM’s Sinterstation in action, but the SLA had a more dramatic appearance. Watching the spot of laser light dancing across the surface of an eerily glowing vat of resin with a partially formed object gestating beneath the surface, I felt as if I had stepped onto the set of a science fiction movie.”

Burns documented that trip, and other trips and meetings that followed, in vivid detail. He kept a personal journal of observations and reflections, and started what he came to call his “knowledge base,” a comprehensive, computer-enabled database of relevant contacts, meetings, correspondence, publications, research findings, and other information with an intricate system of cross-referencing links. With the fastidious attention to minutiae of a scientist trained to collect and analyze complex data, Burns continued to develop the Ennex Knowledge Base over the course of his career in fabbers.

During and after this epic journey, through the summer and fall of 1991, he applied for jobs at 3D Systems, Ciba Geigy, DTM, Helisys, MIT, Stratasys, and other players in the emerging market. All of them turned him down.

Undaunted and determined to pursue a career in automated fabrication, Burns founded Ennex Fabrication Technologies, which served as the basis for engagements as a consultant, public speaker, and evangelist for the untapped potential of 3D printing. He continued to attend conferences and built an impressive library of print resources in the field, including books and journals. He also began to collect 3D printed objects, gathered from various labs and manufacturing facilities that he visited. On four additional “fabber odysseys” across Europe and Japan during the 1990s, Burns methodically built his collection of objects produced by the machines at the focus of his work. The collection was an invaluable teaching tool in his consulting, helping clients understand both the possibilities and the limitations of the various machines on the market, as well as those that were still under development.

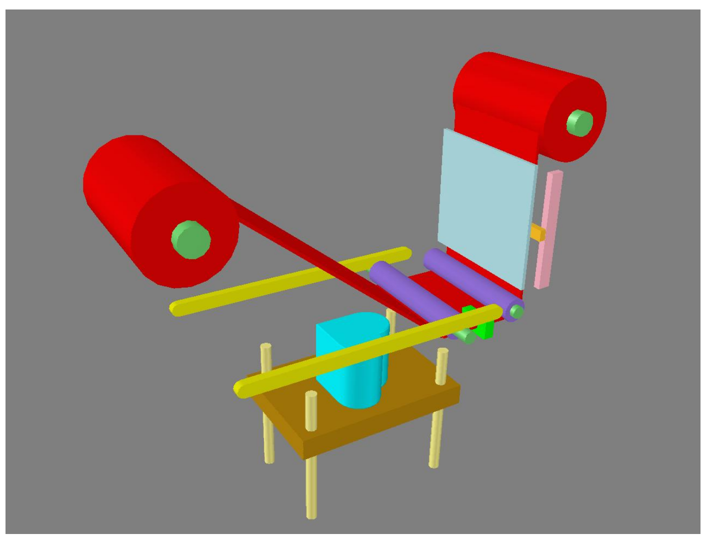


Burns, Marshall. *Automated Fabrication*. Englewood Cliffs, N.J. : PTR Prentice Hall, 1993.

In the midst of this, Burns was contracted to write what would become the first commercial monograph on the subject, *Automated Fabrication: Improving Productivity in Manufacturing* (Englewood Cliffs, NJ : PTR Prentice Hall, 1993). Following its publication, he was invited to speak at conferences from Japan to Nigeria and consulted to IBM, Dow Chemical, the US Navy, and numerous other clients on how to use or develop automated fabrication devices for manufacturing, medical modeling, and other applications. He continued his writing career as a contributor to *Rapid Prototyping Report* (San Diego, Calif. : CAD/CAM Publishing, 1993), the leading newsletter of the industry, and other journals.

As the autofab consulting business expanded, Burns developed the concept for a new technology which he hoped to bring to market for consumer use as the Genie Studio Fabber. For the remainder of the 1990s, he strove to build a team of engineers and business professionals to make the project a viable enterprise. But while Burns and his colleagues dreamt of bringing sophisticated prototyping power to homes and businesses across the world, angel investors were chasing a different quarry: projects rooted in the virtual realm of the World Wide Web, not the physical universe of consumer products and manufacturing.

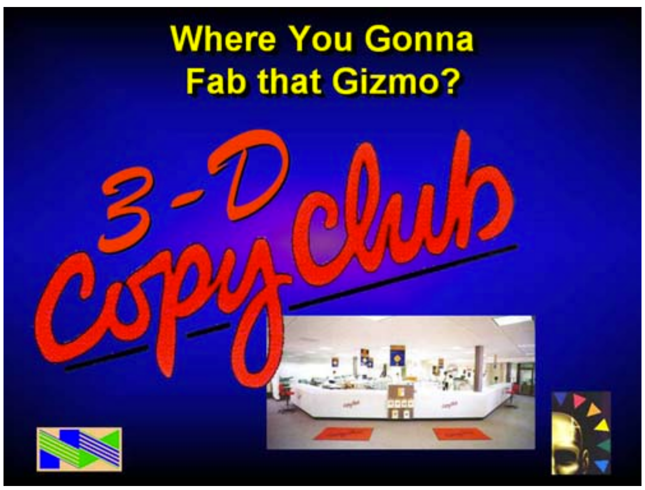
Stymied by engineering challenges and a shortage of operating capital, the Genie failed to launch. The missed opportunity was dispiriting, and the project simmered while Burns earned a living with teaching and consulting, and traveled the world in search of new meaning in the early years of the new millennium.



Trispectives design of an offset fabber mechanism by Behrokh Khoshnevis for Ennex, 1996

By 2005, as Burns was turning away from tech entrepreneurship, the Ennex Autofab Collection was placed in storage, where it has remained to this day as a unique time capsule documenting the history of rapid prototyping and automated fabrication in its infancy.

As it turned out, the future of automated fabrication and desktop manufacturing would be open source, and not so much a product of venture capitalist funding. While Burns explored the wilds of Northern California, the Nevada dessert, Kenya, India, and Sri Lanka, a rising cadre of graduate students and D.I.Y. engineers built on the achievements of his generation of autofab technologies to establish the protocols of RepRap ("replicating rapid prototype"), which have lead to commercially viable home 3D printing systems including MakerBot and other popular devices over the course of the last decade.



Slide from Marshall Burns' keynote presentation for Copy Club Conference 2001

Despite the "curse" of having been too early to market with his dreams for the Genie, Burns has no regrets. He hopes that placing the Ennex archive with a tier-one museum, library, or research institution will allow scientists and cultural historians of technology to learn from both his success and failures.

"My work on digital fabrication in the 1990s was an exciting career," he says. "I'm proud of the contribution I made and I'm grateful for the opportunity I had to work with amazing people on amazing projects, and to travel all over the world in the process."

"Today, I apply my experience as a scientist and businessman to understanding issues of social justice and I'm looking forward to making new breakthroughs in that domain. In the meantime, I'm excited to see a new generation of inventors and entrepreneurs carrying forward on what they now call 3D printers."

III. INVENTORY OF ARCHIVE CONTENTS BY CATEGORY

A. Fabricated Artifacts

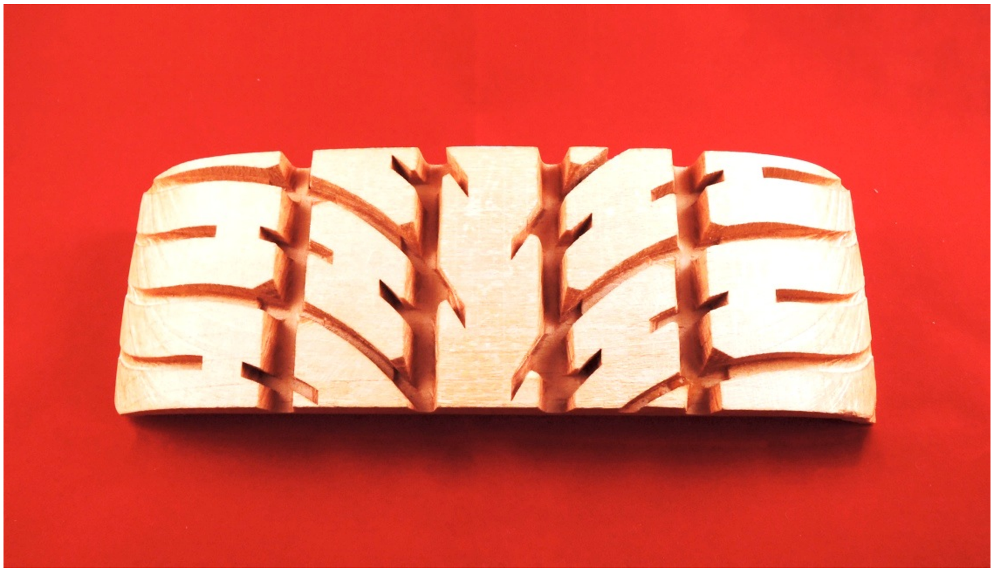
Collection of ninety (90) rare and important 3D printed objects made using a variety of pioneering automated fabrication technologies between 1991 and 2005. The objects range from 1.0 to 28.5 cm (long dimension) in size, including the following highlights.

Ball in a cage, November 1991, 3.5 cm. produced by selective curing, (photopolymer) on a Quadrax Laser Technologies Mark 1000.

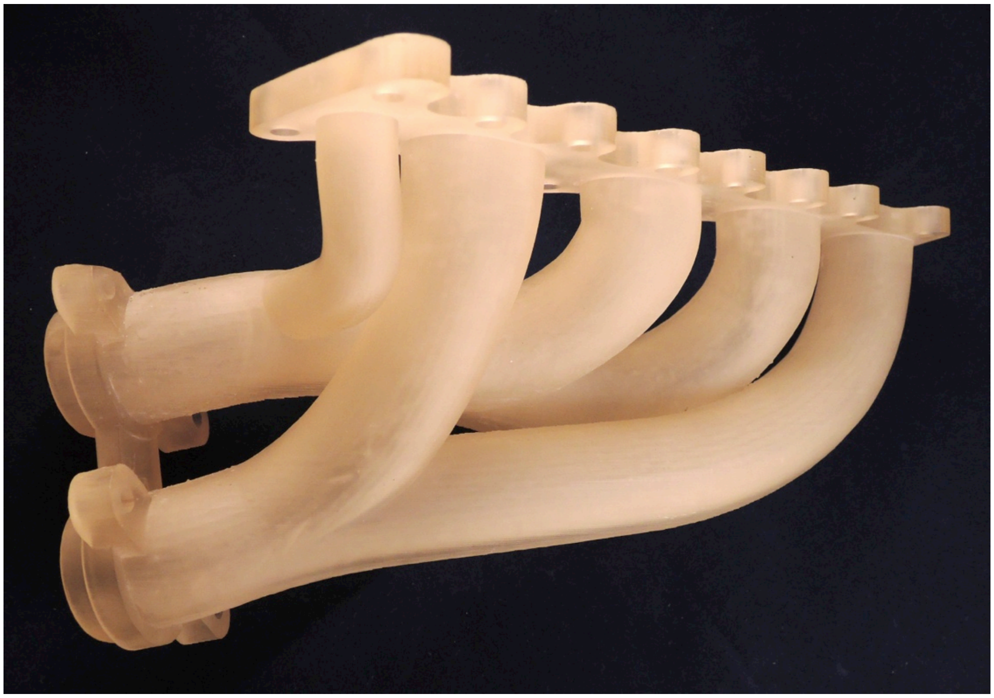
Gear Trees, December 1991, 13.5 cm (large) and June 1993, 10.8 cm (small) produced by selective curing (photopolymer) on a Cubitol Solider 5600.

Human hand, about 1997, 6.2 cm, produced by selective curing (photopolymer) using a 3D Systems SLA printer. *Demonstrates fabrication in two colors, internal material variation.*

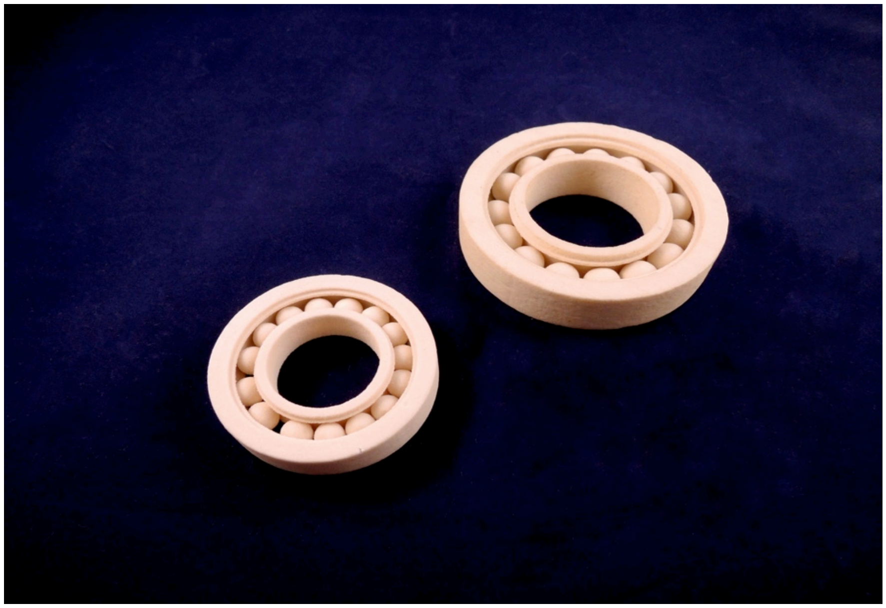
Fractured skull, January 1994, 14.5 cm, produced by selective curing (acrylic) on a 3D Systems SLA printer.
Made for UCLA Medical Center by Scicon Technologies. Demonstrates biomedical solid imaging.
Courtesy of Dr. Nicholas Mankovich, UCLA Medical Center and Scott Turner, Scicon Technologies.



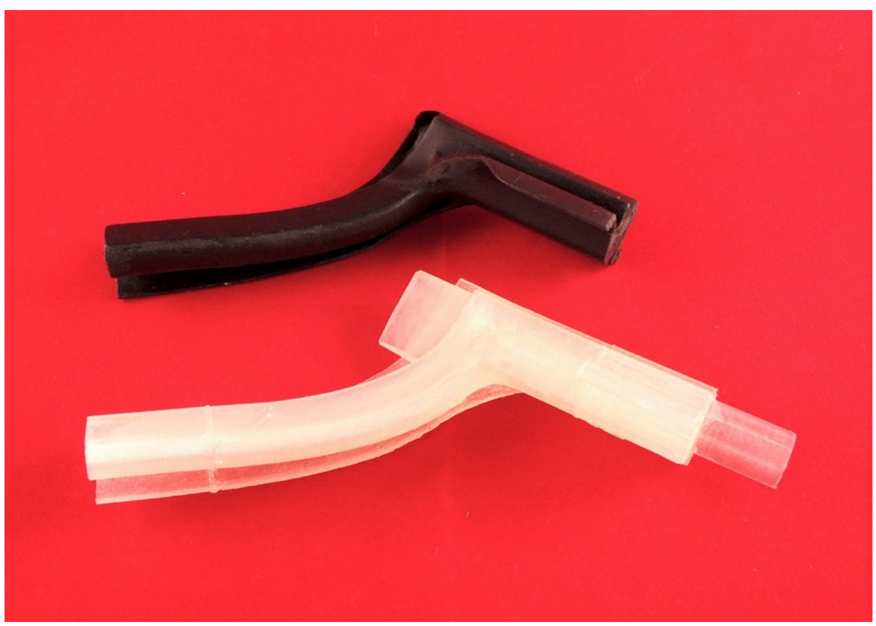
Automotive tire tread, about November 1991, 21.0 cm, produced by bond-first pattern lamination (paper) on a Helisys LOM printer.



Engine exhaust manifold, about 1997, 25.0 cm produced by selective curing (acrylic) on a 3D Systems SLA printer.

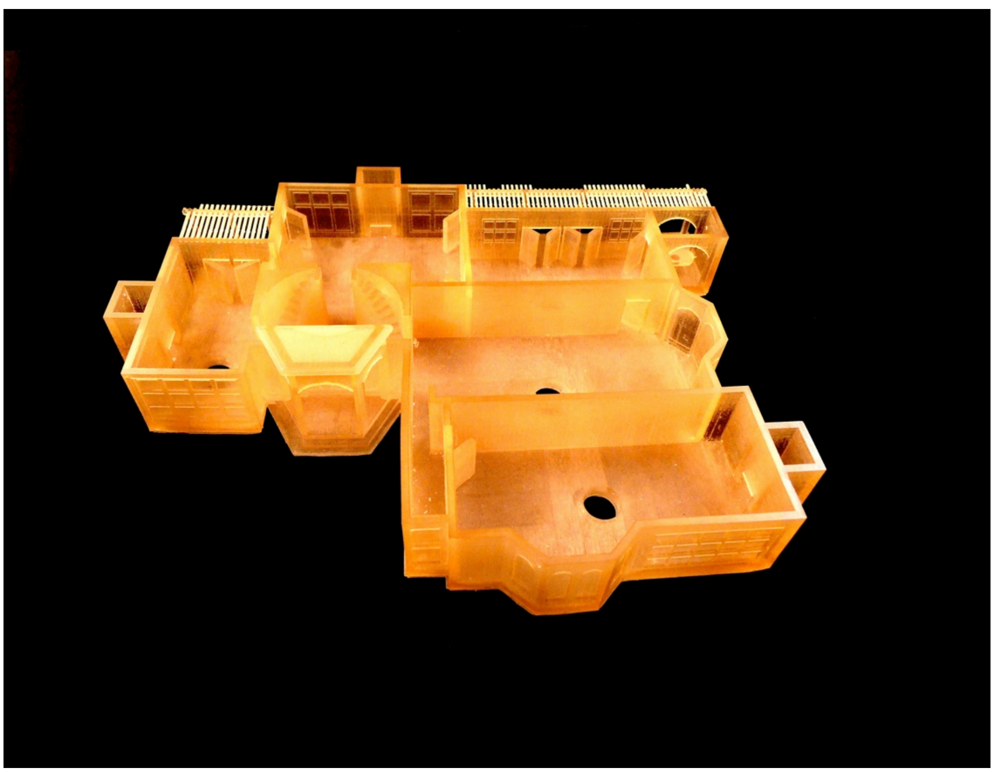


Ball bearings, October 2001, 7.9 cm, produced by drop-on-powder deposition (corn starch) using a Z Corp. Z printer.

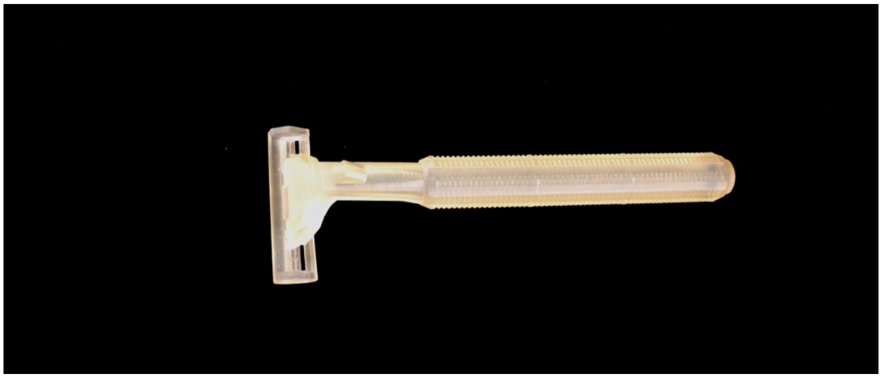


Automotive weather stripping (pattern and rubber copy), April 1992, 15.5 cm, produced by selective curing (acrylic) on a 3D Systems SLA printer by Laserform Corporation.

Wedding ring, November 1991, 2.6 cm, produced by selective curing (acrylic) by the Du Pont Solid Imaging Materials Group.



Architectural model, about 1997, 23.5 cm made by selective curing (acrylic) on a 3D Systems SLA printer.



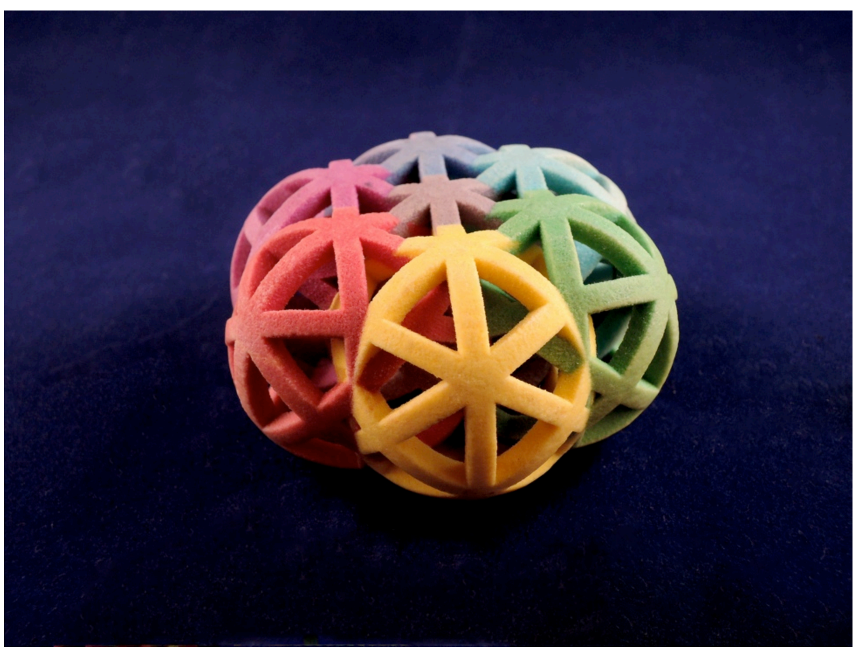
Disposable razor, July 1992, 11.5 cm, produced by selective curing (acrylic) on a 3D Systems SLA printer for the Gillette Corp. by 3D Systems.

Tensile bars, November 1991, 14.7 cm, produced by selective curing (SOMOS 3100 by Du Pont) by Du Pont Solid Imaging Materials Group.

Gavel, November 1991, 21.8 cm, produced by selective curing (XB 5143 acrylate ester blend) on a 3D Systems SLA printer.

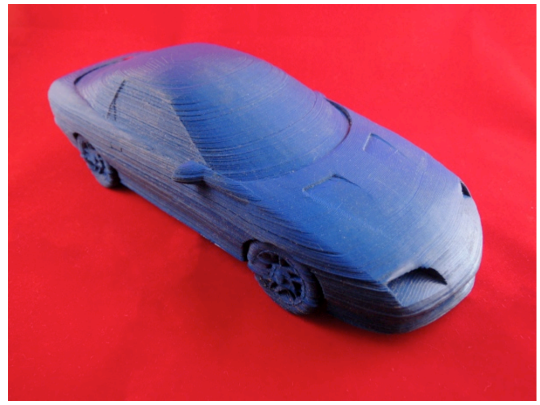
Chain with fob, April 2000, 11.5 cm
produced by drop-on-powder deposition (corn starch)
using a Z Corp. Z printer.

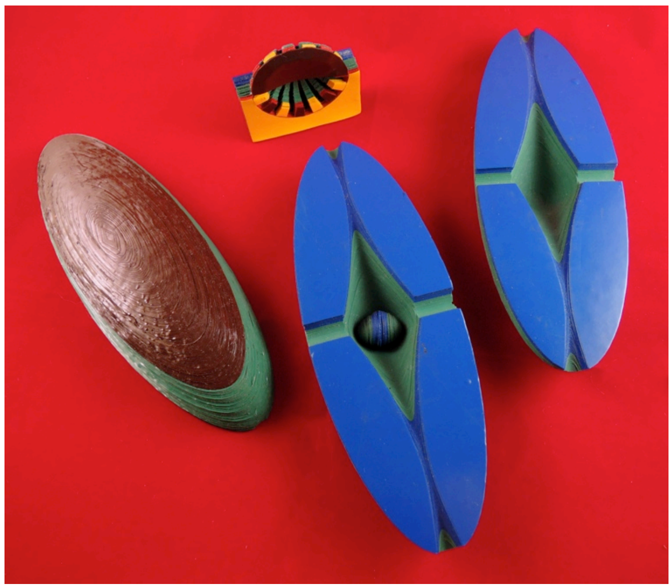
Trefoil torus knot, September 2000, 7.5 cm, produced by drop-on-powder deposition (corn starch) using a Z Corp. Z printer by artist Stewart Dickson.



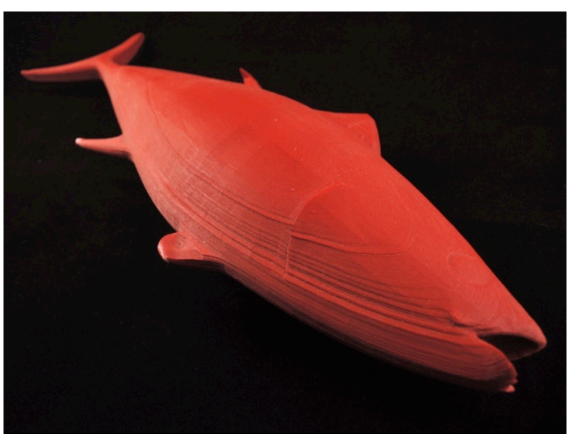
Interlocking color balls, April 2000, 6.9 cm produced by drop-on-powder deposition (corn starch) using a Z Corp. Z printer.

Camaro, July 1996, 23.4 cm, made using cut-first pattern lamination, (vinyl) on the Ennex Genie prototype.





Gear ball, 1994, 5.4 cm, and **Star Seeds** December 1994, about 16.4 cm each, made using cut-first pattern lamination (vinyl) on the Ennex Genie prototype.



Tuna, September 1996, 28.5 cm made using cut-first pattern lamination (vinyl) on the Ennex Genie prototype.

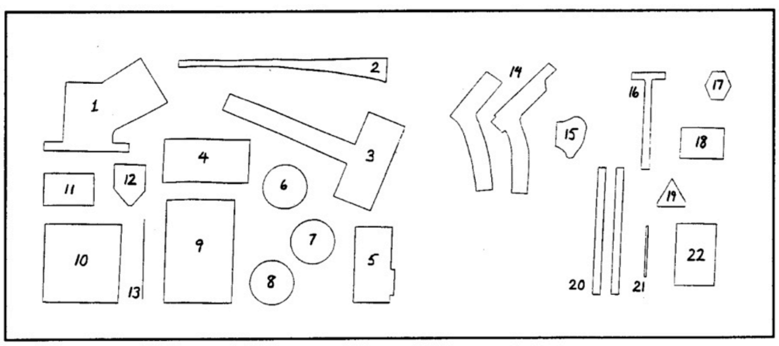
The Ennex Autofab Collection

Traveling Selection

Ennex Fabrication Technologies maintains a growing collection of sample fabricator output to help its clients understand the capabilities (and the limitations) of the various machines on the market. The traveling selection consists of the most interesting pieces in the collection that are not too big. The key below identifies each of the items in the traveling selection, and the following pages explain what special features or properties each item exhibits about its fabricator. This is intended to help you as you look at the collection, and to trigger your memory after our meetings.

The Ennex Autofab Collection includes several other, and larger, examples of fabricator output, including experimental results from processes not yet on the market. The collection also includes hundreds of slides and several videotapes. If you need to know about an automated fabrication process or application not exhibited in the traveling selection, please inquire about it. Chances are we have some material on it.

Many thanks are extended to the fabricator vendors and users who have contributed sample output to the Ennex Collection.



1. *MCN* benchmark
2. Submarine propeller blade
3. Gavel
4. Automobile air conditioning vent
5. TNO benchmark
6. Wax master
7. Coil
8. Enneper's minimal surface
9. Geneva mechanism
10. Shoe tread
11. Tray or bracket
12. Clip
13. Window
14. Automotive weatherstripping
15. Human ear
16. Disposable razor
17. Ball in a cage
18. ProtoMod benchmark
19. Tetrahedron
20. ASTM test bars
21. Strip
22. Block

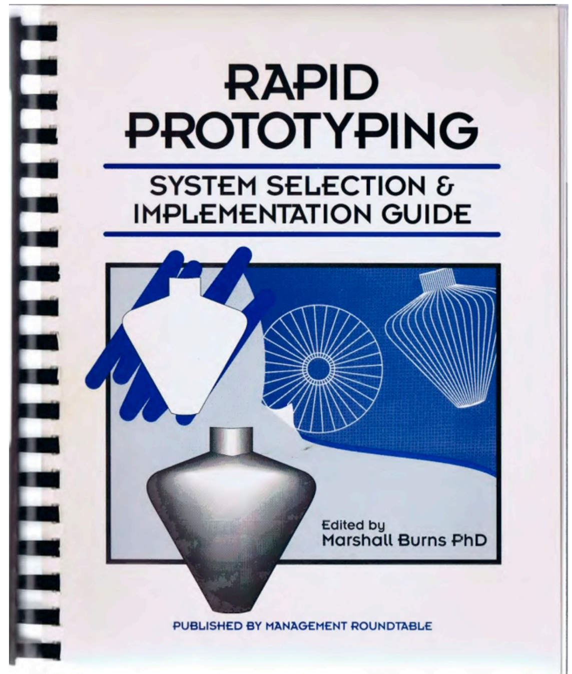
Please see the following pages for brief comments on each item.

This document is provided as a special service to clients of Ennex Fabrication Technologies.
Copyright © 1992, Ennex Corp.

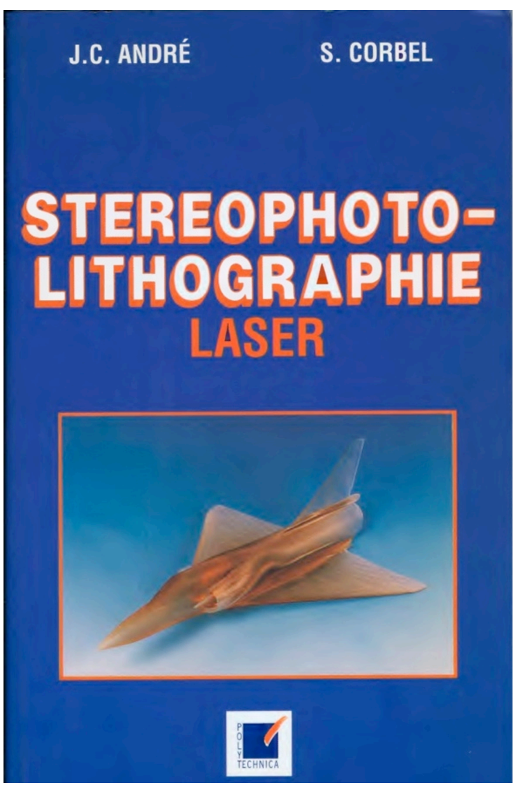
The Ennex Autofab Collection Traveling Selection, 1992, 8.5 x 11 in. printed document showing how the firm's collection of "sample fabricator outputs," i.e., 3D printed objects, were used to educate Ennex clients.

B. Paper Based Materials

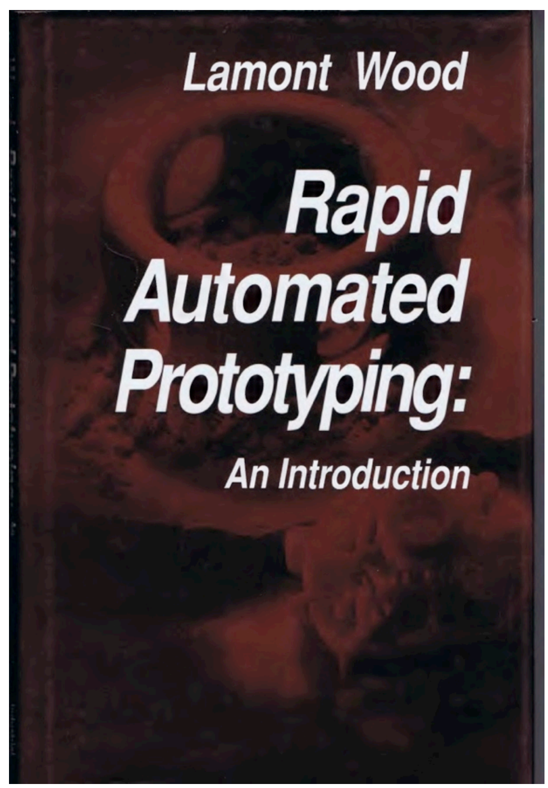
1. The Ennex Archive houses an extensive **industry library** incorporating twenty (20) books; twenty-eight (28) conference proceedings; and rare serials including a complete run of *Rapid Prototyping Report*, a head-of-series run of *Rapid Prototyping Journal*, and various issues of *Time-Compression Technologies-North America*, *Prototyping Technology International*, *Rapid News,* etc. It also houses a substantial number of annual directories, booklets, brochures and other industry print ephemera.



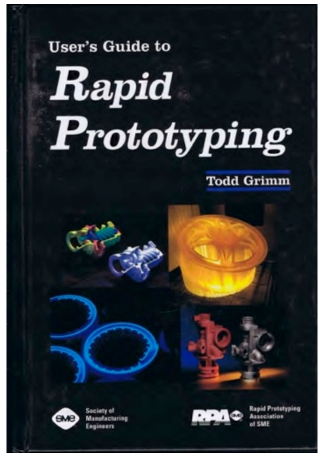
Burns, Marshall (ed.) *Rapid Prototyping*.
Management Roundtable, 1991.

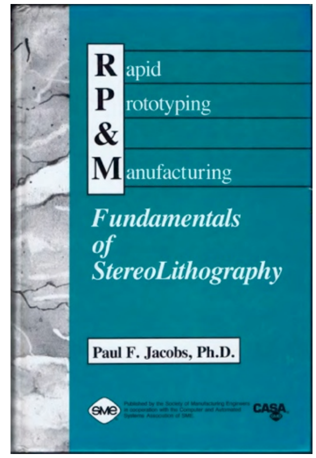


Andre, Jean-Claude and Serge Corbel.
Stereophotolithographie Laser.
Polytechnica, 1994.



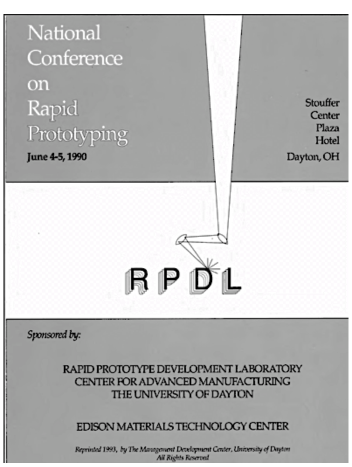
Wood, Lamont. *Rapid Automated Prototyping*.
Industrial Press, 1993.

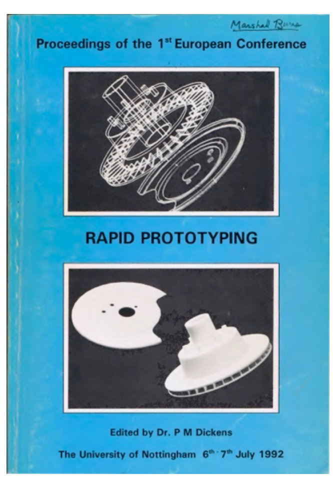


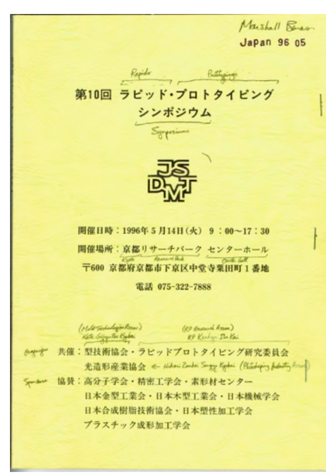


Marutani Yoji, et. al. *Hikari Zokai Hou*. Nikkan Industrial News, ca. 1996 (left) ; Grimm, Todd. *Rapid Prototyping*. Society of Manufacturing Engineers, 2004 (center) ; Jacobs, Paul F. *Rapid Prototyping & Manufacturing*. Society of Manufacturing Engineers, 1992.

Shelf view (above): Proceedings of every English-language conference held on auto-fabrication worldwide, ca. 1991-1999, and two proceedings in Japanese; cover examples (below).





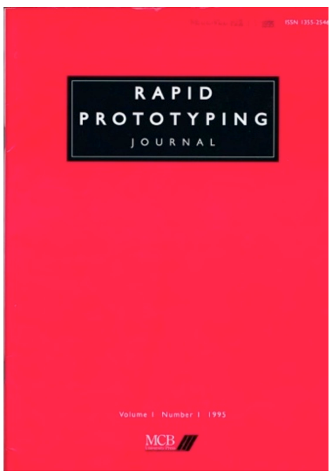


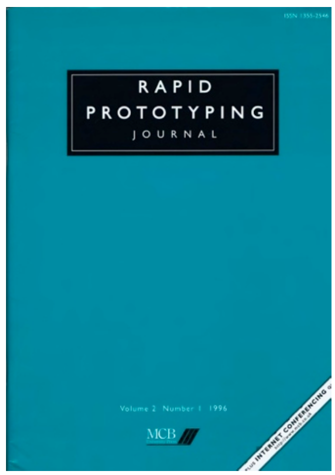

Rapid Prototyping Report
The newsletter of the desktop manufacturing industry
Volume 1, Number 1
June 1991
Unusually large, complex model built for wind tunnel testing
NEW PRODUCTS
STEREOLITHOGRAPHY SOFTWARE
TECHNOLOGY FOCUS
LAMINATED OBJECT MANUFACTURING
BUSINESS NEWS
INSIDE...

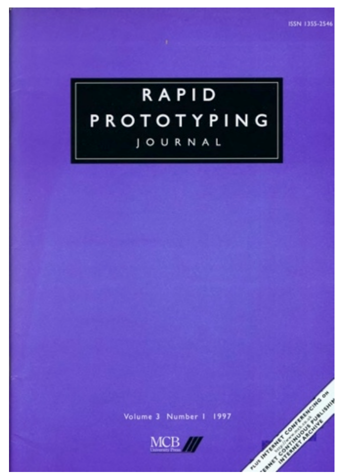

Rapid Prototyping Report
The newsletter of the desktop manufacturing industry
Volume 1, Number 7
December 1991
TECHNOLOGY FOCUS
SELECTIVE LASER SINTERING
THE TECHNOLOGY
Solid ground curing builds functional "assembly" in one piece
INSIDE...


Rapid Prototyping Report
The newsletter of the desktop manufacturing industry
Volume 12 Number 3
March 2002
Rapid prototyping brings royal wedding into the new millennium
INSIDE...

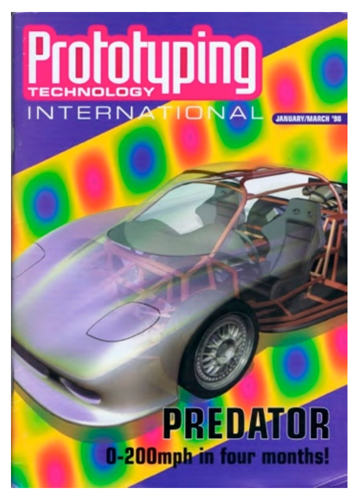
All 129 print issues of *Rapid Prototyping Report,* vol. 1 no. 1 (June 1991) through vol. 12, no. 3 (March 2002) (all published). San Diego, Calif. : CAD/CAM Pub, 1991- [serial moved online in 2002.]



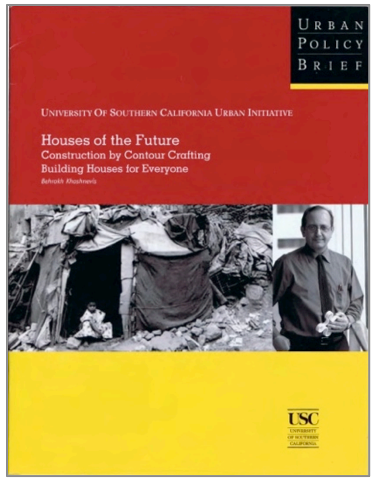


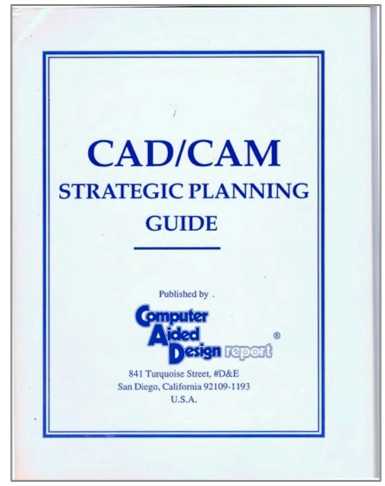


Head-of-series run (twelve issues) of *Rapid Prototyping Journal*, vol. 1, no. 1 (March 1995) through vol. 3, no. 4 (December 2001). Bradford, united Kingdom : MCB University Press, 1995 - [?].

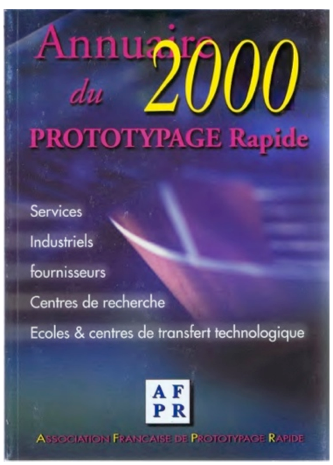


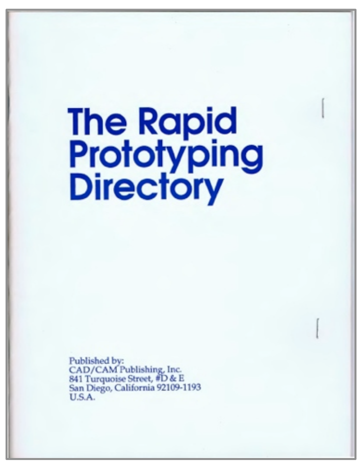
Individual issues and short runs of other industry magazines are also present in the collection, along with several issues of general interest magazines including features on automated fabrication.

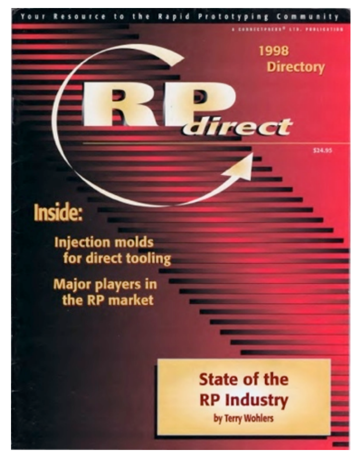




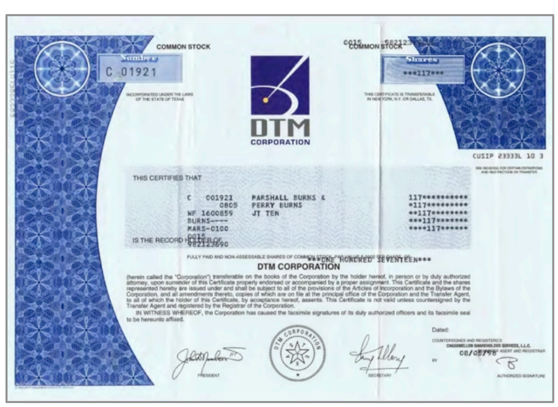
Selected industry brochures.



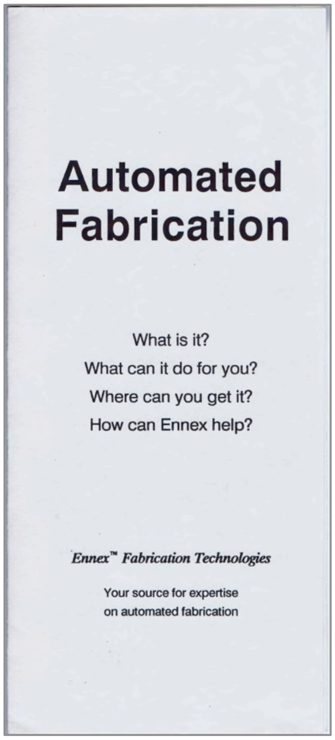




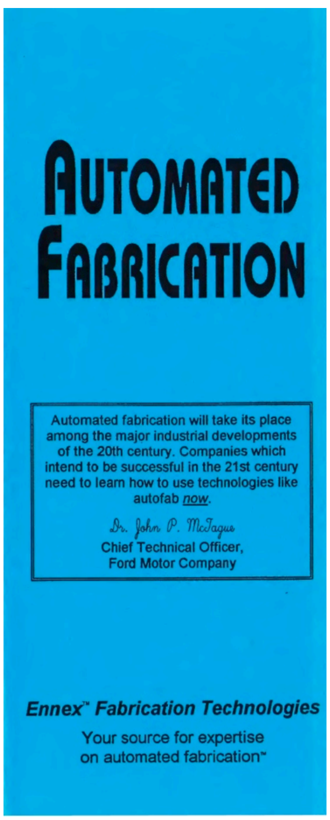
Annuals and directories (above) ; company stock certificate for DTM Corporation (below).

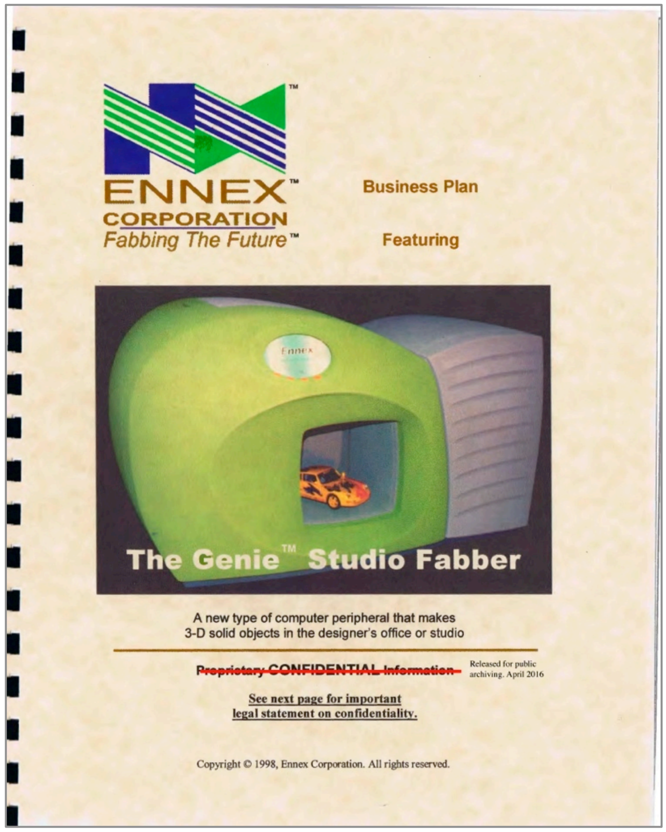


2. The Archive also includes an extensive **library of print publications developed by Ennex**, including fourteen (14) business plans; thirteen (13) client reports; (18) brochures; three (3) U.S. patents; and various other items of ephemera.



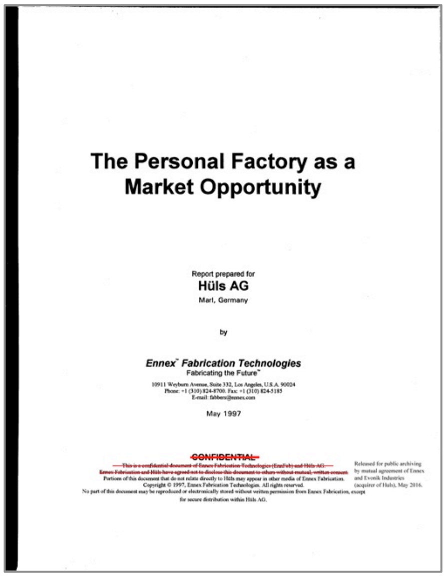
Ennex brochures, 1991 (above) and 1994 (below).



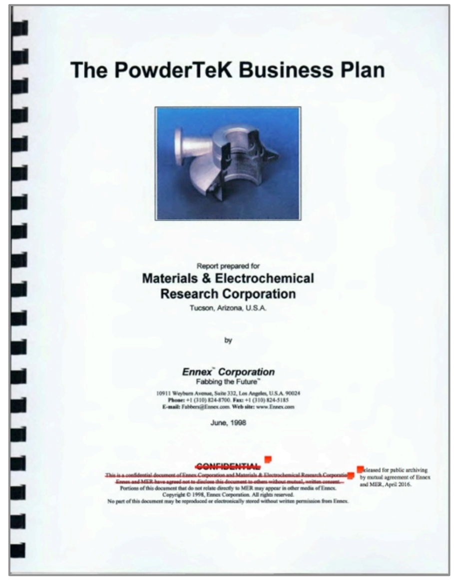


Genie Fabricator business plan.
Ennex Corporation, 1998.

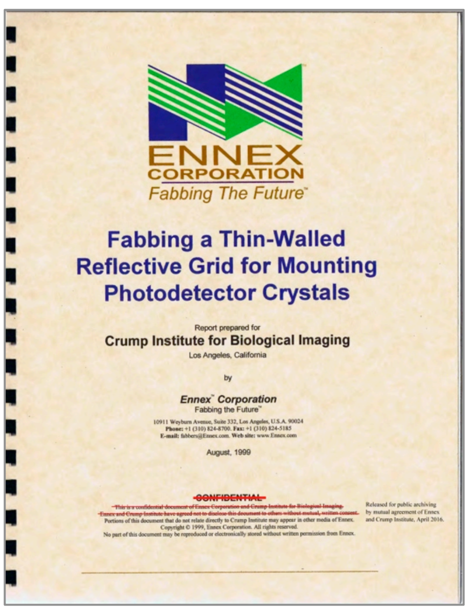
Pin-back button, 1999. "Fabbers: Undoing the Industrial Revolution" (front) ; "Fabbing the Future: Ennex Corporation" (back).



"Personal Factory as a Market Opportunity," client report for Hüls AG (Germany). Ennex, 1997.



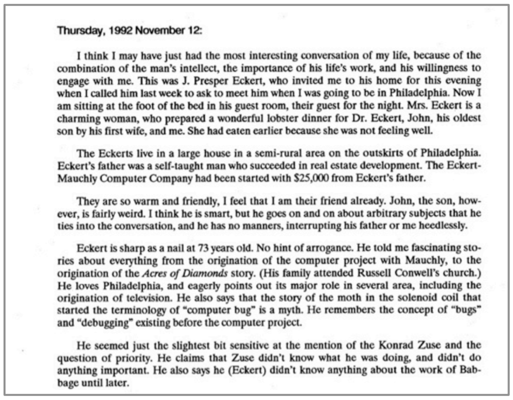
"PowderTeK Business Plan," client report for Materials & Electrochemical Research Corporation. Ennex, 1998.



"Fabbing a Thin-Walled Reflective Grid for Mounting Photodetector Crystals," client report for Crump Institute. Ennex, 1999.

"Launching an Autofab Business in Japan," client report for Engineering Model Associates (Japan). Ennex, 1995.

3. **Personal papers** related to Marshall Burns' activities in the field of 3D printing are included, among them more than nine hundred (900+) manuscript notes, journal excerpts, letters, printed documents (many annotated by hand), photographs, news clippings, and other items.



Thursday, 1992 November 12:

I think I may have just had the most interesting conversation of my life, because of the combination of the man's intellect, the importance of his life's work, and his willingness to engage with me. This was J. Presper Eckert, who invited me to his home for this evening when I called him last week to ask to meet him when I was going to be in Philadelphia. Now I am sitting at the foot of the bed in his guest room, their guest for the night. Mrs. Eckert is a charming woman, who prepared a wonderful lobster dinner for Dr. Eckert, John, his oldest son by his first wife, and me. She had eaten earlier because she was not feeling well.

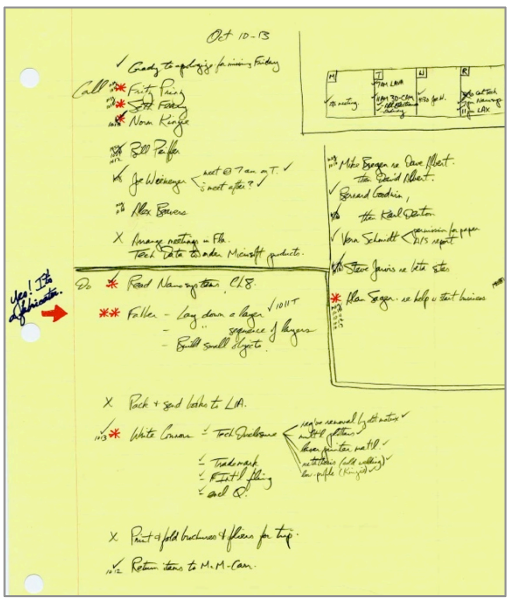
The Eckerts live in a large house in a semi-rural area on the outskirts of Philadelphia. Eckert's father was a self-taught man who succeeded in real estate development. The Eckert-Mauchly Computer Company had been started with $25,000 from Eckert's father.

They are so warm and friendly, I feel that I am their friend already. John, the son, however, is fairly weird. I think he is smart, but he goes on and on about arbitrary subjects that he ties into the conversation, and he has no manners, interrupting his father or me heedlessly.

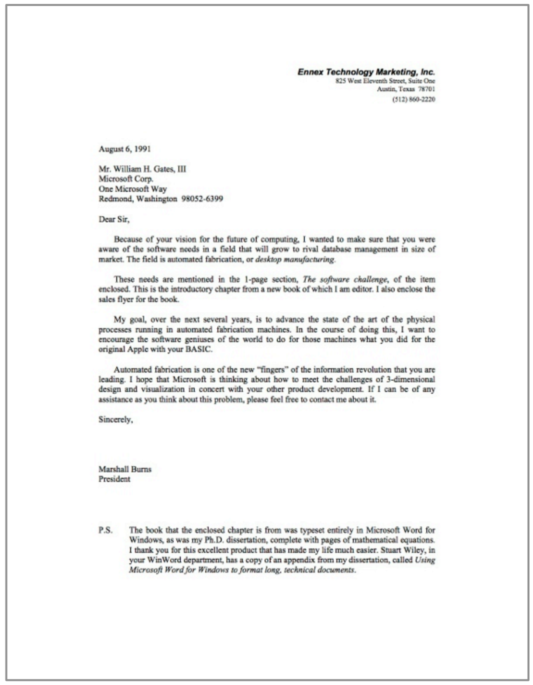
Eckert is sharp as a nail at 73 years old. No hint of arrogance. He told me fascinating stories about everything from the origination of the computer project with Mauchly, to the origination of the *Acres of Diamonds* story. (His family attended Russell Conwell's church.) He loves Philadelphia, and eagerly points out its major role in several area, including the origination of television. He also says that the story of the moth in the solenoid coil that started the terminology of "computer bug" is a myth. He remembers the concept of "bugs" and "debugging" existing before the computer project.

He seemed just the slightest bit sensitive at the mention of the Konrad Zuse and the question of priority. He claims that Zuse didn't know what he was doing, and didn't do anything important. He also says he (Eckert) didn't know anything about the work of Babbage until later.

Journal entry, Nov. 1992, reflections on a meeting with computer pioneer Presper Eckert.



"Yes! Its a fabricator," task-list notes on Ennex's fabber prototype, operated successfully for the first time in Oct. 1994.



Ennex Technology Marketing, Inc.
825 West Eleventh Street, Suite One
Austin, Texas 78701
(512) 860-2220

August 6, 1991

Mr. William H. Gates, III
Microsoft Corp.
One Microsoft Way
Redmond, Washington 98052-6399

Dear Sir,

Because of your vision for the future of computing, I wanted to make sure that you were aware of the software needs in a field that will grow to rival database management in size of market. The field is automated fabrication, or *desktop manufacturing*.

These needs are mentioned in the 1-page section, *The software challenge*, of the item enclosed. This is the introductory chapter from a new book of which I am editor. I also enclose the sales flyer for the book.

My goal, over the next several years, is to advance the state of the art of the physical processes running in automated fabrication machines. In the course of doing this, I want to encourage the software geniuses of the world to do for those machines what you did for the original Apple with your BASIC.

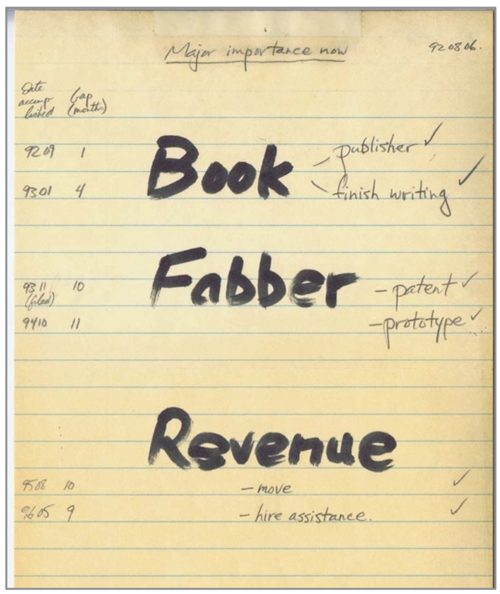
Automated fabrication is one of the new "fingers" of the information revolution that you are leading. I hope that Microsoft is thinking about how to meet the challenges of 3-dimensional design and visualization in concert with your other product development. If I can be of any assistance as you think about this problem, please feel free to contact me about it.

Sincerely,

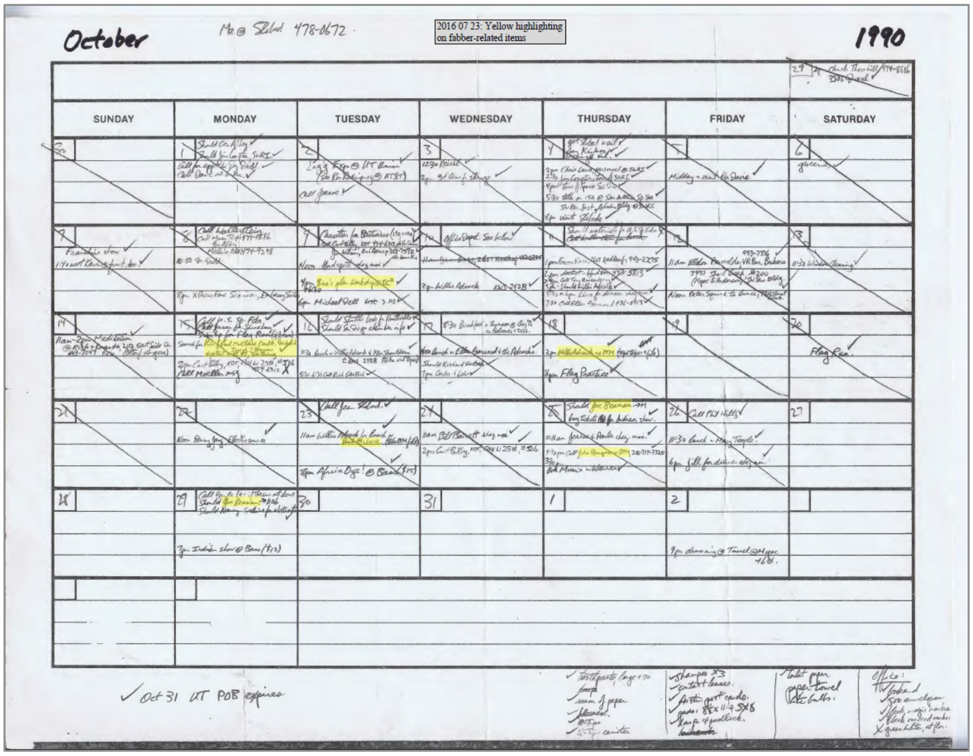
Marshall Burns
President

P.S. The book that the enclosed chapter is from was typeset entirely in Microsoft Word for Windows, as was my Ph.D. dissertation, complete with pages of mathematical equations. I thank you for this excellent product that has made my life much easier. Stuart Wiley, in your WinWord department, has a copy of an appendix from my dissertation, called *Using Microsoft Word for Windows to format long, technical documents*.

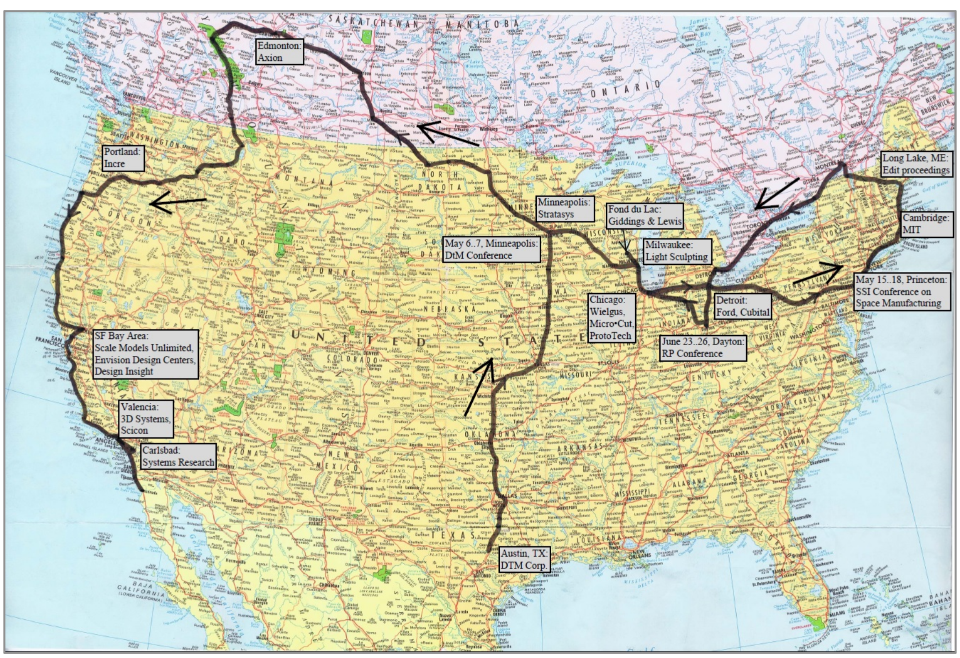
Marshall Burns' Aug. 1991 letter to Bill Gates, apprising him of new developments & software needs in automated fabrication.



"Major importance now," list of three goals for Aug. 1992.



October 1990 activity calendar, with autofab items highlighted in yellow.

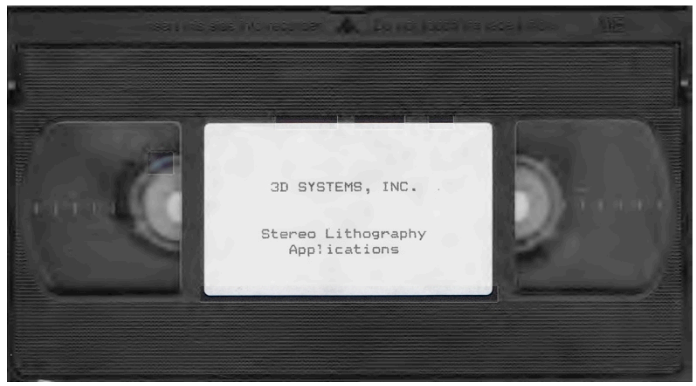


Driving route for first autofab research trip, May 4 to September 17, 1991 (annotated).

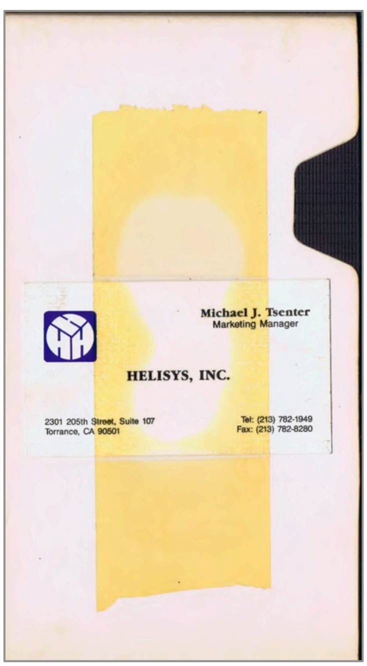
C. Multimedia Materials

1. The Archive includes a rich trove of rare **video and audio tape recordings**, among them thirty-one (31) promotional and documentary VHS cassettes produced by industry sources including DTM, 3D Systems, Stratasys, Helisys, Cubital, Ennex and others, as well as thirty-nine (39) audio & video cassette tapes in various formats documenting autofab speaking engagements by Marshall Burns. *Note: A digitized collection of many of these materials is included with the offering.*

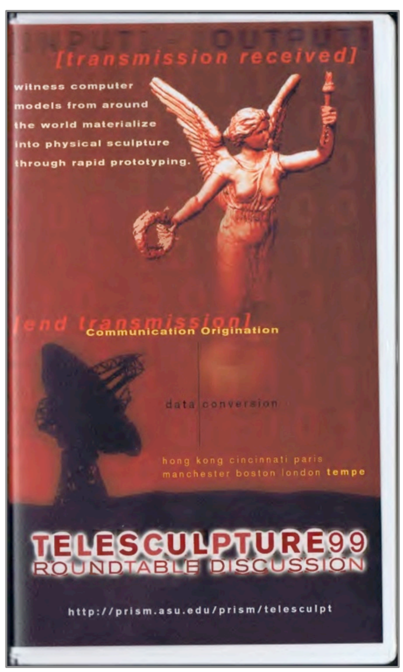
Fabricators, AAAS interview with Marshall Burns for Science Update, October 1994.



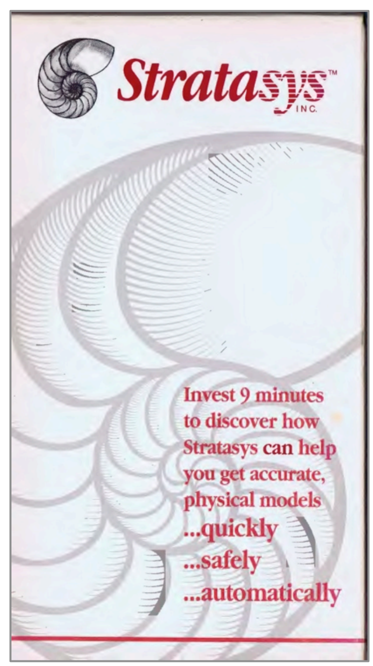
Stereo Lithography Applications, promotional VHS. 3D Systems, ca. 1992.



Untitled promotional VHS. Helisys, Inc., ca. 1992.



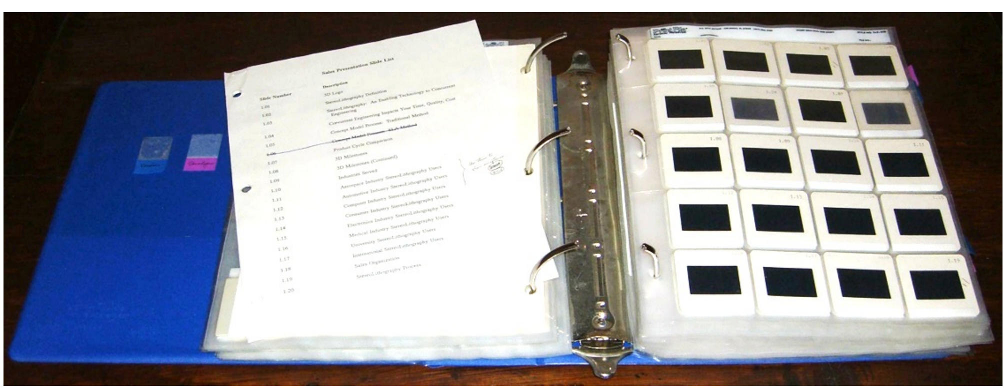
TeleSculpture, VHS recording of event roundtable discussion. Arizona State University, 1999.

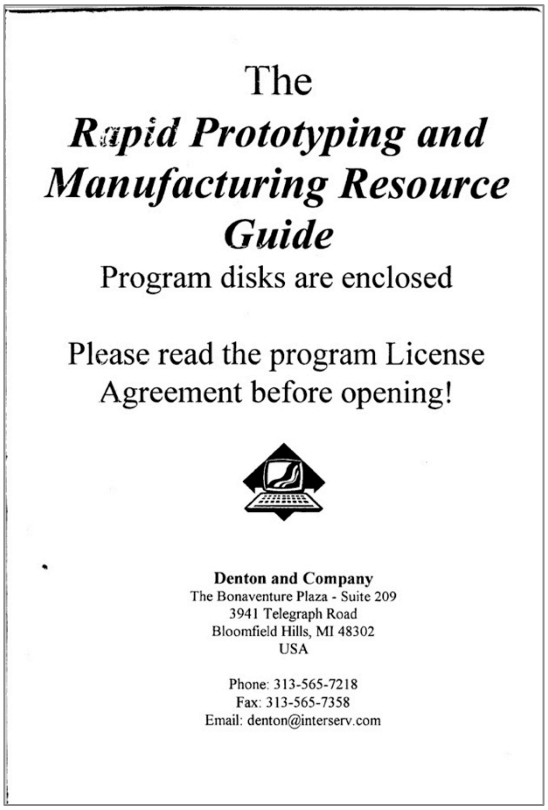


3D Modeler, promotional VHS. Stratasys, 1992.

Shelf view (left): Fabber industry promotional video collection, also including two Board of Customers meetings held by Ennex Corporation (1998), in which prospective customers, including representatives of Disney, Mattel, and Sandia National Lab, spoke frankly about their needs and wants for the technology.

2. Five hundred and fifty-three (553) **35 mm photographic slides**, most with metadata recorded on the slide mount it self, or accompanied by a brief explanatory text by Marshall Burns. The collection includes extensive high-res documentation of autofab industry developers, users, vendors, machines and 3D CAD/CAM files and outputs.

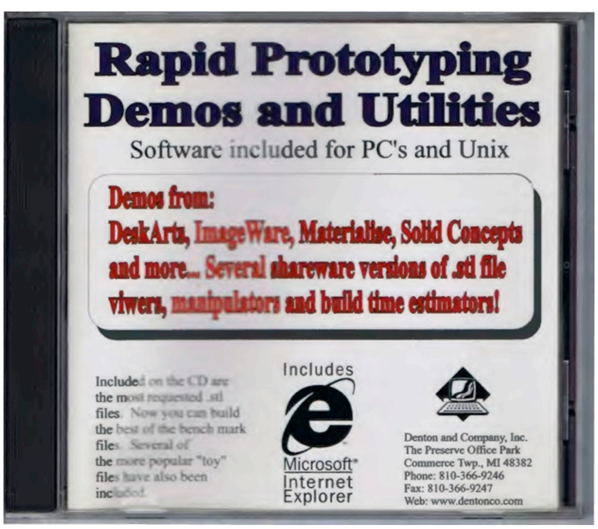




Rapid Prototyping and Manufacturing Resource Guide, printed envelope and two 3.5 floppy disks. Denton and Company, 1996.

3. Sixteen (16) **computer disks and CDs** are present in the Archive, representing examples of software and early electronic resources for 3D printing, CAD model output files, Ennex client proposals, and various industry demos.

3.5 in. floppy disks housing CAD files for 3D outputs



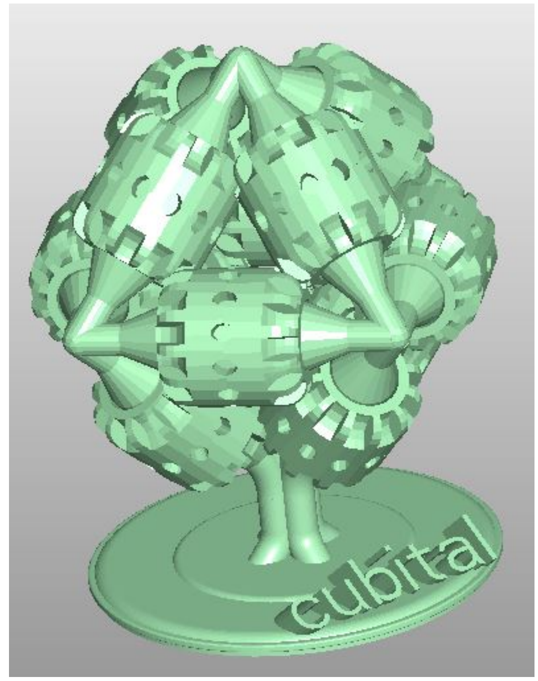
Rapid Prototyping Demos and Utilities, printed card and CD. Denton and Company, 1996

Mattel and Fabbers, printed card and CD of Ennex Corp. Powerpoint presentation to Mattel senior vice president Doug Glen, with mockups of two proposed toy products, *Barbie Designer* and *Custom Car Designer*.

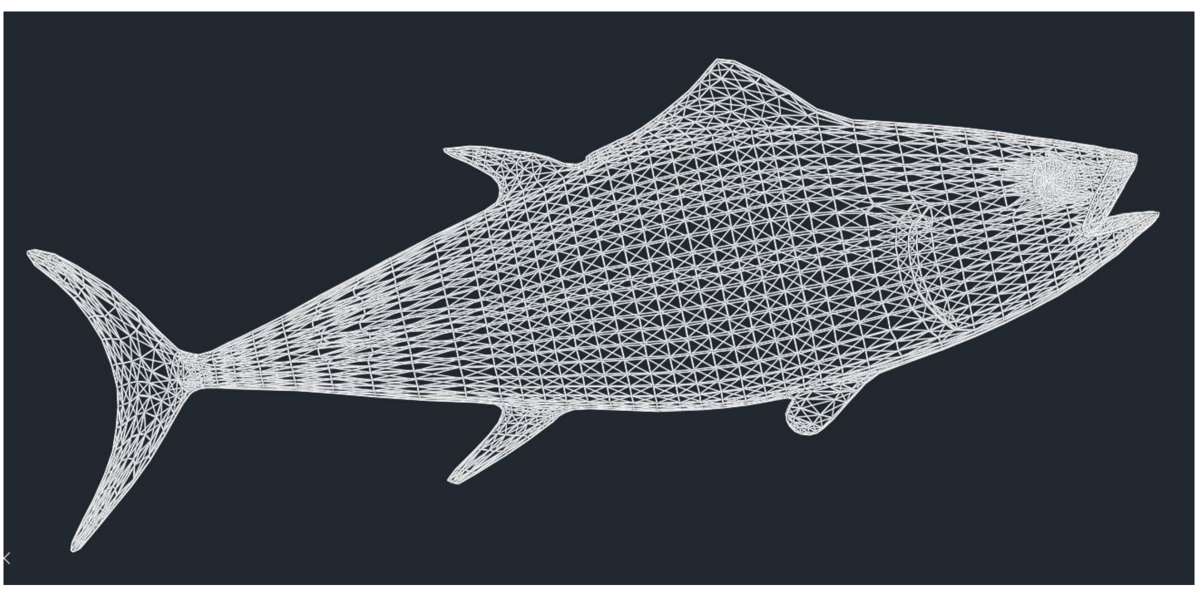
D. Born Digital Materials

NOTE: D. 1-5 housed on hard drive

1. **Autofab Industry Files,** comprised of seven hundred and seventy-four (774) items from the "fabbers" folders of the hard drive containing Ennex's collection of digital documents, photographs, and CAD designs relevant to the fabricator industry in general.

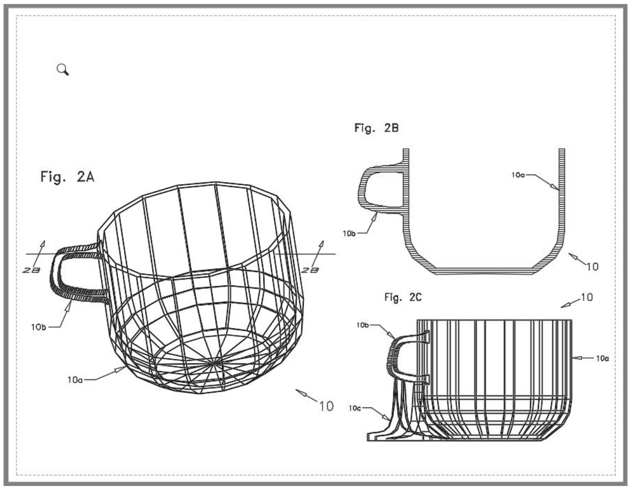


Screen grab of StL file for gear tree output – by Cubital ("brain_gr.stl") August 14, 1996 (file date), .stl

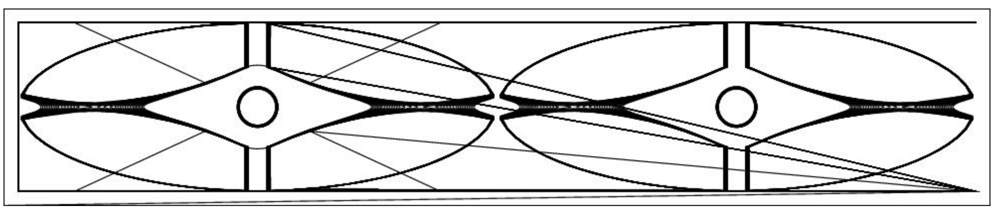


Screen grab of DXF file for tuna output – by Viewpoint ("tuna.dxf") October 23, 1995 (file date 1996 09 25), .dxf

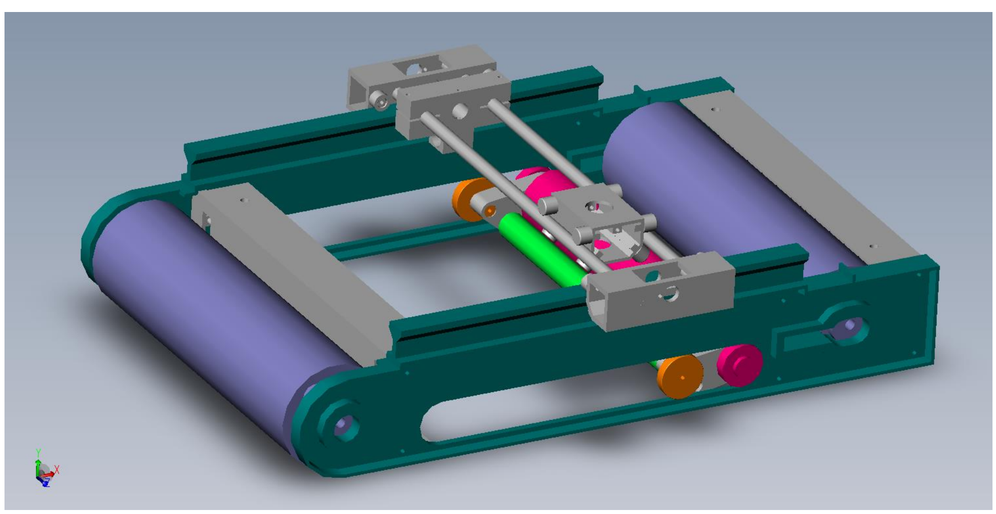
2. **Ennex Company Files,** comprised of two thousand five hundred forty-one (2,541) files from the "Ennex" folders of the hard drive containing records specific to the business and projects of the company from 1991 to 2005, among them CAD files showing designs for the Genie fabricator and various 3D printable objects



Screen grab of Fig. 2, AutoCAD design of sample object to be fabricated by Marshall Burns, Ennex ("cup.dwg") January 5, 1995 (file date), .dwg



Screen grab showing HPGL contours of Star Seed output – by Ken Hayworth, Ennex ("MDL-BLU1.HPG" fixed as "hpgl") November 11, 1994 (file date 1995 07 30), .hpg

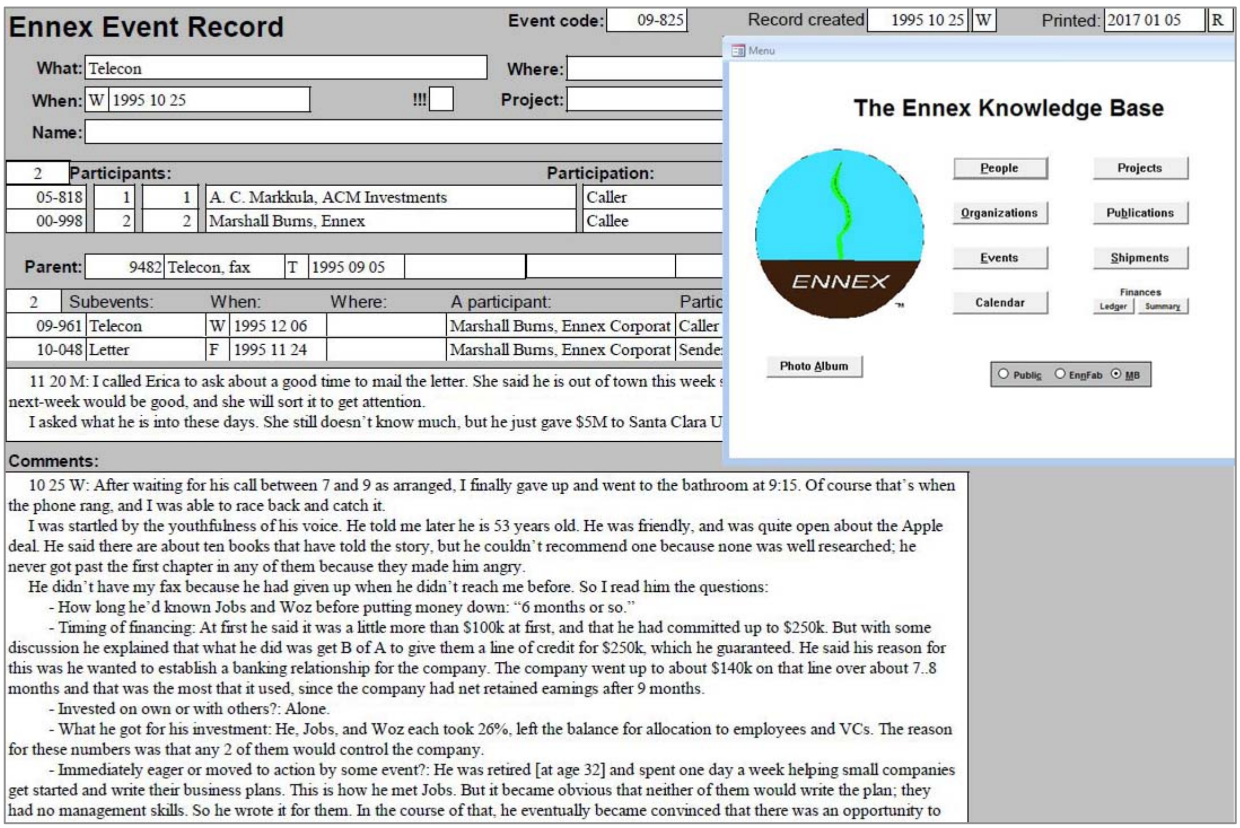


Screen grab of SolidWorks design file for Genie prototype film feeder – by Jorge De Joya, Ennex ("Filmfeed.SLDASM") September 25, 1999 (file date), .sldasm

3. **Ennex Web Root Files Section**, comprised of nine thousand, two hundred-and twenty (9,220) items from the "Web root/Old" folders, containing six (6) archives of the Ennex family of websites from October 2001 to October 2004.

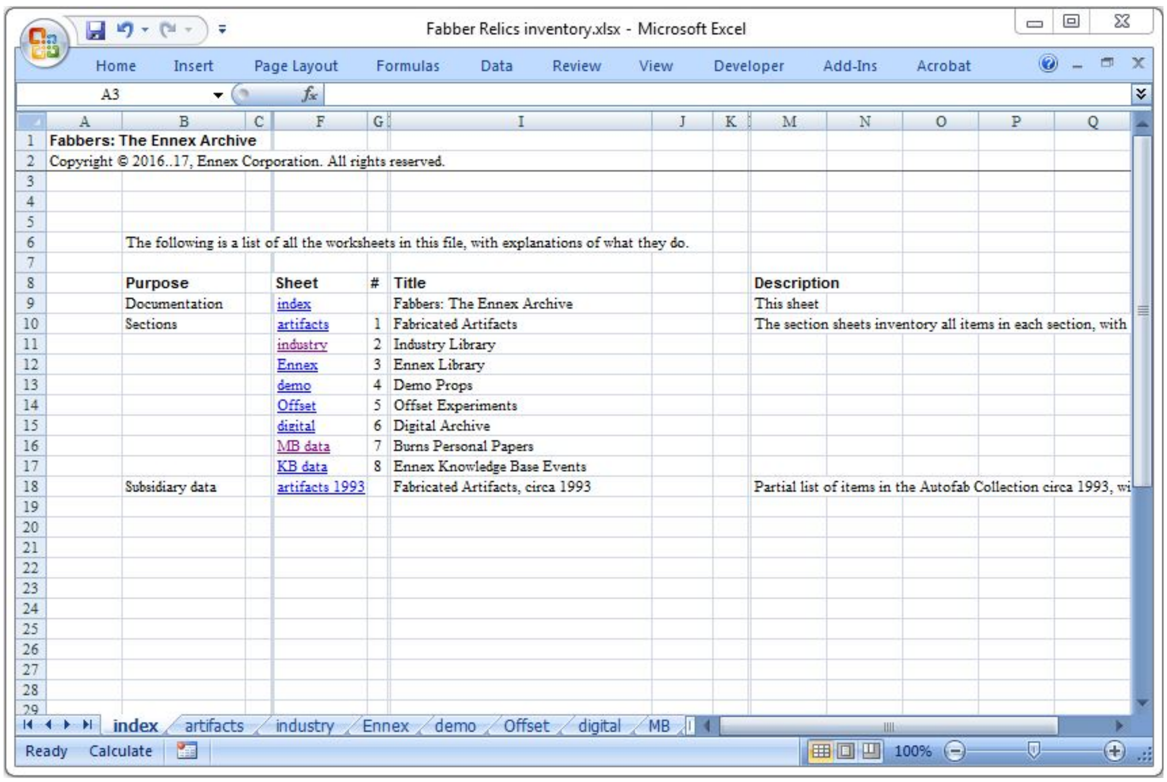
Screen grab of original Ennex.com home page – by Ennex ("index.sht" fixed as ".shtml")
August 17, 2001 (file date), .sht

4. **Ennex Knowledge Base**, comprised of more than five thousand (5,000+) descriptive event records from Ennex's internal database. The events are mostly meetings or correspondence in Ennex's fabber business, but they also include patents and other publications dating back as far as 1902, as well as financial transactions, such as payment of office rent and payments received for consulting projects.

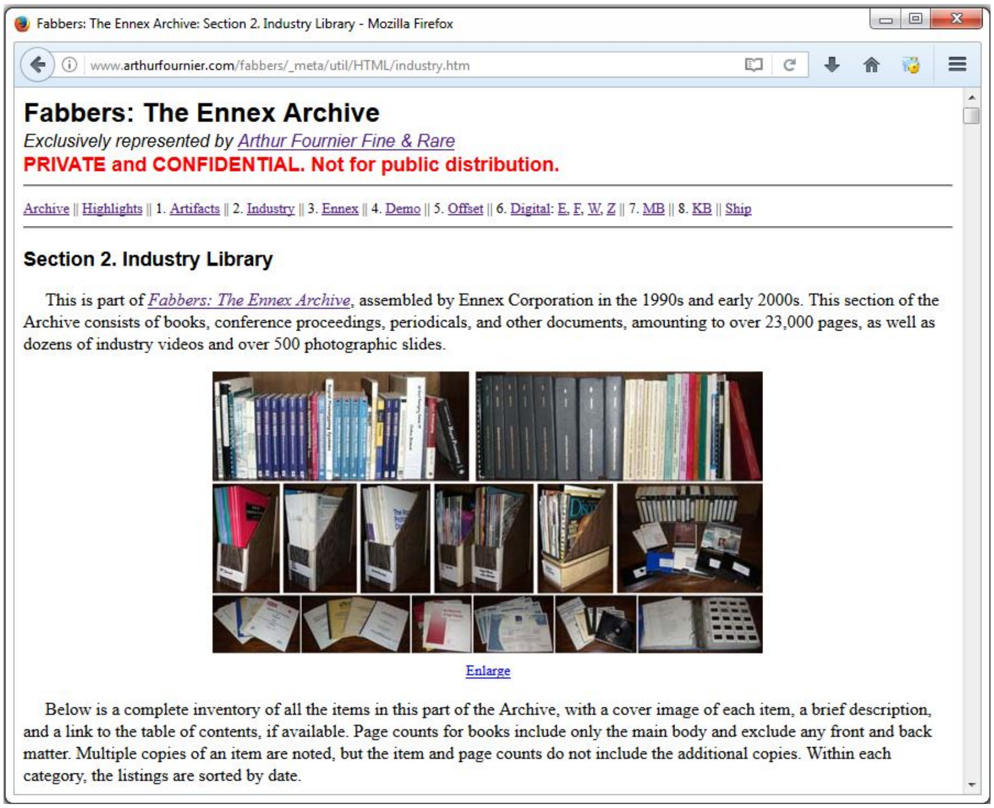


Event record concerning a phone call with Marshall Burns and Mike Markkula, (founding investor of Apple Computer) on October 25, 1995.

5. **Fabbers: The Ennex Archive inventory spreadsheet** ("Fabber Relics inventory.xlsx") ca. 2016-2017, providing a granular and copiously annotated database of all components of the Ennex Archive. Complied by Marshall Burns himself, the spreadsheet supplies readily manipulable data for input into collections management software. Currently, it serves as the basis for Dr. Burns' private website describing the collection, available for viewing by qualified purchasers only at www.arthurfournier.com/fabbers.



Screen grab showing Fabbers: The Ennex Archive Excel spreadsheet index page by Marshall Burns, Ennex ("Fabber Relics inventory.xlsx") January 13, 2017, .xlsx



Screen grab showing Fabbers: The Ennex Archive HTML webpage, "Section 2. Industry Library," by Marshall Burns, Ennex, derived from the "Fabber Relics inventory.xlsx" Excel database, ca. January 2017, .html.

<u>Note</u>:

In addition to the foregoing items listed in sections A through D (pp.14-39), the Ennex Archive also includes certain materials available for donation to a qualified buyer, among them a set of props and teaching tools used by Marshall Burns during his live presentations to demonstrate and explain the three fundamental methods for giving products shape (subtractive, additive, and formative fabrication), as well as a quantity of experimental adhesive sheet materials used by Ennex in the development of Offset Fabrication, together with the results of experiments using the process. For more information, see sections 4 ("Demo") and 5 ("Offset") of Fabbers: The Ennex Archive website, available via password access at www.arthurfournier.com/fabbers.

Acquisitions

Inquiries concerning the sale of the Ennex Archive may be directed to Arthur Fournier, info@arthurfournier.com, +1 (917) 749-9431, www.arthurfournier.com.

Custom-made by push-button

Factotum a leader in producing 3-D objects by computer design

By Dana Flavelle
TORONTO STAR

You could call them personal factories.

Anyone will be able to sit down in front of a personal computer, design a three-dimensional object and have it custom-made out of plastic at the touch of a button.

> *"We're a long way from the Star Trek replicator, but (stereolithography) represents a dramatic change in the way we do things."*
>
> **Craig Ferchat**
> **Factotum Compusystems**

At least, that's what technology gurus like Marshall Burns are predicting is the future of a new automated fabrication process called stereolithography.

"These machines are going to start a revolution in manufacturing," says Burns, a physicist, consultant and author of a new book on the subject.

Called *Automated Fabrication: Improving Productivity in Manufacturing*, it's published by PTR Prentice-Hall Inc.

"In 20 to 25 years, these will be as common as computer printers," says Burns, comparing it to desktop publishing, which allows computer users to create everything from personalized Christmas cards to small magazines. "Everyone will have their own."

For the moment, the technology is too expensive for average consumers.

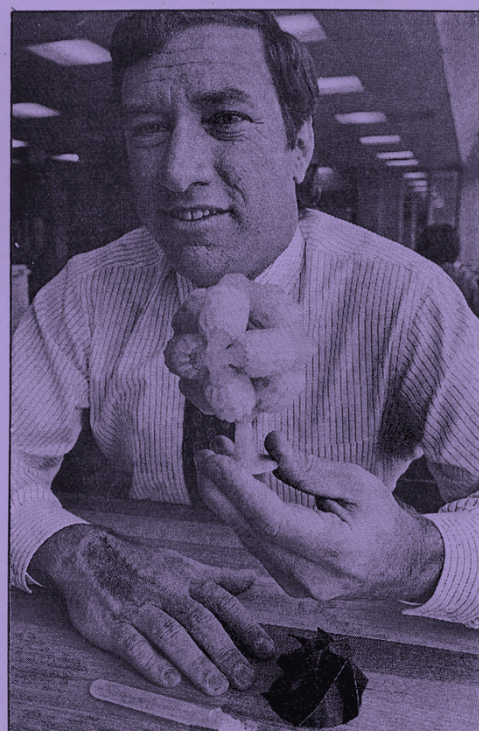
"We're a long way from the *Star Trek* replicator, where you speak into a box and the part pops out," says Craig Ferchat, owner of Factotum Compusystems. "But stereolithography still represents a dramatic change in the way we do things."

Mississauga-based Factotum is the only Canadian company supplying this service.

For major corporations, stereolithography is slashing the cost of developing one-of-a-kind items, Burns says, whether it's a prototype for a new razor or a custom-built knee-pad for a hockey player.

Doctors are using this technology to develop models

Please see NEW/page C2



TONY BOCK / TORONTO STAR

MACHINE OF FUTURE: Marshall Burns shows a meshed-gear tree, a razor and an impellor — plastic objects turned out by the automated fabrication process.