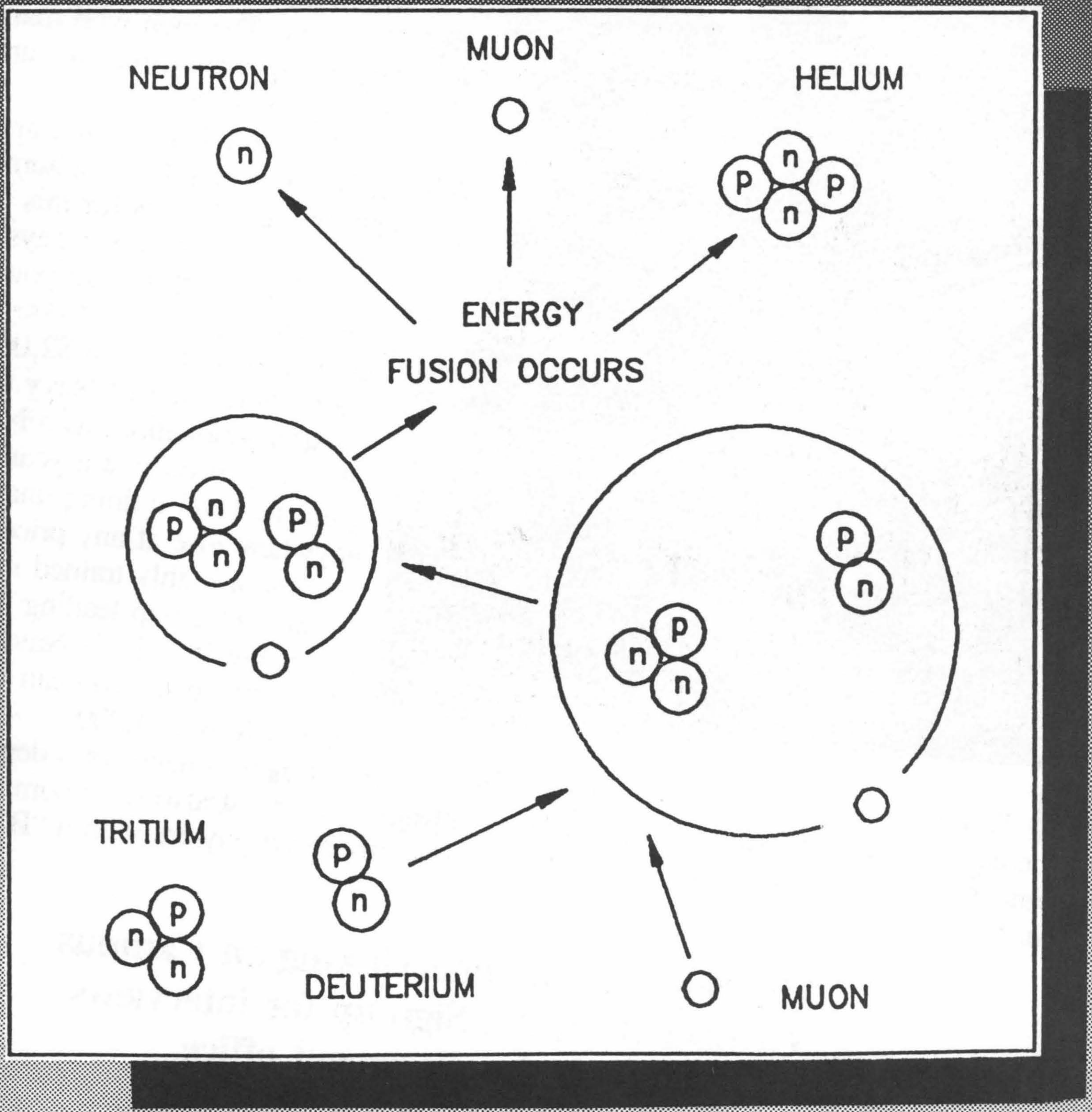
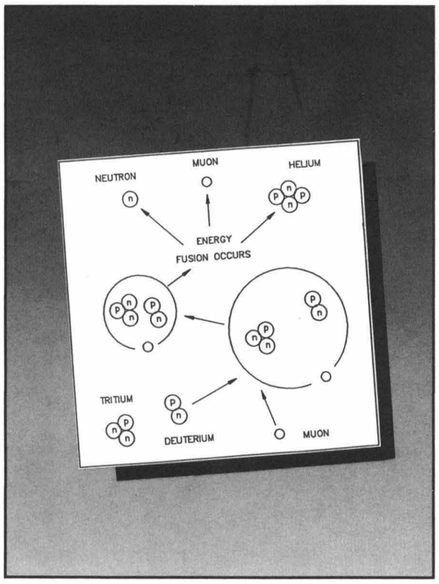
Engineers' Forum

VIRGINIA TECH SEPTEMBER 1989



Cold Fusion Controversy



On The Cover

Cold fusion has been a debated topic since it was first reported. Though many scientists dispute the Fleischman-Pons findings, some valid questions remain.

Engineers' Forum

Engineers' Forum is Virginia Tech's student engineering magazine. *Engineers' Forum* magazine is published four times during the academic year. The editorial and business office is located at 112 Femoyer Hall, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. Phone (703) 231-7738. Member of Engineering College Magazines Associated, Lynn A. Nystrom, Chairperson.

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Darkroom facilities donated by Virginia Tech Communications Department.

VOLUME 8

NUMBER 1

SEPTEMBER, 1989

Table Of Contents

EDITOR'S PAGE

How Society Views Engineers

Picture this: you're sitting in front of the TV on a Thursday night, waiting for the beginning of your favorite show at 10 p.m. Images flash across the screen, but not of hot-shot lawyers parading around their fancy offices in three-piece suits. Instead, we see people diligently working at drawing boards and CAD terminals, with shirtsleeves rolled up and hands moving. Yes, "L.A. Law" has been replaced by "D.C. Engineer," a show about the glamorous world of defense-contract engineering.

Unfortunately, this is an unlikely scenario. Despite the high regard held for engineers by other engineers, and most students at this campus, society in general holds a different view. The reality is that engineering's important discoveries and achievements are often unknown to the masses, and hence an engineer is not viewed in the same light as a doctor or lawyer. A typical parent will wish his child to study medicine or law before engineering. Even though engineering does more of a service to the public than an ambulance-chasing lawyer, it lacks the status. Why?

One reason is engineering's distance from the public. While an average person may see some sort of doctor a few times a year, rarely will one interact directly with an engineer. And if one is involved in an accident, one will consult a lawyer rather than a traffic engineer. It may well be true that a significant segment of society knows nothing of what engineers do. I will never forget the time I visited a neighboring school and told someone of my major. This brought a frown to the person's face and the question, "Why would you want to drive a train?"

Lack of media portrayal may also be to blame for engineering's place in society. A deficiency in the area of technical reporting at the major newspapers no doubt has kept many engineering feats unknown to the public. This area has improved dramatically in the past 10-15 years, however. Still, the publicity (and thus notoriety) afforded engineering sorely lags the medical and legal practices.

Finally, engineering's traditional low-visibility role in many corporations brings it a lack of recognition. Often management will take credit for a technical achievement, and the praise will never even filter down to the responsible engineer. Obviously, an engineer must be visible and his achievements known in order to be respected.

With the recent technology news — stealth aviation, cold fusion, and the U.S. space program — engineers are being thrust into the public limelight more and more. And with more positive publicity will come more status. Yet it will take some time to raise engineering to the echelon of law and medicine, if it ever happens at all. Don't expect to see a television show entitled "Trapper John, M.E." anytime soon.

Andrew E. Stalder
Editor

Tech to Field Entry in GM Sunrayce USA

By Andrew Stalder

An ambitious group of Tech engineering students and faculty members are currently constructing a solar-powered automobile for competition in the General Motors-sponsored Sunrayce USA. The race, which will include teams from universities across the country and Canada, will traverse the U.S. in July 1990.

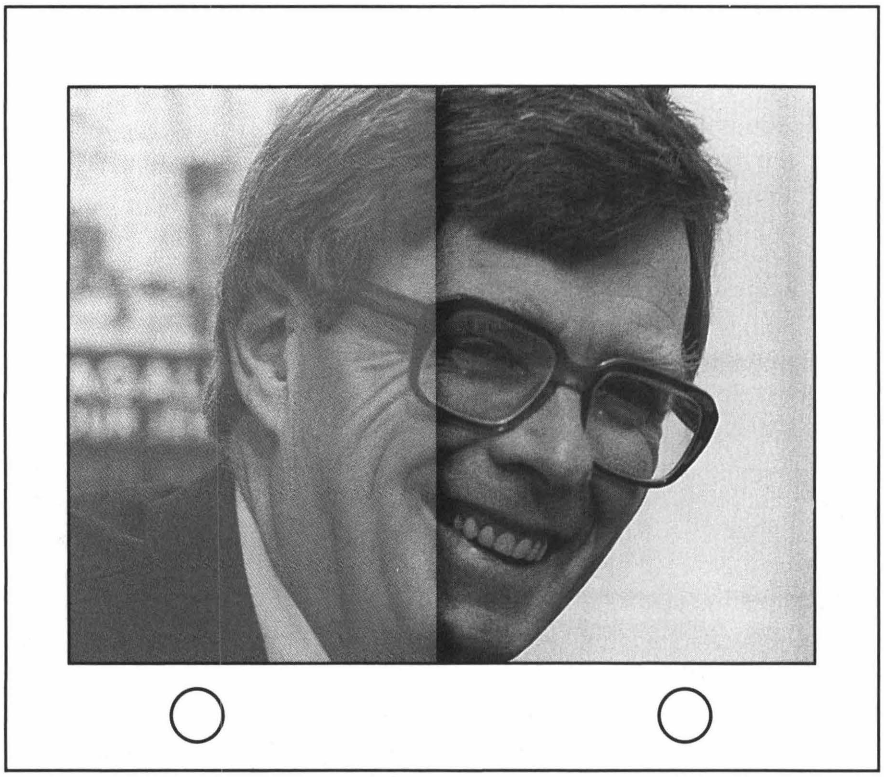
The solar car project was stimulated by a two-day visit from the GM Sunraycer in January. The visiting vehicle was a prototype for the car that had just won the Pentax World Solar Challenge in Australia a few months earlier. While at Tech, the Sunraycer team informed students and staff of the Sunrayce USA to take place in 1990. Shortly after the Sunraycer left, Tech's team began to form. In little over a month the team had formed a plan for design, construction, and testing of their car, in addition to targeting potential suppliers of necessary equipment.

At the time of this writing, the design process is near completion, with construction to follow. The car will have a silhouette somewhat similar to that of the Sunraycer, but will also incorporate many concepts that will be unique to Virginia Tech's entry. As the final design will likely be determined during testing, however, any further speculation would be conjecture. Nevertheless, given the departmental facilities — including AOE's three wind tunnels, ME's CAD and machine shop facilities, and EE's Power Engineering division — and brainpower at the team's disposal, no doubt the final product will be highly competitive.

The team is headed by team leader and Professor of Mechanical Engineering Dr. Charles J. Hurst. Additional faculty members working on the project include Dr. Jaime DeLaRee Lopez and Dr. Robert Miller of Electrical Engineering, and Dr. Hal Moses, Dr. Larry Roe, and Dr. Douglas Nelson, all of Mechanical Engineering. Undergrad team members include Steffen Brocks, David Gillikin, Donald Guthan, David Hunt, Moji Ijaz, Ed Kwasnick, Tom Lusco, Donald Mannus, Greg Murray, Janis Oandasan, Kerry Peters, Jeff Poston, Eric Schardt, Jay Swami, Eric Taylor, Keith Van Houten, and John Wilson.

The General Motors solar car visited campus last winter. Tech's vehicle was inspired by this meeting and in many ways is similar to this vehicle.

High Definition Television: The Big Picture



By Tom Glaab

While most of the scientific world's attention is focused on creating nuclear reactions in a test tube, there is a lot of research time and money being put into another tube: the boob tube.

High definition television (HDTV) has become a reality, but so many technical and political obstacles remain that it probably won't be showing up in your living room for a few years.

The Japanese already have a working HDTV system, and plan to start transmitting experimental broadcasts via satellite by the end of the year. The problem with their system is that it is not compatible with any existing television broadcast standards. This hasn't bothered the Japanese; they figure the higher quality is worth the expense of a new television set. Americans don't like the idea of making millions of TVs obsolete, and are trying to create a HDTV broadcast standard that is compatible with the existing NTSC standard.

Virginia Tech electrical engineering professor Charles Bostian is spending 1989 in Washington, DC, as a congressional science fellow working for Pennsylvania Congressman Don Ritter. Part of his work involves writing legislation to encourage U.S. research in HDTV.

One of the leading HDTV labs is the Advanced Television Testing Center in northern Virginia. This laboratory, sponsored by broadcasters and the television industry, will test 20 proposed HDTV systems later this year. Only systems which are ready to use will be evaluated, said Dr. Bostian. The FCC will test these systems under "realistic conditions," which means that manufacturers are racing to turn their computer simulations into working prototypes.

The biggest obstacle to making a HDTV broadcast standard that is compatible with NTSC is the increased signal bandwidth required by HDTV. According to Dr. Bostian, one of the more popular schemes involves transmitting NTSC video and audio signal on existing channels and broadcasting the additional information needed for HDTV on an unused VHF or UHF frequency. A special code in the NTSC signal would tell the television where to find the balance of the HDTV signal, eliminating the need for the viewer to manually select the additional channel.

Another system involving a fiber optic transmission network has met with a lot of criticism. Author George Gilder is one of the leading proponents for such a system, claiming that it would offer an almost infinite bandwidth and no interference with existing broadcasters. But as Congressman Ritter pointed out, "The American tradition of allowing free reception of broadcast signals [means that] anyone can buy a receiver and turn it on. Cable service isn't free." He also notes that there is already $40 billion invested in over-the-air transmission facilities and a switch to fiber would be extremely costly.

Gilder has also met a lot of opposition

Continued on page 5

Continued from page 4

by claiming that HDTV needs to use digital signal processing. Digital signal processing would work best with a digital signal, but that would not be compatible with NTSC. Tech electrical engineering professor Dr. Timothy Pratt thinks that analog signal processing will be used merely because it is already here and works well.

Gilder has some support though. Nicholas Negroponte of MIT said that a HDTV set "will probably have 50 megabytes of random access memory and run at 40 to 50 MIPS. It will be basically a Cray computer." Jeffrey Bairstow, editor of Electronic Business magazine said this isn't too unrealistic. He cited the large number and complexity of personal computers in America, which is "a business U.S. companies have built from nowhere in less than 10 years."

So what are you going to be able to watch on your Cray TV? Several groups such as NASA and 1125 Studios are working on HDTV films. These efforts are primarily to learn how to use the medium and to show what can be done. Some successful recent projects include a space shuttle launch and championship boxing.

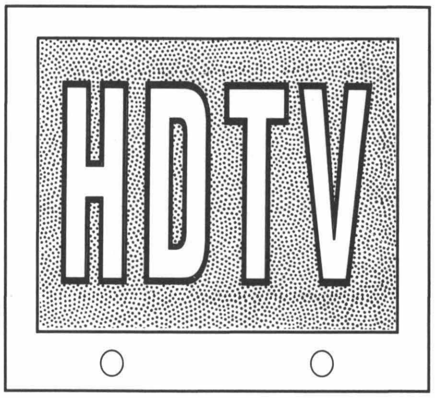
Will a picture more than twice as sharp as NTSC promote better programming? "We should hope so," said Dr. Bostian. Unfortunately programming is driven by money, Dr. Pratt pointed out. The big networks program for the least common denominator of viewers, and they must make money to pay their shareholders. Public television is a better forum for HDTV, but there are fewer viewers to support the cost. Whether people will pay the higher price for HDTV programming, "I don't know. In fact I don't know if consumers will pay for HDTV in the first place," Dr. Pratt said.

Five years ago people said the same thing about VCRs, but they didn't figure on movie rentals becoming so popular. But consumers do not necessarily choose quality. The VHS tape format has outsold the technically superior Beta format for the simple reason that the tape runs longer.

The television industry has more pressing problems than consumers though. Foreigners are ready to sell their HDTV systems while U.S. companies have hardly started designing them. Congressman Bob Torricelli said, "Government is taking the lead [in HDTV research]. The problem is, it is not our government." In March Congressman Ritter said, "The Annenberg Policy Forum name should be 'Out of the Starting Block for US HDTV Policy' rather than 'At the Crossroads of U.S. HDTV Policy.'"

These are harsh criticisms for the country that made TV a reality in the 1930s, and Jerry Pearlman, President of America's only TV manufacturer, Zenith Electronics Corp., said, "Only the government can remove the long-standing and still-prevalent barriers to commercial success and get private investments flowing."

The U.S. Congress is trying to do that now. Dr. Bostian acted as a technical consultant to Congressman Ritter, who wrote HR 1267, a House bill to "stimulate the design, development, and manufacture of high definition television technology." This bill is known as the High Definition Television Competitiveness Act of 1989 and provides tax incentives for HDTV R&D, relaxes anti-trust laws to allow cooperation between HDTV



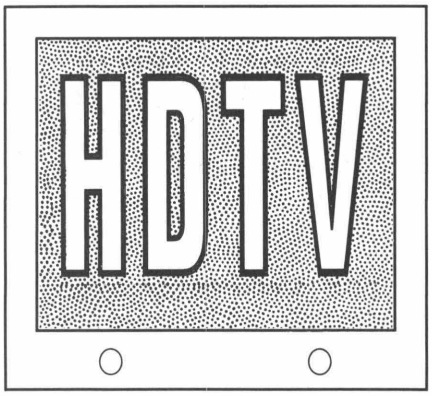
manufacturers, approves government's matching of R&D money (up to $100 million per year for five years), and help coordinate HDTV research. It also provides more money to the FCC to establish a HDTV standard through labs like the Advanced Television Testing Center.

Where does Tech fit into this? It doesn't, really. Dr. Bostian's work can not represent a conflict of interest with Tech projects, and nobody here is particularly interested in working on HDTV. There are already so many research projects going on that Dr. Pratt says seeking a HDTV project would be too great a change of direction. If Tech were to do HDTV work, he said, it would most likely involve the radio distribution of the HDTV signal. The electrical engineering department is a leader in computer simulation of terrestrial and mobile propagation effects on broadcasts.

But does all of this really matter? There is a large market for high definition

Continued on page 6

"...government is taking the lead [in HDTV research]. The problem is, it is not our government."



Continued from page 5

screens for computers, the military, and the broadcast industry; the United States has an opportunity to become a leader in the electronics industry; and according to Congressman Ritter, HDTV will become "increasingly important to the economic well-being and security of the nation."

HDTV research will probably continue in the U.S. with or without government support. There is hope for U.S. domination in the television world, though. HDTV is predicted to become generally accepted within ten years and in that time Intel Corp., which recently purchased RCA's digital video interface technology, should have time to develop DVI to the point where it will do for television what sound did for movies.

All of this will take some time. There is a lot of international competition since HDTV represents the opportunity for a nation to take a strong position in its manufacture. Hopefully the television programmers will prepare to take advantage of HDTV's better resolution, because I don't think the world is ready for Gilligan's Island in 1000+ scan line detail.

Cold Fusion Cools Off

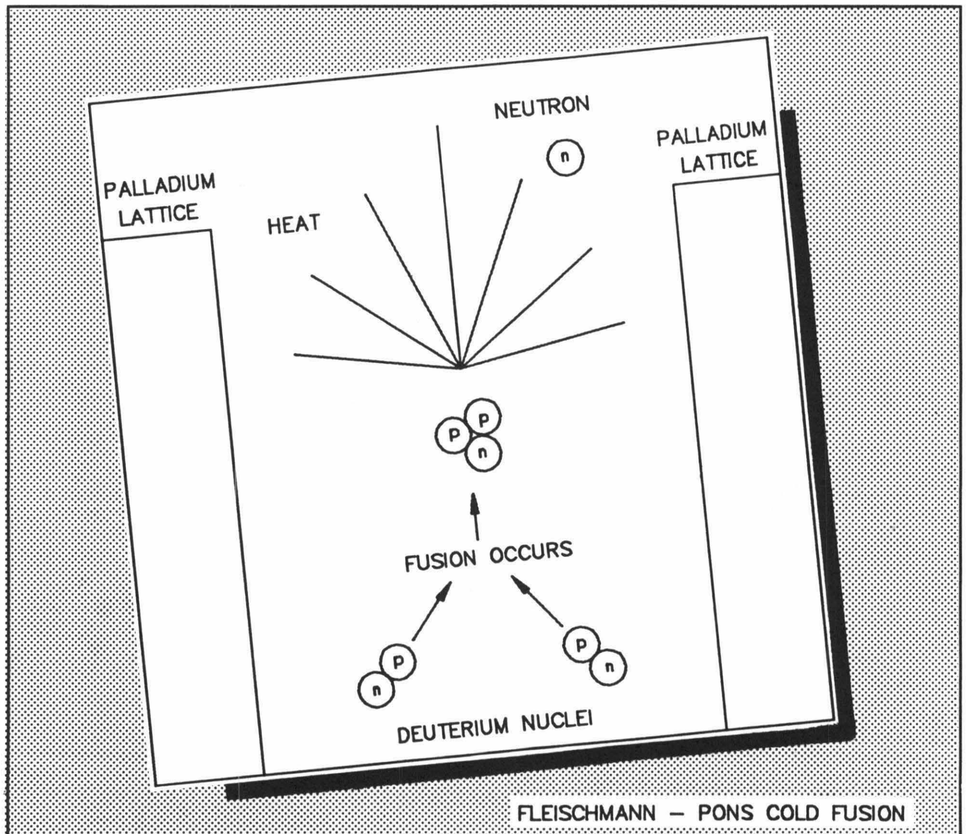
by Tony Giunta

Imagine a virtually unlimited energy source that produces almost no pollution. Now consider that this "magic" could be reproduced in almost any chemistry laboratory. Although the excitement over cold fusion has since been subdued by scientific scrutiny, these tantalizing thoughts briefly gripped the nation and the world when two relatively obscure scientists announced a possible scientific breakthrough.

The words "cold fusion" seem somewhat contradictory, as fusion brings to mind images of the sun or of the colossal experimental reactors currently under development. However, two chemists, B. Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton in England, startled the scientific community with their announcement of "fusion in a jar."

Unlike more conventional fusion experiments which require vast amounts of energy and equipment, cold fusion uses heavy water, in which deuterium atoms have replaced hydrogen atoms, and two metals, palladium and platinum. In the Fleischmann and Pons configuration a platinum rod is coiled around a cylinder of palladium. When an electric current is passed through the platinum, the deuterium atoms migrate toward the palladium rod and become tightly packed in the lattice of the metal. At this point the deuterium atoms begin to fuse and release neutrons and more importantly, heat.

The scientific controversy over cold fusion centers around the critical value of heat production. Pons and Fleischmann claim a heat energy yield of three to eight times the amount of electrical energy used to power the experiments. Such an output surpasses any known chemical processes, and to the chemists, is an indicator of fusion. The neutron emissions, a known by-product of fusion reactions, also support their theory.

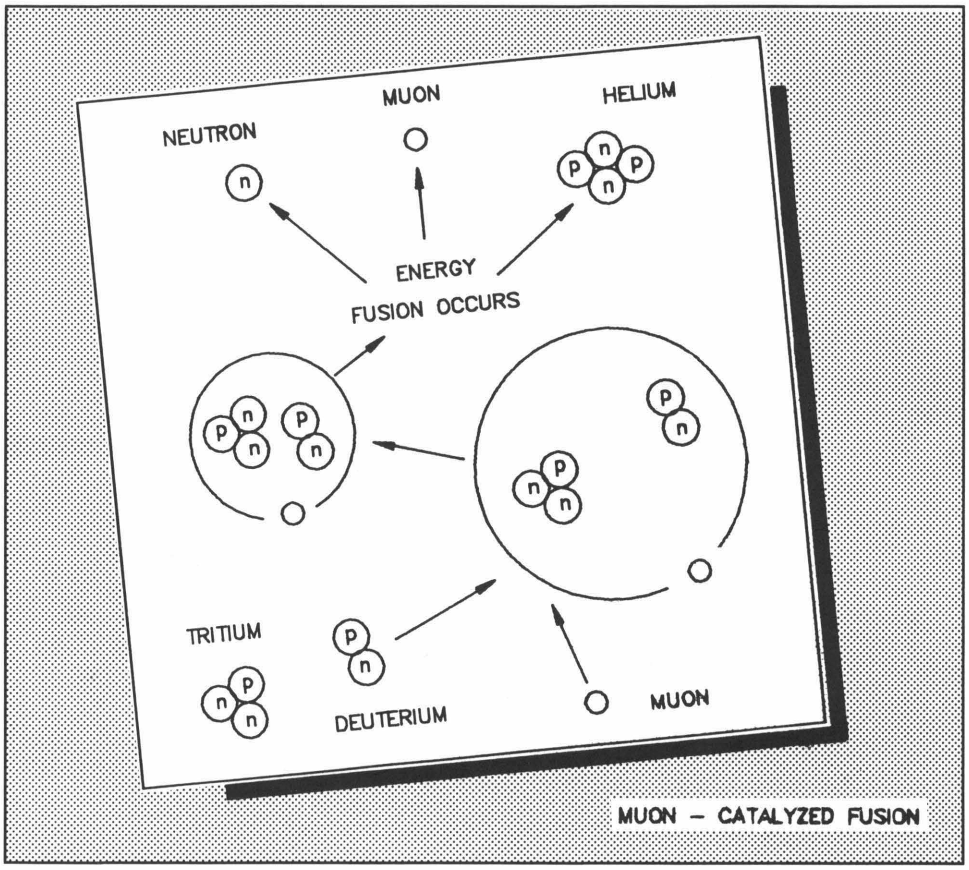


FLEISCHMANN – PONS COLD FUSION

Although considerable efforts have been made to reproduce the experiment, only somewhat sketchy results have been published to confirm the reaction. Georgia Tech scientists claimed to have produced fusion, but were forced to retract the statement when it was discovered their instrumentation was faulty. Researchers at Texas A&M University measured both heat and neutron emissions, but in different amounts than in the Fleischmann and Pons experiments. Other universities and institutions around the globe have also attempted to verify cold fusion. Some of these scientists used variations of the original apparatus, but the modifications only produced mixed results.

Perhaps the most difficult obstacle which the supporters of cold fusion have failed to surmount is gaining the acceptance of other members of the scientific

Continued on page 9



MUON – CATALYZED FUSION

community. MIT researchers believe that Pons and Fleischmann's results were obtained through experimental error and poor procedures. Additionally, a paper submitted by the two chemists to the science journal Nature was rejected because it did not contain enough details on the experiment. By breaking the standard procedures for announcing experimental findings, Fleischmann and Pons have brought unusual publicity to their work. However, this is precisely the factor which may determine the future of cold fusion.

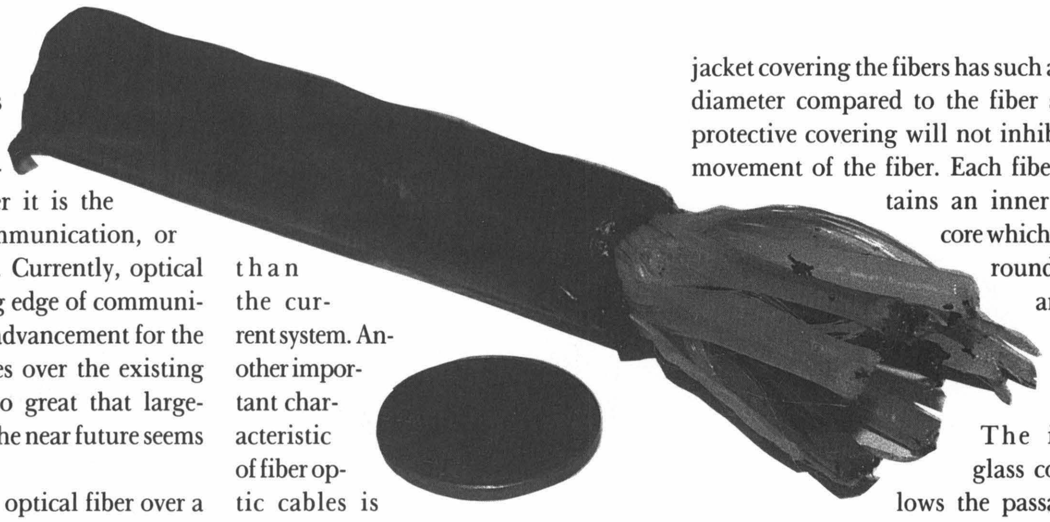
Although still somewhat overshadowed by the claims of Fleischmann and Pons, the media attention has focused light on another possible method for producing cold fusion. At the forefront of these advancements is BYU physicist Steven Jones. His procedure, known as muon-catalyzed fusion, utilizes the subatomic particles, muons, to replace electrons in deuterium or tritium —another isotope of hydrogen. Muons, which are heavier than electrons, shrink the radii of the atoms and in doing so, allow the nuclei to become close enough to fuse. The muons can be reused to form a chain reaction in much the same way a fission reaction occurs. If the chain reaction can be sustained for a sufficient number of repetitions this method may prove to be economically feasible.

Some scientists believe that a combination of the two cold fusion reactions may hold the future for research in this area, since neither method is currently capable of producing enough power for commercial use. For now, the debate over cold fusion continues, but the possibility for a quick answer to our energy problems becomes more remote as reaction data is accumulated. Even though there may not be an immediate breakthrough, Pons and Fleischmann brought the idea of cold fusion to the leading edge of scientific study. It may be that today's advancements in this field will prove to be the foundation for energy production in the next century.

"Perhaps the most difficult obstacle which the supporters of cold fusion have failed to surmount is gaining the acceptance of other members of the scientific community. MIT researchers believe that Pons and Fleishmann's results were obtained through experimental error and poor procedures."

Fiber Optics:

Wide-Scale Networking?



by Jonathan Hess

Each day our lives are dependent upon some form of telecommunication, whether it is the telephone, data communication, or some other medium. Currently, optical fiber is at the leading edge of communications networking advancement for the future. Its advantages over the existing copper system are so great that large-scale application in the near future seems inevitable.

The advantages of optical fiber over a network controlled by conventional conducting lines are extensive. First, the small, lightweight cables are able to fit into small areas including existing ducts, especially on ships, submarines, and airplanes where space management is critical. Aside from this, when replacing the current cables, increased space will become available and optical communication transmits 10,000 times the information that copper wire using electrical signals does. In addition, this volume of data can be transmitted twenty-four times the distance using fiber optic cable. Perhaps optical fiber's greatest advantage is its immunity from noise sources, such as man-made electrical disturbances, cross-talk from other lines, and lightning. Furthermore, these cables do not generate any spurious radiation which might cause interference with other equipment. Because of the difficulty involved in tapping into fiber optic cable, optical communication offers greater security than the current system. Another important characteristic of fiber optic cables is their ability to transmit light at multiple wavelengths, with a very large bandwidth which enables speech, data and video signals to be transmitted simultaneously by high-capacity systems. The future looks promising for optical fiber because it is a data transmission medium that will be able to employ tomorrow's electronics without replacing the cable.

Today, fiber optic cables have many applications. For example, they are used for jobs like long haul trunking, inter-office trunking, subscriber feeder, intra-building links, data communication, and military applications. The cables used for tasks such as these are protected by an outer jacket about one-half of an inch in diameter. Inside this covering is a layer of aramid yarn embodying many smaller plastic tubes which serve as further protection for the delicate optic fiber used. Within each of the smaller plastic tubes there may be a single 0.005 inch fiber or many of these fibers. The plastic jacket covering the fibers has such a large diameter compared to the fiber so the protective covering will not inhibit the movement of the fiber. Each fiber contains an inner glass core which is surrounded by an outerglass cladding. The inner glass core allows the passage of light waves while the outer cladding minimizes the loss of light energy and directs the lightwaves along the core. Because even the smallest impurities in the glass fiber will cause the scattering of light energy, special plastic cables are starting to appear in research labs in hopes of finding the best optical fiber cable possible.

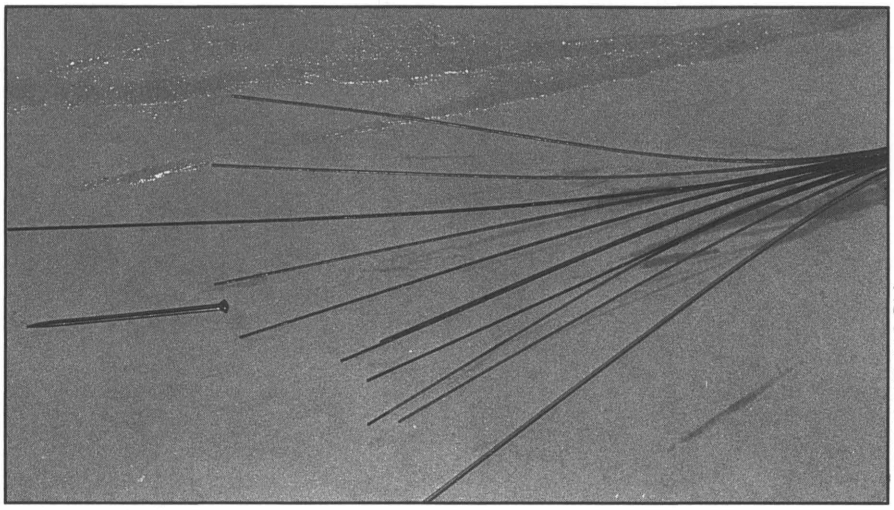
Although optical communication seems to be the answer to many of our largest communication problems, it too has some drawbacks. The largest problem with optical fiber cables is splicing. Presently, there is not a system that is economically feasible or simple enough to utilize on a large-scale basis. This problem presents the greatest complication when bringing fiber to the home. In comparison with the long-haul system already in use in the United States, deploying fiber optic cable to the home will require about eight times the cable and

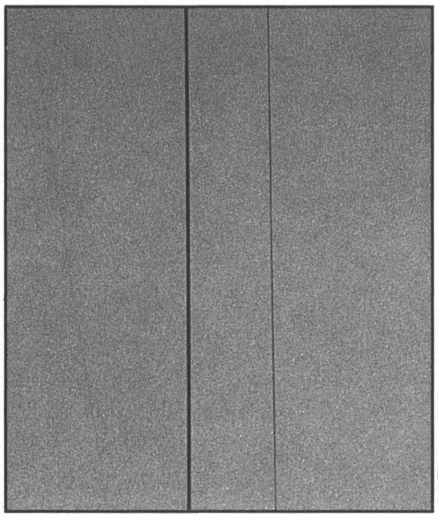
Continued on page 11

Continued from page 10
twenty times the splices per mile. Today, splicing is a complicated process involving the use of either a fusion splicing machine or special adhesives and epoxies cured by ultraviolet light. Both of these methods are extremely expensive; fusion splicing machines range anywhere from $15,000 to $30,000. Aside from this, each method is also time consuming and complicated.

However, with the research and testing currently underway at 3M corporation, an affordable, fast, and easy method of splicing may be available for use sometime in the 1990s. The product 3M is working on is called Fibrlok. Problems such as insertion loss, temperature cycling, tensile load capability, and environmental stability are minimized using this splice. The cost will be cut dramatically because the machine is easy to use, eliminating the need for advanced technical training, and the machine itself is inexpensive. The time saved preforming each splice is considerable since it will only take a mere forty-five seconds to preform a splice using the Fibrlok machine. Finally, with this machine slated to make an appearance on the market during the 1990s, the dilemma of splicing may no longer hinder fiber's entry into the home.

Optical communication is being introduced around the world and is performing extremely successfully. For this reason, and the promising future fiber optic cable seems to possess, we can expect optical fiber to become a vital part of our communication systems. Research is providing more efficient and less expensive means of production and installation all the time, causing a complete fiber optic network to become more and more feasible. Labs used for optical fiber studies, including Virginia Tech's own located in Whittemore Hall, must continue to strive for breakthroughs in this field so that its advantages may be used to advance our entire communications network.





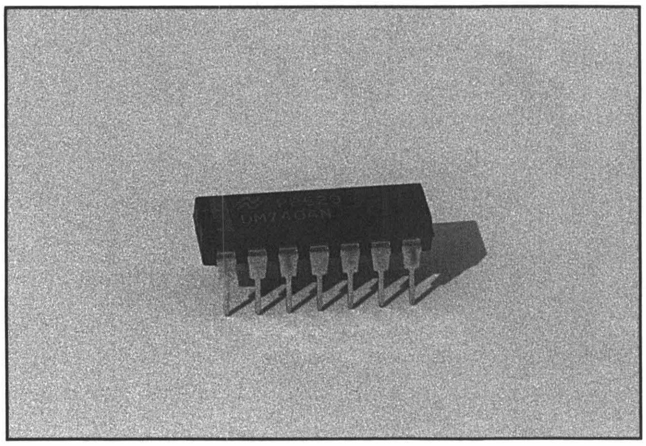
These enlargements show the size relationship between optical fibers and a penny (opposite page), a pin (top), and a human hair (left).

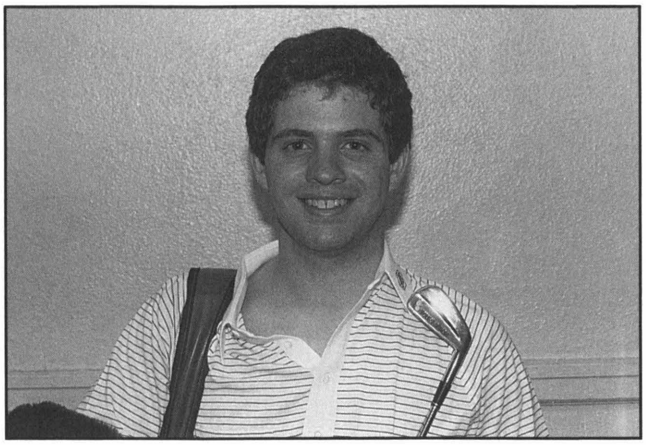
PICTURE QUIZ

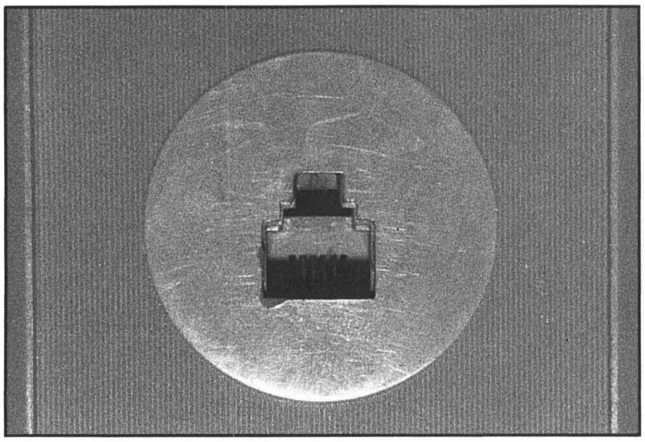
Photos by Howard Kash

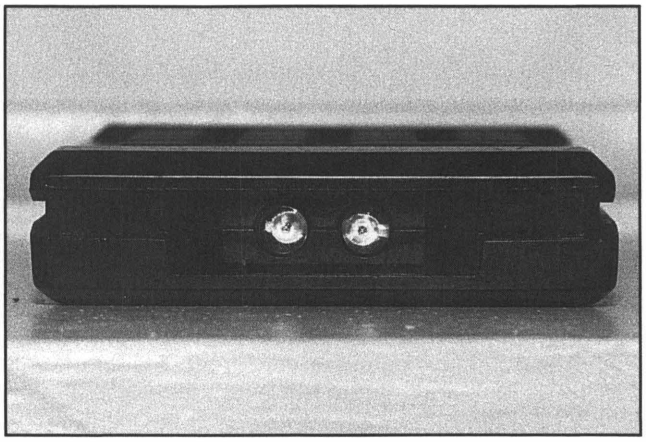
Match these items with the photographs on this page:

Integrated chip
Cue stick
Spark plug
Rifle bullet
Ad manager on his way to work
Switchblade
Barbed wire
Lamp on/off switch
Phone jack
Fake ID
Whistle
Lane Stadium ticket









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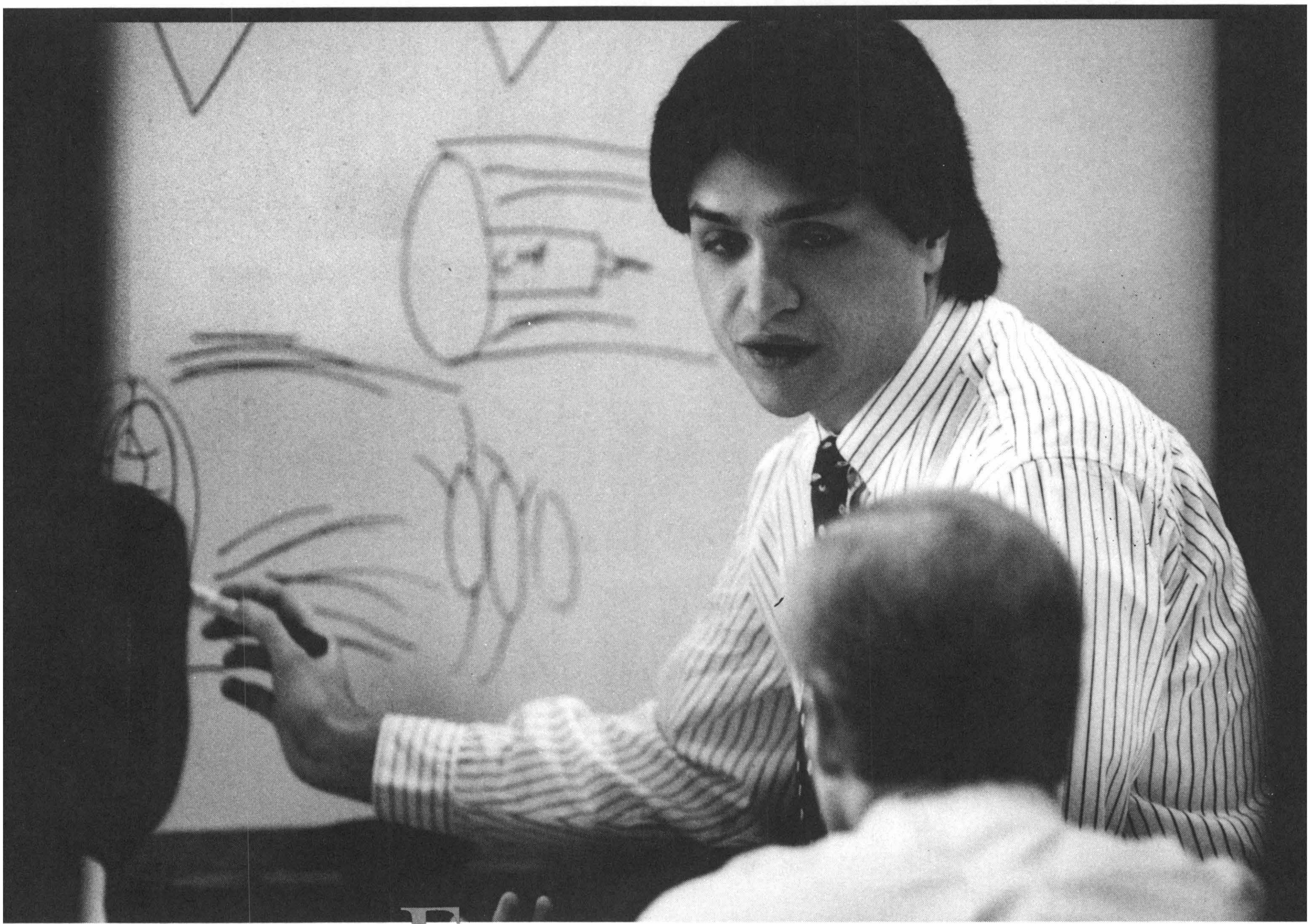

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