Engineers' Forum

VIRGINIA TECH OCTOBER 1987

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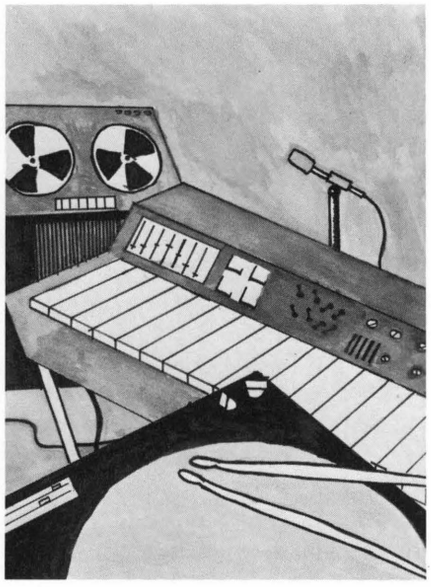

Artwork by Matthew Dawson

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Engineers' Forum

Volume 6, Number 1
October, 1987

Editor's Page

Swamped?
Get Off Your Apathy

Things were different when our parents were in school. Riots, protests, sit-ins, demostrations... You have to wonder if they ever studied or even went to class. Now all we do is go to classes and parties. Is this what we're going to tell our kids about?

Classes are important, and parties are great, but there are many things in between. They're called extracurricular activities. (We can probably do without the riots.) These activities can involve you in anything from star-gazing to supporting presidential candidates.

Virginia Tech is a large school with a varied student body. Even if you're into something really weird, there's probably a student organization that would love to have you join. Here are some good reasons to join one (or more) of Tech's organizations:

Extracurricular activities are educational. You can learn anything from Parliamentary procedures to why motorcyclists wear leather jackets. In a professional or honor society, you may develop a marketable skill.

Even a fraternity or sorority can beef up your resume. Perhaps the most technical skill you mastered was mopping cow patties out of the clubhouse, but you also learned how to deal with people. Employers want people who can relate to people.

They're a great excuse for an occasional set of low grades. A botched quarter now and then can be explained away as a sign of your increased involvement with a group. "Everything got dumped on me and I lost study time, but I learned something about myself."

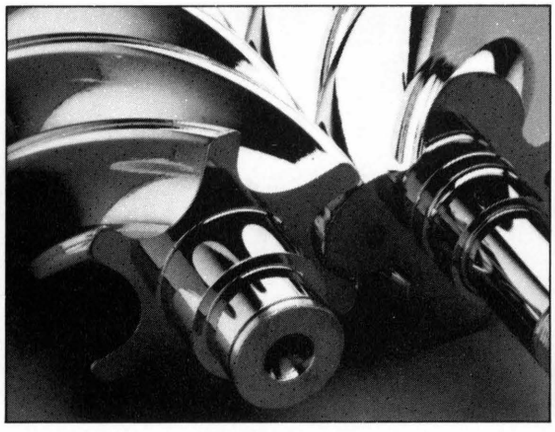
Working on something unrelated to your courses helps clear your mind of worries and stress. When you hit the books again, you have a fresh, improved attitude.

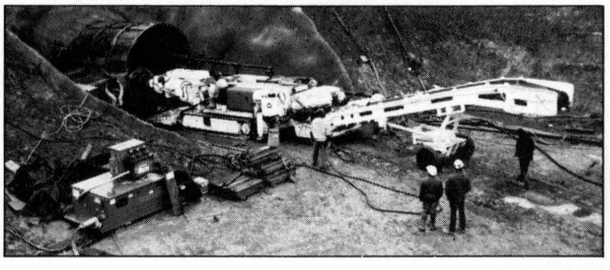
Dividing your thoughts among a variety of activities helps keep them all in perspective. But when you're up to your neck in alligators, it's easy to forget that you set out to drain the swamp.

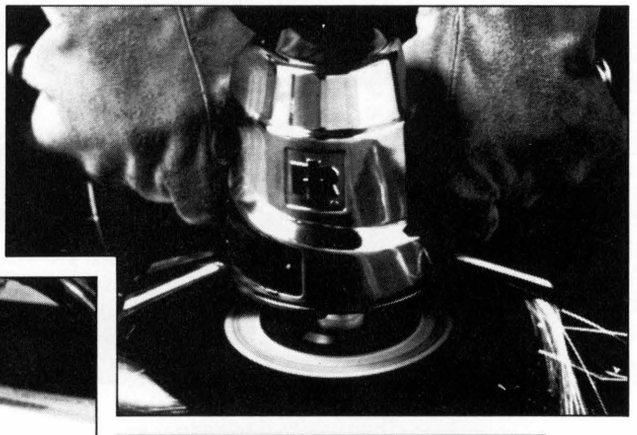
Join a student organization. Take a moment to care about something other than your grades. Chances are, they'll improve.

Alex Derr
Editor

A MULTITUDE OF OPPORTUNITIES







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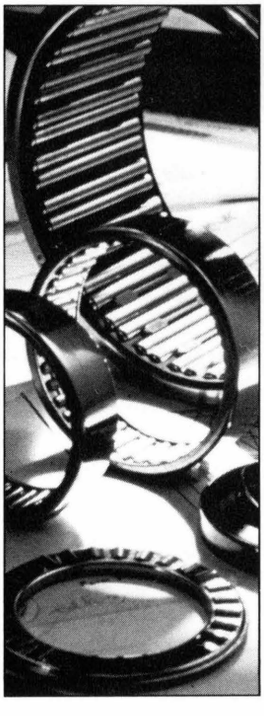

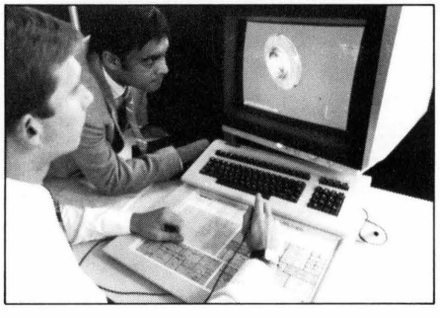

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EXPO '87
A Technology Showcase

by Theresa Kennihan

What's new in technology today? Are you interested in working for a local company, an international corporation, or perhaps a government agency? What are these companies looking for in engineering graduates? Do you have questions you would like to ask professionals working in the business world today?

EXPO '87 is the eighth annual Technology Showcase presented by the Student Engineers' Council of Virginia Tech. Each year, over 80 companies and government agencies representing a broad range of technical disciplines arrive on Tech's campus. They set up information display booths for the two day event and are eager to talk with students. Without the formality of an interview, you can ask questions and discuss opportunities, current projects, and research with company representatives.

In addition to companies and governmental agencies, all 11 engineering departments will be represented through their professional and honorary societies. Their booths and demonstrations are set up to familiarize you with each of the engineering disciplines. The undergraduate and graduate Cooperative Education Program and the University Placement Services will also be available to answer your questions.

Some companies will be giving special thirty minute technical presentations to share with you and in-depth views of new products, technical advances, or specialized research. With the aid of computers, audio visuals, models, and products, you will receive a glimpse of the current trends in industry.

The Student Engineers' Council extends to you a personal invitation to attend EXPO '87. Whether you are a freshman, graduating senior, or graduate student, come see what the business world has to offer you and what you can offer it at EXPO '87.

Theresa Kennihan is a junior in Industrial Engineering. She is President of the Student Engineers' Council and a member of Phi Mu Fraternity for Women.

The following companies will be attending:

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Allied-Signal, Inc. Chemical Sector
Aluminum Company of America
American Electric Power Service Co.
American Electronic Labs, Inc.
AMP Inc.
Arinc Research Corp
Armstrong World Industries
AT&T Technologies (Radford)
AT&T Technologies (Richmond)
Babcock & Wilcox
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Bechtel Power Corp.
Bell Communications Research
Burlington Industries
Celanese
Central Intelligence Agency
Chesapeake Corp.
Computer Sciences Corp.
Corning Glass Works
Cummins Engine Co.
David Taylor Naval Shipyard R&D
DMA Hyrographic/Topographic Center
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Perfect Illegal Copies

by David Ling

For about 188,000 yen or about $1225, Japanese consumers can purchase the long awaited but controversial DAT recorder. Digital audio tape, or DAT as it is more commonly called, is the newest musical medium to hit the consumer audio market since the introduction of the now familiar CD (compact disc). In March, 1987, Aiwa Co., Ltd. became the first manufacturer to sell DAT recorders. In a news press demonstration, Aiwa played back a 250th-generation copy (a copy of a copy of a copy...etc.) of a DAT recorded with music in comparison to the original DAT and showed that the copy was indistinguishable from the original! Unfortunately, DAT has only been released in Japan due to the controversy surrounding illegal copying.

The advantage that the DAT has over the CD is that it is a recordable medium. Compact Discs have a playback only format analogous to the ROM (read only memory) of computers. DAT's format, analogous to a computer's RAM (random access memory), allows not only playback of music but the ability to record music digitally with a clarity that is audibly indistinguishable from the source.

DAT FORMS

DAT can be implemented using either of two systems: R-DAT (rotary-head digital audio tape) and S-DAT (stationary-head digital audio tape). The major Japanese audio manufacturers have chosen to use the rotary head design. S-DAT lags far behind R-DAT in terms of research and development and will not be ready for commercial use for some time.

The DAT cassette looks much like a VHS video cassette but is about half the size of a conventional audio cassette. The DAT cassette has a sliding cover to protect it from dust and dirt, and it also has recognition slots for tape type, tape speed, and record lockout. Like the CD format, the DAT format has been standardized by a standards committee to maintain compatibility among different manufacturer's recorders. Without this standardization, numerous compatibility problems would evolve as exemplified by some of the problems experienced with interfacing between different computer products.

The Aiwa machine specifications include: frequency response up to 22 kHz (above human hearing and also above the CD's upper limit of 20 kHz), dynamic range of 99 dB, THD (total harmonic distortion) of 0.005%, and a wow-and-flutter of 0.001%. Dynamic range is the difference between the softest and loudest sounds possible. By comparison, a conventional LP record has a dynamic range of 55 dB. Total harmonic distortion is a measure of the infidelity of the output signal and wow-and-flutter is a measure of tape speed variation.

DAT decks are capable of playing back at three different digital sampling frequencies. Playback can be done at the deck's main sampling frequency of 48 kHz, at 44.1 kHz, at the same frequency of CDs, and at 32 kHz, the proposed frequency standard for upcoming digital satellite broadcasts. However, sampling frequencies for the recording mode of DAT decks is the source of much heated debate and controversy.

THE DAT CONTROVERSY

Whether or not to allow DAT decks to record at the CD's sampling rate of 44.1 kHz has been a major stumbling block toward marketing development. If a deck is allowed to record at this frequency, then the user can obtain a "perfect" digital copy of a digital source such as the CD. This could lead to rampant copyright infringements as already occurs with analog tape recorders. This is exactly what the recording industry fears would happen if recording on DAT decks is allowed at 44.1 kHz.

The recording industry in the United States is trying to prevent this by introducing legislation that would force manufacturers to build copy protection systems into their machines to prevent direct digital-to-digital dubbing. Some CD manufacturers have already begun to encode some of their CDs with copy protection codes that will prevent taping the CD regardless of the sampling frequency the DAT recorder might use.

In addition, the recording industry has proposed that taxes be levied on the actual blank tapes to augment the record company's income and the recording artist's royalties. The industry fears that they will experience heavy financial losses if these steps are not taken.

Only a few years ago, the recording industry foresaw a great rise in the popularity of audio cassette recorders but failed at passing legislation to have taxes levied on audio cassettes. Disney feared the downfall of the movie industry and tried to prevent Sony from selling video recorders. In retrospect, cassette recorders have not significantly lowered the financial income of record companies and VCRs have actually helped increase the income of the movie industry. In fact, some recording industry statistics indicate that slightly more prerecorded cassettes are purchased than LP records. Video sales have not hurt the movie industry, but instead have boosted their revenues through prerecorded video tape sales and rentals.

In contrast however, illegal computer software piracy has hurt many of the smaller software companies and even has had a significant impact on the much larger companies. A 1982 study (Digital Audio, March 1987) revealed that 90% of people using lower cost software were using illegal copies. Because of DAT's potential for mass copying, DAT recorders could severely hurt the recording industry. In order not to cause such a controversy, Aiwa's recently released machine does not allow direct digital copying of CDs. This still may not be much of a deterrent to copying because the analog output of CD players can still be recorded. These copies are still indistinguishable from the original CD. However, direct digital-to-digital copying from another DAT deck is still possible, which poses the threat of piracy of prerecorded DAT tapes.

DAT OR CD?

One of the advantages of DAT is that commercial duplication can be done quickly and inexpensively. Sony has developed a high-speed duplication process similar to video tape duplication called "contact printing."

The master tape and the blank tape are wound on the duplicating machine and pressed together against the contact-printing drum by means of compressed air so that they touch at one point. Meanwhile a bias head saturates the blank tape with a magnetic field (bias field) to help magnetize the magnetic particles on the tape. The master (original) tape acts like a record head by transferring the musical signal to the blank tape.

Du Pont has engineered an alternate contact-printing method that involves the use of a laser. In place of applying a bias field, Du Pont heats a section of the duplicating tape with a laser, making the magnetic particles assume the properties of the master tape. After cooling, the duplicated tape keeps these magnetic properties intact.

Due to the duplication process of DAT, prerecorded music on DAT should be much cheaper than CDs and also in greater supply since it can duplicated much more quickly. DAT also is capable of a playing time of up to 2 hours as compared to the CD's 74 minutes, 33 seconds. DAT can also hold more data than a CD, packing 114 megabits per square inch, equivalent to the data capacity of 39 IBM standard floppy diskettes!

S. M. Kiess

Compact Disks are the only form of digital audio currently available to American consumers. Their monopoly may soon be crushed.

The biggest drawback to the DAT format, however is its longevity. Because the CD is read by a laser, it never experiences any physical wear and thus can conceivably last forever with moderate care. Digital audio tapes, on the other hand are played through moving parts and will inevitably experience wear and dropouts (loss of data) much like a conventional audio tape. How many times a tape can be played back before it experiences any detrimental effects has not yet been determined. Users could, however, make back-up copies of their prerecorded tapes.

Aiwa president Heitaro Nakajima stated that he would like to offer his DAT machines for sale in Europe and North America but regretted that opposition from copyright laws and record manufacturers prevented such action. It may be some time before the U.S. market sees DAT recorders, but their introduction could compete with the CD format and possibly bring down the high price of CDs.

Even if DAT is introduced with copy protection schemes, the copy protection will eventually get foiled. Furthermore, sampling frequency converters would eventually surface to the consumer market resolving the incompatibility between different sampling frequencies making this type of protection ineffective.

Until DAT's arrival in this country, CDs will still reign as the only available digital format and state of the art in musical reproduction.

David Ling is a senior in Electrical Engineering and an audiophile extrordinaire.

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MIDI
A New Language for Musicians

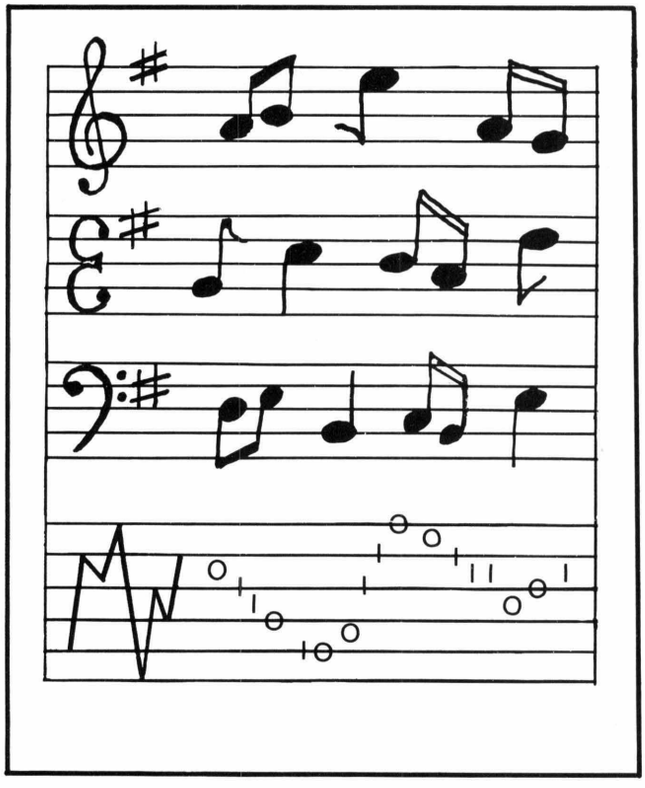
by Martin Gendell

Communication is the name of the game. Without it, we'd be nowhere. Communication takes many forms: a message in a bottle, formulas on a blackboard, or electrons in a wire. We communicate from person to person, person to computer, and even let our computers talk to each other. The next thing they'll be telling me is that keyboards and other musical instruments will soon be chatting away. Well, thanks to MIDI (Musical Instrument Digital Interface) they already are.

Technically speaking, MIDI is an industry standard developed four years ago for communications between computers and microprocessor controlled instruments. What it means to the musician, however, is flexibility! By linking many instruments together, MIDI greatly increases the amount and complexity of music one person can play. With the addition of computers to control a set-up, the possibilities are even greater.

HOW IT WORKS

As the name implies, MIDI communication is digital. Instead of actually recording the sound produced, it records the information about the key that was struck. In this sense, MIDI can be compared to the piano-roll of the old player pianos since only the information that triggers the sounds are actually recorded. Commands are sent in bundles of information. When I strike a key on my keyboard, three numbers (or bytes) are sent out the MIDI port. The first byte says "OK, get ready. A key was just hit." The second byte tells the receiving end exactly which key was hit. Finally, the third byte is the velocity with which the key was struck, which is used to determine volume. When I release the key, the synthesizer sends two more bytes of information. The first being another warning, this time that a key was released. The second byte gives the released key (See Figure 1).



C. M. Van Balen

Note On/Off information isn't the only thing sent by MIDI. Most synthesizers have pitch-bend wheels built-in. MIDI recognizes these, and sends data on how much bending is taking place. Other MIDI transmitted information include sustain, and After Touch. (After Touch is the amount of pressure applied to the keys while they remain pressed.) Through System Exclusive MIDI codes, non-standard information unique to a particular synthesizer can be sent via MIDI.

COMPUTER ACCOMPANIMENT

Musicians often store the sequence of MIDI data. This is very useful when a song calls for more parts than one person is capable of playing. The musician simply records the overflow of music into a sequencer. The sequencer can then play the recorded part while the musician plays another part live. With a good sequencer and a few synthesizers, one person can literally play an entire symphony from a single keyboard.

Sequencers have traditionally been stand-alone hardware units, but more and more people are beginning to use software written on micro computers to perform this task. This allows considerably more flexibility. Notes can either be recorded in realtime (like recording on a tape) or entered one at a time. Since MIDI data is purely numerical, it can be manipulated like any other set of numbers. Playing notes backwards, at twice or half the speed, or transposed to different keys are just a few of the options current sequencing software offers.

MIDI supports up to 16 channels of communication. A device can receive on all channels, or on only one. The latter allows the musician to individually direct what each instrument will play. This way, the drums don't play the piano part, and vice versa. Sixteen channels don't mean sixteen individual lines. Bytes are sent serially on a cable. The second four bits of the first byte in every command contain the channel number. The first thing a device does when it receives MIDI information is check those four bits. If programmed to use data received on that particular channel, it does. Otherwise, it is ignored.

For example, say I set up a sequencer to transmit the violin part of a song over channel 0 and the piano part over channel 1. I would set the synth playing the violin part to receive only on channel 0. Another synth, set up to sound like a piano, would perform commands received only on channel 1.

INTERFACING OTHER INSTRUMENTS

Keyboards aren't the only MIDI-equipped instruments. Guitar-to-MIDI converters are available, allowing you to play any MIDI equipped synthesizer from the strings of your guitar. MIDI devices are also available for wind and percussion instruments. Also, some totally new instruments have been developed as a result of MIDI, such as Airdrums, which are gesture sensing wands. These hand-held tubes can generate MIDI codes depending on how they are shaken or moved. Other, more bizarre instruments are destined to be developed. Who knows, perhaps the term "Musical Chairs" will take on a whole new meaning! Processing boxes are also available. Their functions vary from combining MIDI signals from more than one source, to generating digital reverb.

Although MIDI is still fairly new, it has made an enormous impact on the electronic music industry. The amount of equipment and universal industry acceptance shows that while the realization of MIDI's full potential has not yet been reached, it is not far off. The ingenuity and creativity of both engineers and musicians will see to it.

Martin Gendell is a senior in Electrical Engineering and an accomplished musician.

A. W. Moore

They still sound great, but Steinways are tough on roadies.

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To Beat or Not To Beat

by Karen Koger

Modern electronic drum machines, the newest breakthrough in electronic instruments, can produce sounds identical to those made by acoustic drum kits. Many popular artists have used partial or wholly machine-made rhythm tracks like those in "Wild Boys" by Duran Duran and in "Dress You Up" by Madonna. Other groups, such as the Human League, use a drum machine as the basis for their sound.

The first major electronic drum machines that hit the market were push-button and looked somewhat like miniature synthesizers. One of the least expensive is the Roland DR-55 for $200. It has the capability for snare, bass, hi-hat, and rim shot sounds and can send a trigger pulse to another machine. One of the most expensive is the Linn Drum for $3000. This machine can imitate the sounds of a snare, a bass, tom-toms, hi-hat, cymbals, claps, congas, a tambourine, a cow bell, and a kabasa. The Linn Drum can be triggered by external sources and can trigger other machines. Also, additional computer chips with new or different sounds are available from the manufacturer.

These push-button machines provide several advantages to professionals in the recording business. Machines are not bound by human limitations (like having only two hands and two feet with which to play). Therefore, they can handle a rhythm pattern as fast and as complicated as the composer can imagine and never miss a beat. Electronic drum machines cost more than acoustic drum kits, but they are more economical in the long run because, unlike human drummers, they do not charge for their time and will play as long as desired. Some composers do all their preproduction work in their homes or offices, saving time and money because no rehearsal room or musicians are needed. They can try out new ideas quickly and easily. Drum machines also provide a good drum sound regardless of the quality of the studio. All of this allows musicians to spend valuable studio time recording instead of experimenting.

Roadies appreciate push-button machines because they are easy to unload, set up, and pack. Also, tuning is not required and there are no heads to change.

However, these machines do not satisfy traditional drummers. They want to use sticks and play on five-piece kits in order to feel like legitimate drummers. When electronic drums in conventional configurations finally arrived, they were viewed as either a fad or the future of drums. Most people, however, thought that electronic drum components should be combined with conventional elements to enhance, but not abolish, the sound of the traditional drummer. One way to combine acoustic and electrical elements is through the use of add-ons. For example, external microphones or triggers can be attached to a drum head to send an acoustic signal to an electronic sound generator. The Digisound by MTI ($200-$400), a single-voice unit designed to be triggered by acoustic drums, can produce sounds such as snare, bass, tom-tom, cymbals, percussive effects, and human voices. The E-drum from E-mu Systems ($400) is a pad-type unit with pitch, sensitivity, tone, and decay adjustments. The E-drum uses user-changeable digital voice cards which are available for $60 each.

A wide variety of electronic drum kits are available that are designed to be used as complete instruments. Tama's Techstar ($1300), a five-piece kit that includes snare, bass, and three tom-tom pads with analog voices, features a rack-mountable voice module and tensionable, changeable playing surfaces. The snare drum has a separate channel for rim shots and a raised lip off the snare pad for triggering it. The Simmons SDS8 ($1550) also has five pads (snare, bass, three tom-toms) with softened playing surfaces. This unit includes a five-channel, non-expandable brain with many different sounds in memory. The Simmons SDS7 ($4300) includes the same five pads and five sound modules. The SDS7 has a twelve-channel, expandable brain with analog and digital memories. Each channel has space for programming and storing up to 100 preset sounds.

Many different accessories are now available for electronic drum kits. Digital samplers allow musicians to fill memory chips with their own sounds to be used as sound sources in a systems brain. Sampling can be done using a microphone or line source to store any acoustic or electronic sound. Dynacord manufactures a pad-triggered sampler, the Percuter. The Simmons SDS EPB sampler ($800) is designed to be compatible with the SDS7.

Dynacord also produces some other products for the Percuter drum computer. The Big Brain digital sequencer offers real-time (single-step) and dynamic programming with extensive memory capacity. The Boomer digital sound programmer allows the musician to record and store any live sound on a chip which plugs into the Percuter. The Digital Hit sound module stores a natural sound which can be accessed via a pad, trigger, microphone, or push-button. Dynacord also manufactures small trigger microphones and digital hexagonal pads.

These electronic drum kits have several advantages over their acoustic ancestors. On many units, pitch, volume, and playing surfaces can be adjusted easily; therefore, many

different sounds are available with relatively few pieces of equipment. Also, adjusting the sound electronically takes much less time than changing a drum head. The musician can store his original electronic sounds for later use or purchase prerecorded sounds. Combining acoustic drums and electrical elements produces a clear, hybrid drum sound.

However, the price of electronic equipment is often a disadvantage, especially for nonprofessional musicians. Also, electronic parts are not as easily replaced as are drum heads or other acoustic equipment.

For better or for worse, electronic drum machines and other electronic instruments are affecting musicians and modern music. Some drummers may lose work because of these machines, but machines are only as good as the people who program them and often the best programmers are drummers. Drum machine programmers are considered the new studio specialists. The work of a programmer is mostly technical, so he does not have to be a good musician to be able to make good music. Another interesting effect on musicians are memory chips of a particular artist's sound that are often sold without the artist's knowledge or consent. One of the best-selling chips contains the sound of the late John Bonham of Led Zeppelin. The question of whether or not this is violation of copyright laws has not yet been resolved.

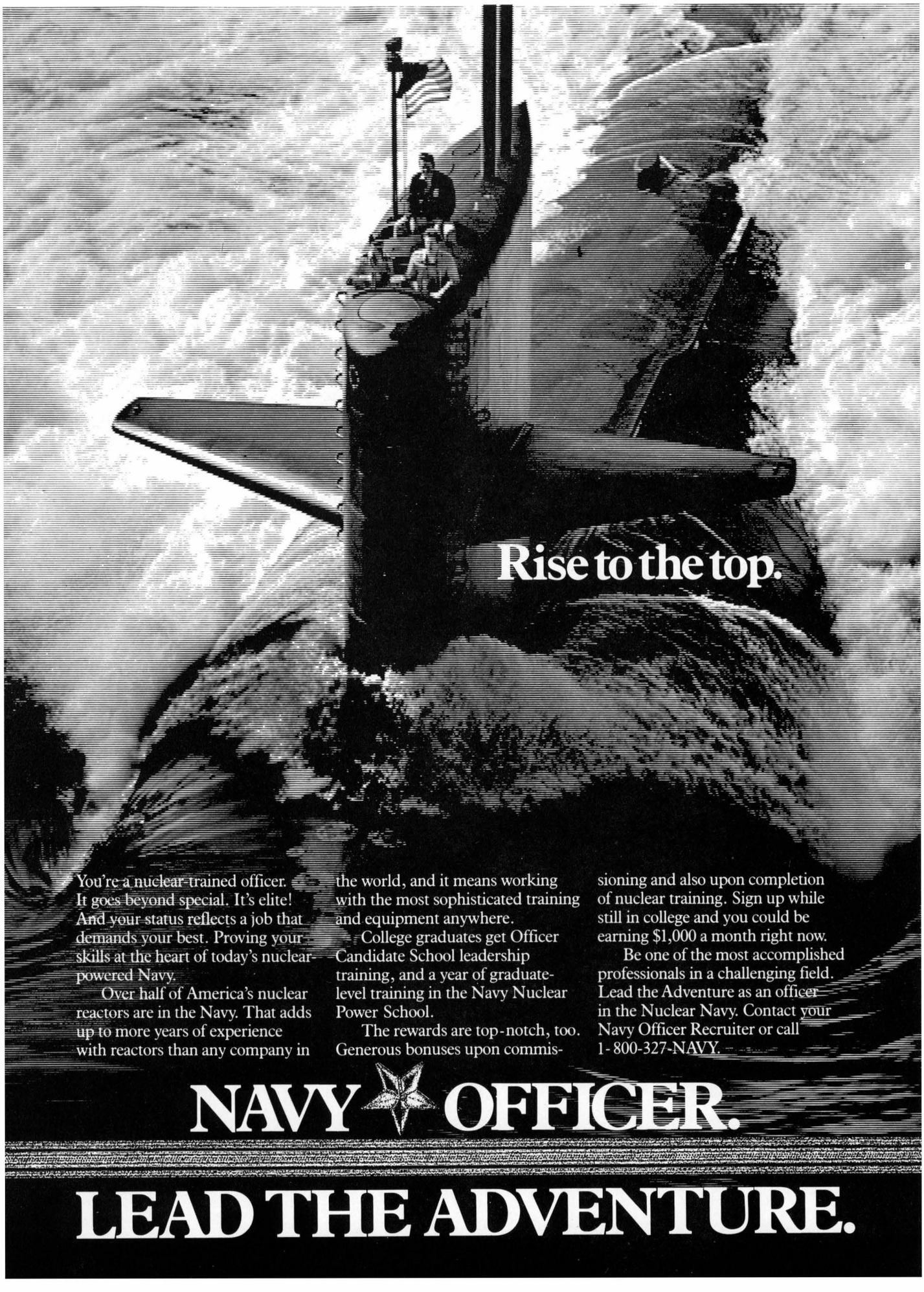
Electronic drum machines have had a different effect on live musicians than on studio musicians. Live musicians may find themselves in the position of having to reproduce a sound on stage that a machine made in the studio. Sometimes this is not possible, so the drum machine is programmed to play during the concert. This forces drummers to follow a predetermined tempo, instead of keeping the tempo themselves during the show. No spontaneity is allowed and drummers cannot adjust the tempo according to the reaction from the crowd. However, live musicians have no need to worry about being totally replaced by these machines, because people will always like the excitement of live musicians. No matter how well it plays, a computer will never be able to stir up a crowd like Alex Van Halen or Stewart Copeland can.

Electronic drums purify music. The fragility of spontaneous performance is eliminated. Anything that can be played once can be repeated. More complex patterns and rhythms can be used, beyond the limits of human physical ability. All mistakes can be erased. Jan Hammer remarks, "It brings music closer to perfect." But who wants perfect music?

Karen Koger is a junior in Mechanical Engineering. She is presently on a co-op assignment with Martin Marietta.

Answers to Trivia Quiz

1. 168 pounds
2. 13 gargoyles
3. 10** 13 laps
4. The group is Boston; the person is Tom Scholz
5. A.E. Fick, 1887
6. Alfred Nobel, 1867
7. Elevators
8. Area
9. Solitude
10. Television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Students Work With Dean to Improve Tech Engineering

by Alex Derr and Myra Wonisch

Would you like to know a bit more about a professor before you take his or her class? Need help with a senior design project? An up-to-date booklet listing research being done by engineering professors would let you see each professor's specialty.

Would you like to increase your software collection for the price of the disks... legally? Tech has many software packages available for students, but most students don't know what these packages are or where to find them. A software dictionary would solve this problem.

The College of Engineering Dean's Committee is working on both of these projects.

Dean's Committee is another thing that makes Virginia Tech engineering unique. It is a group of students who get together to present their ideas and concerns to the dean. Paul E. Torgersen, Dean of the College of Engineering, likes to hear students' concerns face to face.

Surveys, teacher evaluation forms, SGA referendums, and the like are well-meaning, but sometimes personal contact is required to get a feel for what is on the students' minds. Dean Torgersen saves an afternoon several times each quarter to meet with a group of students and discuss issues about the engineering department, curricula, and other activities.

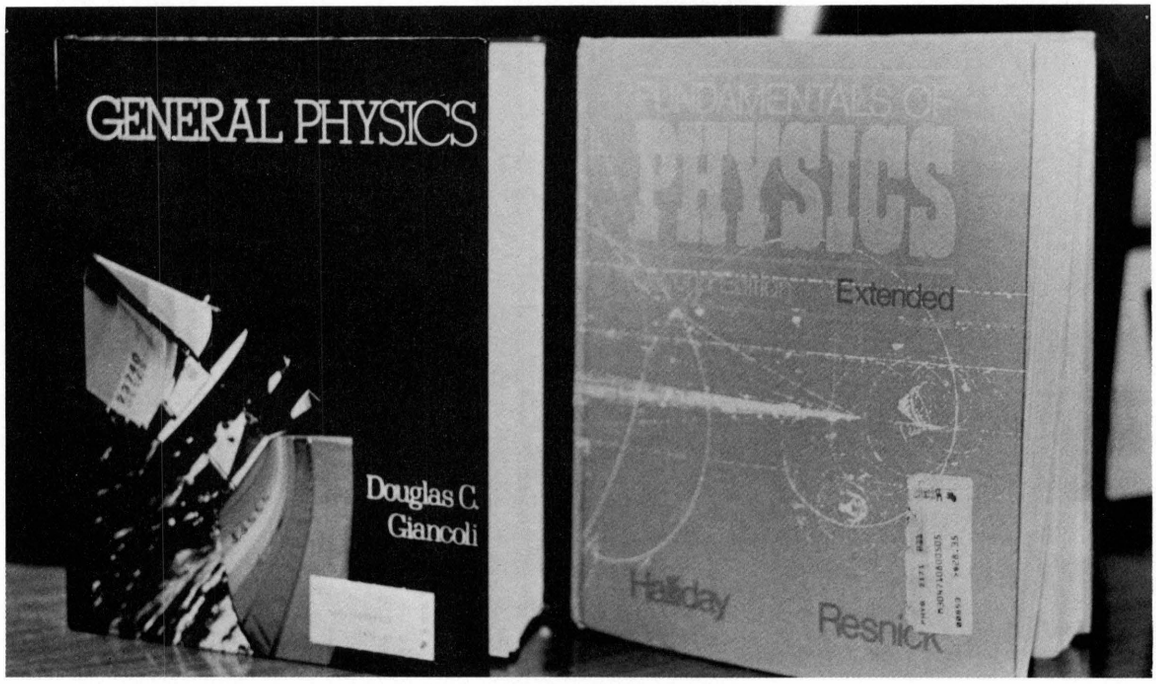
The core of the committee is several members of the Student Engineers' Council (SEC), who represent various engineering departments. Any interested student, however, is welcome to bring in fresh ideas or concerns.

Several years ago, there were complaints among students about the required three quarter physics sequence. The gripes were directed at the professors, the book, and the material. The Dean's Committee surveyed sophomores taking the sequence and documented their grievances in an objective and quantitative fashion. While these problems have not yet been completely solved, students taking Physics 2171,2,3 will be using a new book this year.

Myra Wonisch is a Dean's Committee Chairperson. If you have special concerns you would like to discuss (or would like to see discussed) with Dean Torgersen, call Myra at the SEC office, 961-6036.

Alex Derr just returned from the wilds of New Hampshire and once again traded in his machete for a calculator. This time, the trade is permanent. Alex will be graduating in Mechanical Engineering this year and would appreciate a good job offer.

Myra Wonisch is a senior in Industrial Engineering and has been co-oping with Science Applications International Corporation in McLean, Virginia.



A. W. Moore

A new physics book (left) was a top priority of Dean's Committee.

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Sixty Years Ago

Editor's Note: This poem appeared in the November, 1927 issue of The Virginia Tech Engineer.

The Engineer

Robert Isham Randolph
President Chicago Chapter, A.A.E.

If you can swing an axe, or wield a brush-hook,
  Or drive a stake, or drag a chain all day;
If you can scribble "figgers" in a note-book
  Or shoot a range-pole half a mile away;
If you can sight a transit or a level,
  Or move a target up and down a rod;
If you fear neither man nor devil,
  And know yourself and trust the living God;
If you can wade a swamp or swim a river,
  Nor fear the deeps nor yet the dizzy heights;
If you can stand the cold without a shiver,
  And take Higgin's ink to bed with you at nights;
If you can turn a thumb-screw with your fingers,
  When every digit's like a frozen thumb;
If you can work as long as daylight lingers,
  And not complain nor think you're going some;
If you can sight through tropic heat's refraction,
  Or toil all day beneath a blistering sun;
If you can find a sort of satisfaction,
  In knowing that you've got a job well done;
If your calculus and "descrip" are forgotten,
  And your algebra just serves you fairly well;
If your drafting and your lettering are rotten,
  And your Trautwine's always handy by to tell;
If you can close a traverse without fudgin',
  Or check a line of levels by a foot;
If you can set a slope stake just by judgin',
  And never kick a tripod with your boot;
If you can run a line where you are told,
  And make it stay somewhere on the map;
If you can read your notes when they are cold,
  And know that contours mustn't lap;
If you can line a truss or tap a rivet,
  Or make a surly foreman come across;
If you can take an order as well as give it,
  And not have secret pity for the Boss;
If you can climb a stool and not feel lowly,
  Nor have your head turned by a swivel chair;
If you can always reach your judgments slowly,
  And make your rulings always just and fair;
If you can give yourself and all that's in you,
  And make the others give their own best, too;
If you can handle men of brawn and sinew,
  And like the men and make them like you, too;
If you can boast a college education,
  Or, if you've got a sheepskin, can forget;
If you get a living wage for compensation,
  And give a little more than what you get;
If you can meet with triumph and disaster,
  And treat them without favor nor with fear,
You'll be a man — and you'll be your own master —
  But what is more — YOU'LL BE AN ENGINEER.

— Unifruitco.

CO-OPING

What It Is and How It Can Help You

by Stephen Dalton

Every year thousands of college seniors begin the arduous task of searching for employment. Suits are neatly pressed, references are gathered, and resumes are neatly typed in preparation for the interviewing process. A great variety of questions are asked during an interview, but when examined closely we find the majority of the questions are aimed at finding the answer to the all-important question, "What can you offer your employer?"

It's never too early to think about this question, but it can be too late. Employers take into account various things when interviewing students and checking their credentials. They consider the grade point averages (GPA), student organization and activity involvement, and past job experience.

Many students hope their grades will get them the job they want. Student activities also improve your resume, but they still do not show a prospective employer how well you can apply what you have learned in college.

S. M. Kiess

Have more questions about Co-oping? Stop by the Co-operative Education Office, 252 Henderson.

A strong selling point for any job-hunting engineer is on-the-job experience. Some employers prefer students who have had experience in the field over those with higher grades but no experience. Also, people with prior experience often start at higher salaries and are promoted more quickly. Cooperative education is an excellent way to gain this experience.

Many students have trouble raising money for tuition every quarter. If they do not qualify for financial aid or student loans, it can be very difficult to meet the educational costs. Salaries vary greatly among co-op jobs, but most jobs can help finance your education and leave you with some pocket money as well.

While on the job you will apply and gain appreciation for some of the things you are learning in school. You will work with experienced people in your field, usually performing the same tasks demanded of them. Your work may even precede your courses and help you get better grades.

Co-oping is an excellent opportunity to find where your interests lie and make sure you have made the right career choice. Some co-op students have changed career goals or even their entire field of study after gaining experience in the field. Most enjoy the experience, however, and many return

to their place of employment as permanent employees upon graduation.

Co-oping, however, is not without its drawbacks. It is virtually impossible to work on a co-op job and go to school full-time. The co-op program at Virginia Tech requires students to work full-time for six months of the year and attend school full-time for the other six months. Most co-oping assignments stretch the sophomore and junior years to three years, thus requiring an extra year to graduate.

DOES CO-OPING AFFECT GRADES?

Some students say they are neither at work nor at school long enough to grow weary of either, and their grades benefit for this reason. Other students say they grow accustomed to their work regimen and lose their study habits. How co-oping would affect your grades depends on your academic endurance and personal style.

WHERE CAN YOU FIND A CO-OP JOB?

The place to begin your search for a co-op job is at the Cooperative Education Office in 252 Henderson Hall. There you will find lists of employers who wish to hire co-op students, their locations, and GPA requirements. Notebooks contain information about the employers and reports from previous co-op students on their experiences with each company.

If the co-op office does not already deal with a company you would like to co-op with, you may do your own co-op job search. If you live in or close to an urban area, you are probably surrounded by opportunities. Visit factories, businesses, and consulting firms, and ask the personnel directors about co-op opportunities. If you live in a rural, agricultural area, and your field of study is related to agriculture, you may also find opportunities in your own area.

Many co-op students, however, are unable or do not wish to live at home. This can take a chunk out of your salary, but co-oping should still be profitable.

REQUIREMENTS OF A CO-OP STUDENT

As when applying for permanent employment, there is usually competition when applying for co-op jobs. Grades and interviewing skills are most important. Some employers require a minimum GPA to be eligible for a co-op position. Some of these restrictions are not strictly upheld if the interviewer likes what he/she sees in you. Virginia Tech requires a minimum GPA of 2.0 (2.5 for engineering students) for students to be eligible for co-op positions. Students must complete at least two quarters of study at Virginia Tech before beginning a co-op work assignment.

For more information, call the co-op office at 961-6491, or stop be 252 Henderson Hall.

Stephen Dalton is a junior in Industrial Engineering.

Trivia Quiz

1. If Lt. Montgomery Scott, *USS Enterprise,* weighs 12 stones, how many pounds does he weigh?
2. How many gargoyles are there on the Tech campus?
3. How many laps around the drill field equal one light year?
4. What rock group was master-minded by an MIT graduate with a master's degree in mechanical engineering? Who is this person?
5. Who invented contact lenses and when?
6. Who invented dynamite and when?
7. What is the most-used means of transportation of people on their way to work?
8. What does a planimeter measure?
9. What is the oldest building on campus?
10. What did Vladimir Kosma Zworykin patent in 1928?

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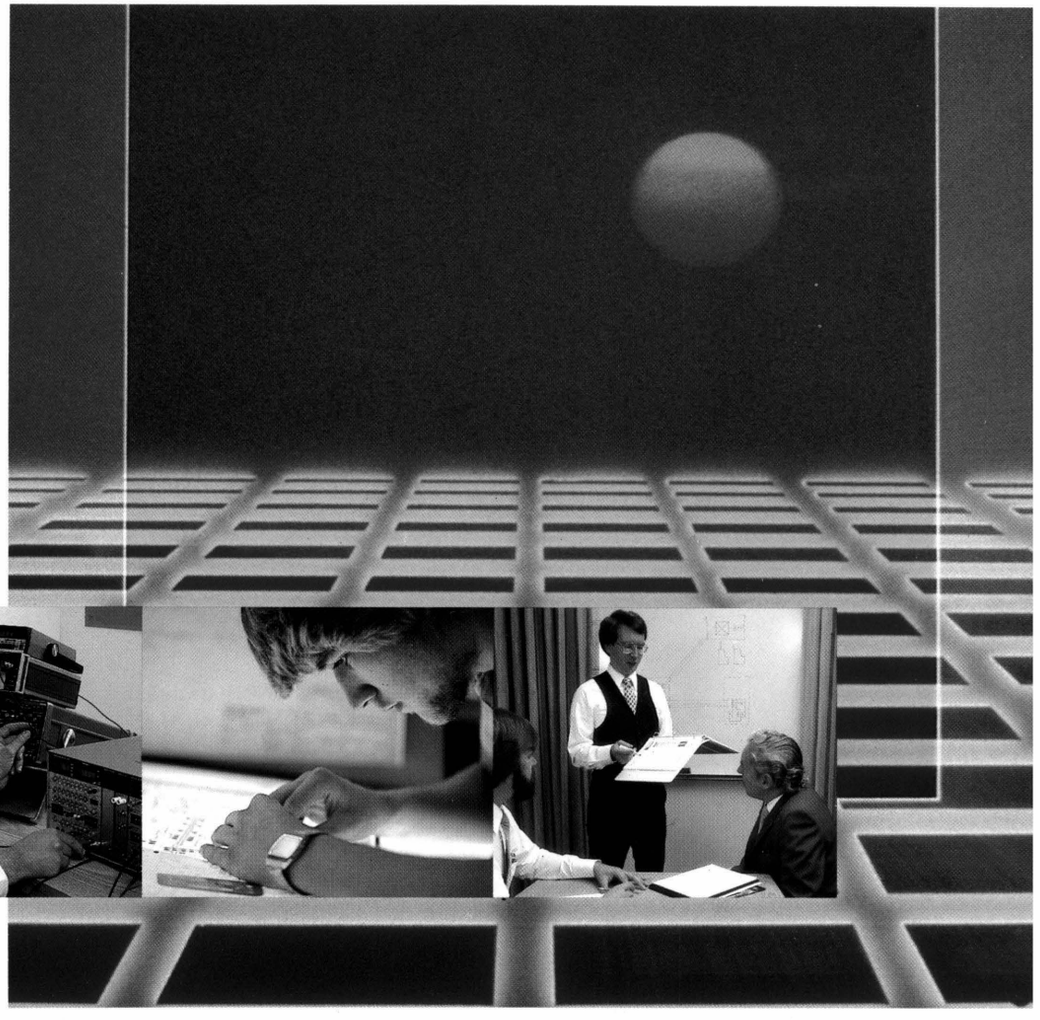

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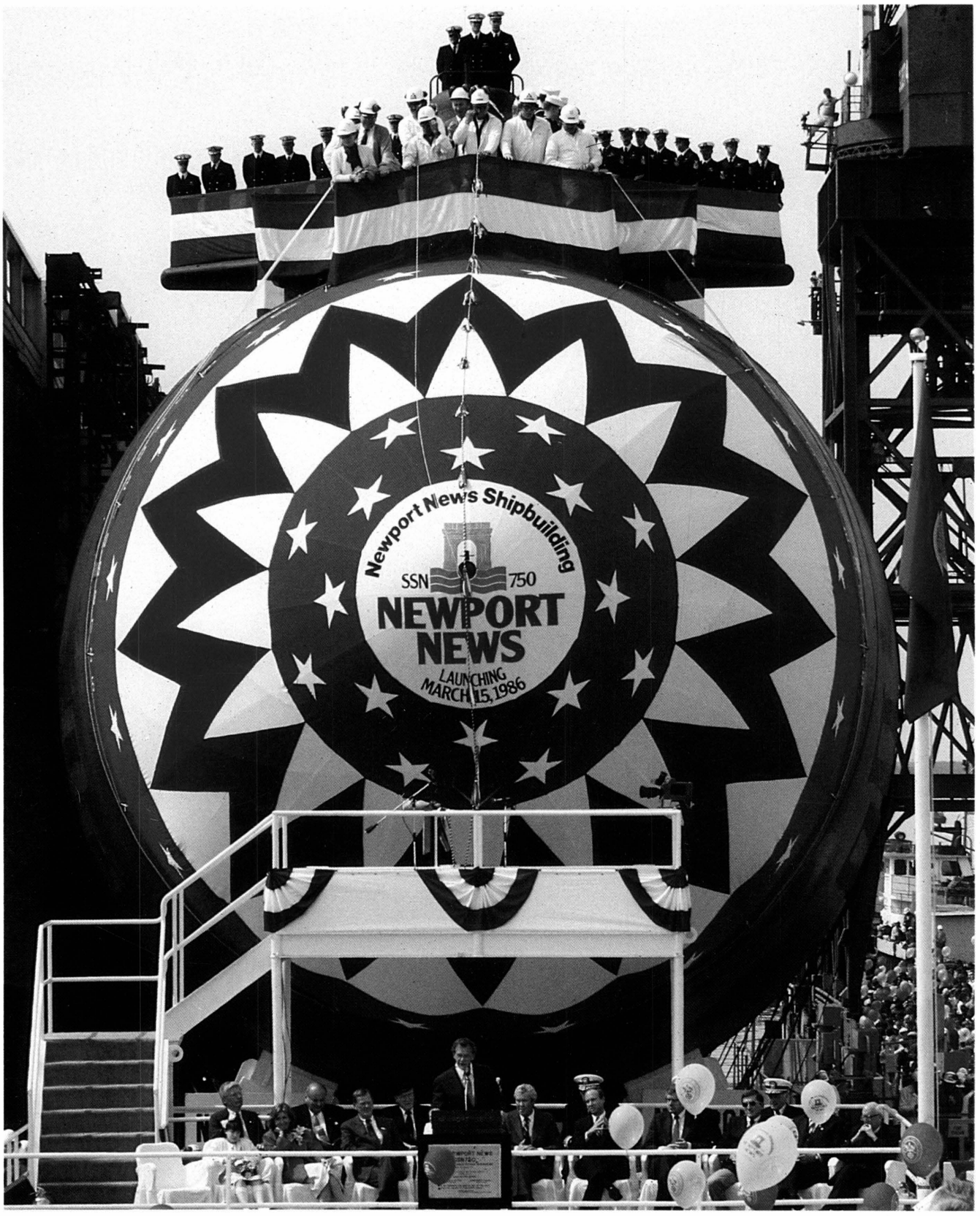

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