nri journal

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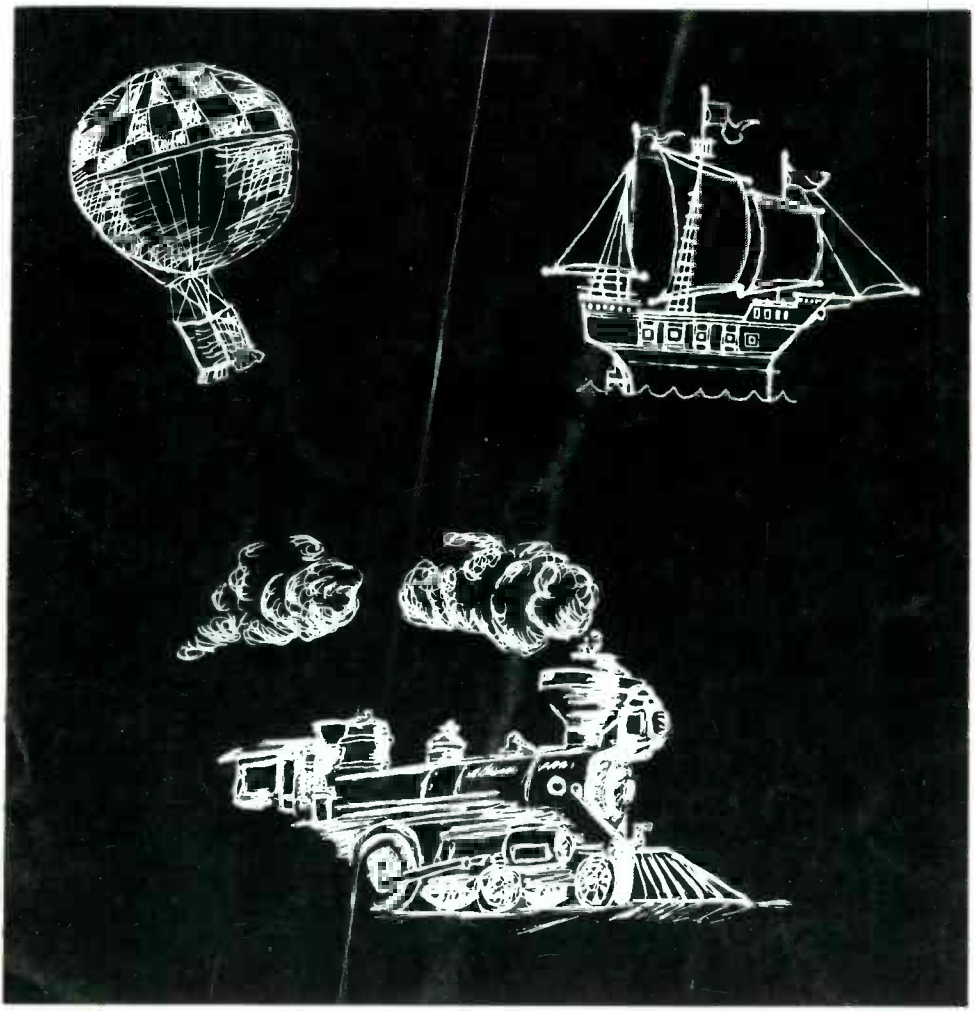

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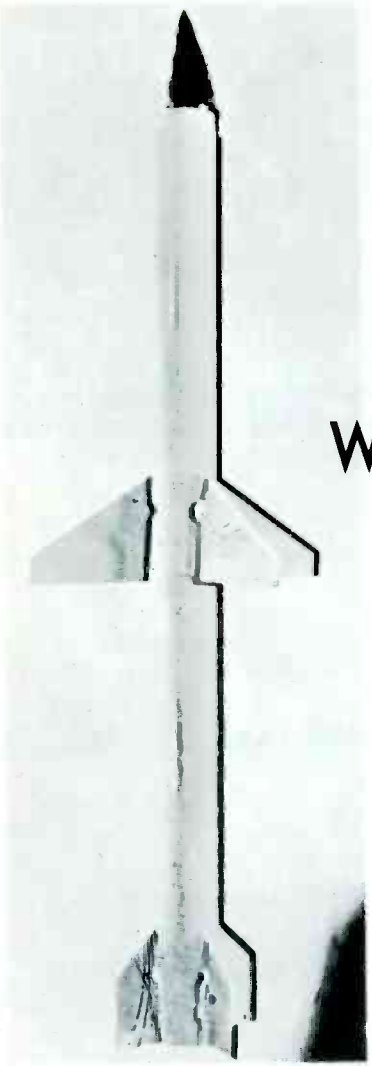


Widening Horizons For Electronics

MAINTAINING A MILLION MILES OF MICROWAVE

Story Courtesy GENERAL ELECTRIC

LYNCHBURG, Va.---Few communications projects in the world have the size and scope of the Southern Railway System's microwave communications network leased by Southern from Citico Realty, and built by General Electric's Communication Products Department here. The Southern Railway system roughly approximates a giant X crossing southeastern U. S. A. over a 10-state area. Its main leg stretches 1,260 miles, from Washington, D. C. to New Orleans; its next longest leg starts at Cincinnati and ends in Jacksonville, Fla., about 1,050 miles away.

The crossover point of the X is Atlanta, Ga., which is the nerve center for the million miles of microwave installed over the Southern system. A million miles sounds like a lot. It is, when you consider the fact that all of the railroads in the entire country comprise only a few hundred thousand miles of tracks. The million figure, though, is accurate---it is the total number of channel miles, 3,774 path miles with 4,256 channel ends.

When Southern's own communications engineers and GE telecommunications system planners began their joint efforts on devising the network, it was recognized that unique problems were bound to be encountered in the operation of final facilities, and that a comprehensive maintenance plan would be required to meet operational criteria. Equipment characteristics, functions, and user requirements were different than anything that had been tackled in a combined system before.

In addition to the backbone of microwave and multiplex equipment, subsystems were involved, linking together Southern's multi-state operations. VHF train communications, hot-box monitoring circuits, centralized traffic control, dial trunks, subscriber phone circuits, 240 kc wideband video and long-distance xerography for high-speed transmission---all had to be tied into the microwave document. And all of this equipment, plus 20 private automatic telephone exchanges, antennas, buildings, towers, batteries, chargers, generators, and air-conditioners come under maintenance.

A great variation in terrain and climate exists over the huge area covered. Near New Orleans and Jacksonville, for example, high temperature, humidity, and salt air, complicated by an occasional below-sea level site or the wind and flood waters from the hurricane season, combine to make air-conditioning and humidity control major problems. The Okefenokee Swamp provides a picturesque backdrop, but the maintenance man on a periodic visit there is more interested in avoiding cottonmouths than he is in admiring the view. At the northern end of the X, microwave stations are

Photos by Hugh D. Coyle, Jr. unless otherwise specified

perched on mountaintops that exceed 3,700 feet in altitude. Snow, ice, and subzero temperatures make the going rough in the winter, and temperatures in the high nineties in the summer are another type of strain on man and equipment.

Because the communications system is so vital to the operation of the railroad, and because a failure of essential circuits may affect public safety, Southern's operating and maintenance requirements are very strict indeed.

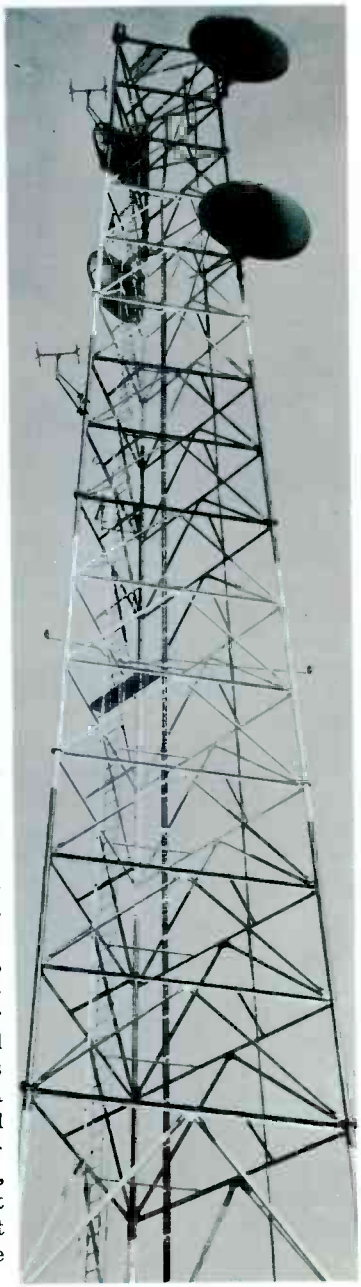
Atlanta is the Operation and Net Control Center, as well as the largest site in terms of equipment, and the point from which all maintenance personnel are dispatched. Its selection as the control center was natural: More than 90% of the telemetering channels and all LDX circuits terminate there; it has the largest number of channel ends; master interrogators for alarms systems are located there; hot-box monitoring and communications for all VHF base stations are from there.

Control is constant, with the center manned on a 24-hour-a-day basis, and malfunctions are quickly taken care of. Alarm tones transmitted over microwave signal the center of any interruption of the line; the dispatcher is then able to pinpoint the source of the trouble and to alert area maintenance men immediately. Idle noise recorders as well continually feel the pulse of the entire system by monitoring signal-to-noise ratio on selected voice channels looped over each major section.

The GE microwave maintenance divisions closely parallel Southern Railway's operating divisions and organization. Under a manager headquartered in Atlanta are Eastern and Western division supervisors; each division has approximately 110 stations, which typically are staffed by six senior product service representatives, 18 product service representatives, and a plant facility specialist. All are trained and experienced in the maintenance of microwave RF, multiplex, VHF communications, telephone, data and logic circuitry, and transistor techniques; in addition they must have a thorough knowledge of the complex Southern Railway telecommunications system and a First or Second Class FCC radiotelephone license.

Each GE representative is given prime responsibility for maintenance of from four to eight stations, plus standby coverage of adjoining maintenance sectors for emergency service. Field personnel, on duty or standby, must keep the Net Control Dispatcher advised of their whereabouts at all times. Each field man is furnished with a maintenance vehicle equipped with a GE VHF mobile radio on the railway's frequencies, and able to reach other stations in the system via microwave. Four-wheel drive station wagons, fully equipped, are supplied for areas where travel may be difficult due to poor roads or weather. Special items of test equipment, parts, and modules are quickly available from depots throughout the system.

Preventive maintenance is performed at all stations



Courtesy General Electric

on a monthly basis, including inspections of such items as RF meter readings, traveling wave tube optimization, functional and operational circuit tests, building and plant facility checks. A six-month check adds inspection of VHF base station routines, fault-sensing circuit adjustment, RF linearization and deviation, multiplex interconnect level, and replacement of tower lights. A yearly check adds to the preceding generator maintenance, air-filter replacement and building maintenance (commonly known as spring cleaning).

The comprehensive maintenance program, coupled with adequate system design, has shown that total system availability can be achieved 99.85% of the time. The Southern Railway system has proved that a large scale microwave system requires not only first-rate equipment, but also a well conceived maintenance plan if total system reliability is to endure. As industry increasingly turns to total, coordinated communications systems, the maintenance factor will become even more important than it has in the past.

Courtesy General Electric

NYC TRACKS TURN TO TECHNOLOGY

The great American author Thomas Wolfe loved railroads and in his own peculiar form of prose-poetry sang in exulting phrases of the lonely romance of railroading. No one ever wrote of them better, for Wolfe described in detail all of the sights, sounds and smells of the trains. To him the trains represented an escape from the hills of his native South Carolina and his feelings toward them were, while introspective, larger than the man himself--even larger than the trains.

Since the thirties, perhaps by and large the boyish dreams of the glamor of railroading have evaporated with the sad demise of the iron horse, which gave off great puffs of steam and smoke and whose shrill, lonely whistle in the night awakened within Wolfe the feeling of a lost wanderer.

But now railroading has entered the age of electronics and the computer--the age of a new kind of competitive bigness, where efficiency can make the difference between black and red ink. The railroads are concerned now with the movement of freight more than passengers and, as the economy of the nation expands, the movement of goods in an ever increasing volume has mandated a more sophisticated approach to record keeping and customer relations.

In the vanguard of progressive railroads who have turned to technology to solve complicated problems is the New York Central Railroad, which nine years ago opened a technical center in Cleveland, Ohio. The center stands in the shadow of the locomotive maintenance backshop. In its brief history it has come up with such railroading refinements as a direct reading spectrometer which examines samples of oil from locomotives and diagnoses the health of the engine from the standpoint of wear.

Also developed at Cleveland were a jet engine snow remover, the "Gamma Densometer" or tie checker, a laminated switch heater, fluid amplifiers which eliminate an engine's complex of electrical and mechanical parts, a solid state signal system, sonic analysis of railhead metal to detect separating of the metal, and an ultrasonic alertness monitor to protect against emergencies arising from illness or incapacitation of the engineer. (A pre-electronic device, "Dead Man's Button", used to do it.)

The New York Central's Transportation Computer Center in New York City maintains a constant record of 125,000 freight cars through the system's 10,000 miles of track. Placed in service in 1963, the center performs customer freight car tracing, car distribution and car utilization functions. Reporting messages originate at 234

points along the Central's right of way. Each time a freight train enters or leaves a yard, all data is transmitted via teletype to "Data Central," the company's automatic electronic communications system. Automatically processed into magnetic tape and punch card data, these messages are fed into the computer. The first transportation computer was developed by the New York Central, and it is the first to operate on a "real time" basis in which the handling of information parallels the physical transaction. In other words, the computer reacts within its physical environment.

Along with the computer center, the Central now uses computer-fed television sets to provide instantaneous freight car information--the world's first commercial use of television to display both words and numbers supplied by computers. Five such units now are in service.

Also tied in is the Central's "Data Central," which handles ten million characters a day--a greater volume of information than any other industrial communications network in the world. Data Central ties together 57,764 miles of circuits for relaying messages from station to station.

Transmission of messages and information is further speeded by "Intercoupler," developed by the New York Central to eliminate human error during data transmission and cut in half the time needed for business machine communication. First installed in 1964, Intercoupler automatically translates data from punch card to teletype and from teletype to punch card, eliminating time-consuming manual code conversions before and after each teletype transmission.

Recently the NYC announced the imminence of its latest customer service aid, "Com Call," a milestone in the railroad's progress toward cybernetic railroading. (We doubt Wolfe's romatic nature would approve of this development.) The system is a unique combination of computer and communications, which enables the computer to telephone a customer and deliver a verbal report on the customer's cars.

Step-by-step, here's how Com Call operates:

1. If a shipment is delayed, computer recognizes report from field and extracts patron name, car location, reason for delay and estimated length of delay.
2. Computer looks up patron's telephone number and determines the hours the patron's office is open.
3. Computer dials customer telephone number as soon as customer's office is open. Dialing is done through an automatic calling unit.
4. Customer picks up phone and computer receives a "phone answered" signal.
5. Computer transmits a 1.5-second tone to the customer.
6. Within five seconds, customer identifies himself to computer by keying a few digits on his touch-tone phone or on a key pad next to his rotary dial phone.
7. Computer delivers verbal report on freight car's status.
8. At end of report there is a five-second delay prior to disconnect. During this time, customer can order a repeat of the message.
9. When the freight car is again on its way, the computer again calls the customer and advises that the car is on a certain train.

The computer's vocabulary of about 1,500 words is maintained in digitally coded voice storage. When a word is to be spoken, the computer determines which of the 16 possible tones are required to form the sounds needed for the word. These tones then are chained together as they are put on the telephone line.

Although it sounds like a dream of the next century, Com Call will go into operation early next year and leads the layman to thoughts on where the science of communication can take the railroads--or, where the railroads will take the science of communication.

And, although Thomas Wolfe's romantic notion of railroading has gone, it has been replaced with the jet-age romance of advanced technology. No longer are the engineer and firemen two against the world as their locomotive pounds its way along the rails. The computor is always beside them. Story Courtesy NEW YORK CENTRAL

ASTRONOMICAL ADVANCES IN THE AEROSPACE AGE

Developments in air and space aviation are happening so fast it is hard to believe American aviation is only sixty years old. Try to remember the time when the delivery of a dozen eggs made worldwide headlines!

It was exactly 40 years ago, in 1927, when a daring young barnstorming pilot air-expressed a gift box of fresh eggs from California across country to President Calvin Coolidge in Washington, D. C.

But the age has come when Americans are becoming blase about man and materials being delivered to interplanetary destinations millions of miles away. The worry of the "how to get there" has been surpassed by the "what to do there".

The American Astronautical Society has been surveying Foundations of business in space--specifically, for space commerce. "What to Do in Space" investigations include communications, information handling, weather and navigation, oceanography and Earth resources, industrial research and manufacturing, and medical research and application.

"How to Do It" programs cover transportation, social implications, education--even plans for a world university. Management, finance, and space law, as well as a long look at the prospective "Space Entrepreneur", are also slated for investigation.

"Tourism" plans are already underway, and include visions of orbiting inns with views of the entire Earth. Watch for the "Hilton Orbiting Hotel" in the not-so-distant future.

Getting "down to earth", space technology of the near future (1970-1980) will provide those without the "fare or the means to the moon" with easier and more economical earth travel by means of the Navigation Satellite.

The Navigation Satellite is a spacecraft whose mission is to provide "useful" services during movements of manned or unmanned terrestrial based vehicles (ships, aircraft, including the supersonic transport, and other advanced types of intercontinental vehicles such as ground effects machines and hydrofoil boats). A UHF type transponder will be used to provide the voice and data transmission needs. This frequency will provide wider bandwidths, non-interference with existing VHF facilities and high-gain antennas. The transponder will be sized to

handle the thousands of aircraft and ships and innumerable other users that will be equipped to operate the satellite. Solar cells will be used to provide the 500-700 watts of RF power needed for the electrical system. Chemical batteries will be employed for the peak power needs and during the night or solar eclipse.

This satellite will be capable of performing a multitude of practical services to mankind. First, it will provide high accuracy position determination services to craft, to people, and to shore stations. To the advanced thinkers in the shipping field who have been looking to the day of the automated ship with its limited crew, consisting primarily of electronics specialists, the satellite will provide the position information needed to keep the vessel on its preset course. To the traveller it will provide telephone service with the same degree of clarity offered to persons on land.

The combination of these two, position-fixing and communications services, can provide worldwide, all weather, instantaneous service of prime importance. It will mean air traffic control, maritime coordination, and increased efficiency in search and rescue systems.

Of equal importance to the technological innovations of the Navigation Satellite is the possibility that this satellite will usher in a true and workable means for international space coordination in the applications area. It can serve all the nations of the world who have airlines and ships. It can prevent accidents to their craft, and aid in saving lives of all people.

NASA has recently funded the first flight unit of a new scientific spacecraft project aimed at mapping x-ray stellar sources within and outside our galaxy.

The Small Astronomy Satellite-A (SAS-A), planned for launch in 1969, will orbit at about 330 statute miles and will circle the globe once every 96 minutes. Total weight of the flight units will be about 330 pounds, with solar cells and rechargeable batteries supplying about 25 watts of power. The spacecraft can be pointed in any position to survey the entire celestial sphere.

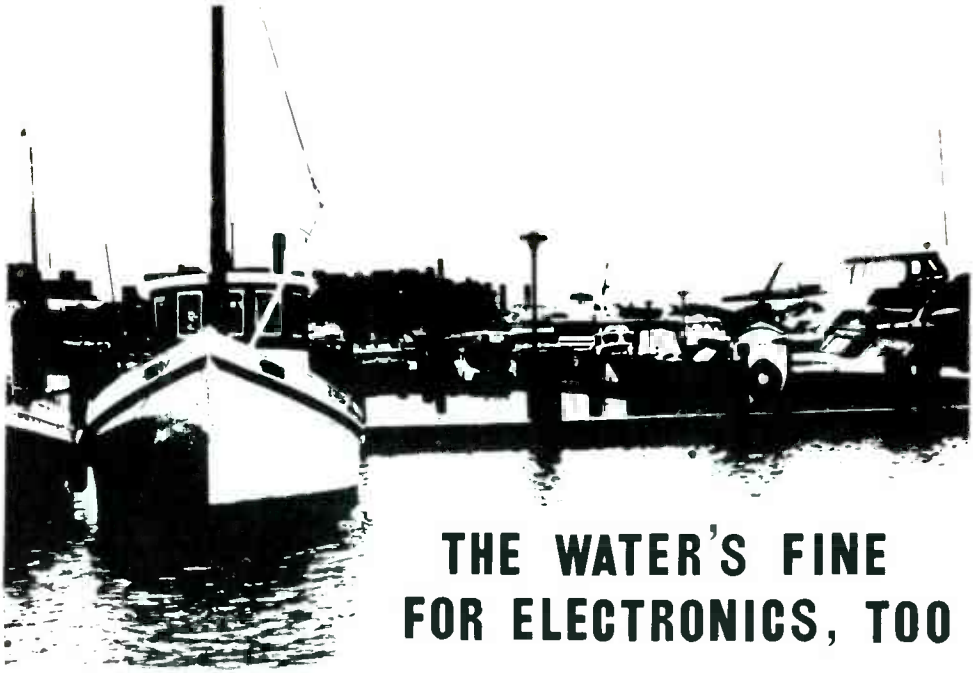
Celestial x-ray energy sources were discovered in 1962. (The constellation Scorpio, for example, emits x-rays at least half as strong as those from the Sun.) SAS-A will measure position, strength, and time variation of all detectable x-ray sources. Later flights may include measurements in the gamma ray, ultraviolet, visible, in infrared regions of the spectrum.

The Space Age also envelops the missile race and consequently the security of this country. The new task of the long-range weapons is the ability to "hit but not be hit".

The Advanced Research Projects Agency (ARPA), Dept. of Defense, is searching for methods of isolating "live" missiles amid hordes of dummy vehicles. Known as ALTAIR (ARPA Long Range Tracking and Instrumentation Radar), the new system was built by Sylvania and will record flight characteristics of projectiles. In effect, the radar will be a powerful "missile autograph collector". If dummy and live missiles perform differently in flight, ALTAIR may be able to spot the difference.

Sylvania has also developed an automatic laser tracker that can pinpoint high-speed rocket sleds traveling at six times the speed of sound. This speed is twice the speed of a bullet fired by a high-powered rifle. A 12" mirror follows the sled at a rate of 360 degrees per second.

A transmitter-receiver projectsa narrow laser beam through the mirror to a reflector on the target. The reflector returns the beam to a sensor, which determines the speed and direction of the rocket sled and automatically aims the mirror at the test vehicle. Recording cameras in the tracking unit view the target through the moving mirror. Although the tracker is manually aligned with the sled, everything is automatic once the rocket is locked onto the target reflector.



THE WATER'S FINE FOR ELECTRONICS, TOO

This summer promises to be no different from previous summers -- vacationers will head for the beaches, the lakes, even that favorite swimming hole for some fun and relaxation. And the electronics industry has recently put some new devices on the market to make that vacation more exciting than ever.

Apelco, a San Francisco firm, has announced an 11-channel VHF marine radio-telephone for both commercial and pleasure boat owners. VHF is being used more frequently in communications gear because of the static-free reception and uncrowded conditions in the VHF band. This new radio has a line-of-sight range: 25 to 35 miles using mast-mounted antenna, or 50 miles using high antenna installations. A typical antenna is less than 2 feet high. Channel 16, installed in the new Apelco Model AF-35M, is used for call, reply, and safety. U. S. Coast Guard ships and stations monitor this channel in all areas. The cost? $595.

Also available from Apelco is a new transistorized depth sounder designed to provide continuous depth reading to 600 feet with a bright flashing light. Designated the MR-203, the instrument also gives instant indication of any underwater objects, such as fish, that may pass between the boat and the bottom. A panel gain control allows precise adjustment for prevailing bottom conditions whether hard, muddy, or sandy. The boat owner can mark the recording at any desired point as an indication of good fishing spots and swimming areas.

If your interests lie under the water as well (and skin diving and treasure troving have caught on like surfing and fishing), why not try a new product from the Radiac Company of Long Island? It's called the NEMO, and it can make your treasure hunt easier than ever. This inexpensive electronic metal detector has been made especially for underwater use, although it works on land as well. The NEMO is ideal for investigating tight places such as shafts, tunnels, crevices, and "crawl" spaces. Who knows -- you could be the one to discover that famous buried treasure of Captain Kidd.

SCIENTISTS SUGGEST LIFE ON JUPITER

Evidence suggests that the building blocks of life (ammonia, methane, and liquid water), and possibly life itself may exist on Jupiter.

Much of the planet Jupiter's behavior is electrical. The planet is like a huge dynamo, with a powerful magnetic field, and much lightning. Also, Jupiter rotates every ten hours, and this rapid change from day to night -- from hot to cold -- is also believed to produce disturbances and electrical discharges in the planet's atmosphere.

NASA scientists have suggested that many of the building blocks of life, and possibly life itself, may exist on Jupiter. In laboratory experiments using a simulated Jupiter atmosphere, there was some evidence that energy transfer and resulting chemical processes in Jupiter's turbulent atmosphere may produce organic chemicals such as the forerunner compounds of amino acids and of the living cell nucleus -- processes similar to those which are believed to have produced life on Earth.

There is much evidence to support the theory that the Earth had an atmosphere of ammonia, methane, and water 4.5 billion years ago. Complex organic molecules may have linked themselves together, in the Earth's primordial oceans, until a molecule able to reproduce itself appeared, marking the origin of life. NASA scientists believe a similar series of events is possible on Jupiter.

The top of Jupiter's atmosphere is believed to contain large amounts of ammonia and methane. Using electrical discharges -- "lightning" -- as an energy source, the NASA researchers found that they could produce various building blocks of living cells by simulating the activity of the top of Jupiter's atmosphere and by using only water to turn the building blocks into even more complex organic molecules.

A similar phenomena occurred when the same procedure was used while simulating Jupiter's lower atmosphere. This layer is thought to be about 1,800 miles below the visible top of the 2,500-mile-deep atmosphere, and to have Earth-like temperatures (0-212° F), allowing the existence of liquid water. When the extreme low temperature of the top of Jupiter's atmosphere (-356° F) was duplicated, complex organic molecules were still produced. Similarly, organic material was produced when Jupiter's extreme atmospheric pressure was simulated.

NASA's laboratory simulations of Jupiter's atmosphere are closely related to earlier primitive Earth experiments in which NASA scientists used an ammonia, methane, and water atmosphere to synthesize the ATP molecule (the energy mechanism for the living cell) and many of the components of DNA (the molecule in each cell which determines cell growth and kind of organism).

the deliberate art of dissonance!

Twenty years ago, when the squeaky sounds emanating from computers were rashly called "music", the perpetrators were laughed at from here to wherever such outre ideas go for awhile. But things as they are, the idea stayed beyond recognizance about as long as a song or fashion stays in mode--a week or two.

Rain, Trains, and Violins

Long enough for the ideas to be played with by people like Pierre Schaeffer, Karlheinz Stockhausen, Vladimir Ussachevsky, and Otto Luening, among others. Schaeffer, for instance, a Paris radio engineer, experimented with "musique concrete", sounds like rain, traffic noises, and violins, and transformed them, by speed and direction changes and editing, into atonal harmony.

On the other hand, Stockhausen, in Germany, tried only electronically generated sounds without natural influence: Columbia professors Ussachevsky and Luening executed a piece for orchestra and tape recorder for the Louisville Symphony.

By the mid-fifties, most of the protagonists had discarded earlier attempts to produce coordinated sounds by the mediums of punched tape, vinyl records, etc. and gone into the use of tape recorders.

Everyone in the Act

Then there began to be more esoteric things like RCA's million-dollar "Synthesizer" (which only one composer, Milton Babbitt of Princeton, was able to master). There was a Columbia-Princeton facility, financed by a $175,000 grant from the Rockefeller Foundation. There was Bell Telephone research and its long-playing records. There were an increasing number of practitioners, a sprouting of studios, including those of some 50 American universities; at least 1500 books and articles and almost 5000 compositions. There were specializations of the genre, such as the work Alvin Lucier is now doing at Brandeis: applying electrodes to the skull to pick up "music" from amplified alpha rhythms of the brain, plus electromagnetic disturbances of the atmosphere.

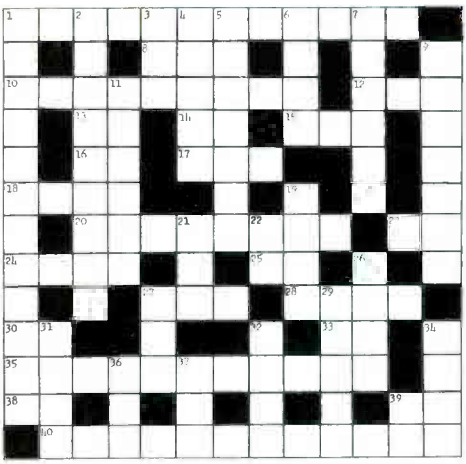
And Karl-Birger Blomdahl's "birdsong" from satellites, etc., Gordon Mumma's effort to record seismic disturbances. There are, at present, competitions for music written for computers; at Control Data Center in Washington, D.C., where at least one computer generates musical sounds to denote errors, computer operators have fun in off-hours by deliberately introducing errors to see what kind of symphonic sounds will develop.

A Pulitzer in Three Days

The culmination of the whole score of efforts came when this year's Pulitzer Prize for music was awarded to Leon Kirchner of Harvard for his "String Quartet No. 3." Kirchner developed his composition in three days, using electronic sounds on tape as background for strings or as another instrument. His medium was the "Buchla Box", a transistorized modular unit of oscillators, filters, and controls, developed by Donald Buchla of the San Francisco Tape Music Center.

With Kirchner's award, where electronic music has been for the last 20 years is apparent: where it is going is as broad and as long as the mind of man, aided by his machines and electronics. One apparent disadvantage exists, apart from the paucity of ears trained to a liking for deliberate dissonance: computer rates, for instance, are something like $600 an hour. Kirchner says that his three day winner would have taken him at least a year to compose-compute by any other method. This particular squeaking wheel needs a whole lot of grease.

ELECTRONICS CROSSWORD PUZZLE



By James R. Kimsey

Word Source: NRI RADIO-TELEVISION ELECTRONICS DICTIONARY

ACROSS

1. What causes an increase in the effective grid-cathode capacitance. (2 wds.)
8. A part used to convert rotary motion to linear motion.
10. A type of clip.
12. Beverage.
13. Two of a kind. (Abbr.)
14. Code for . . -
15. Prefix to indicate two diodes in a tube.
16. Each. (Abbr.)
17. Raw metal.
18. Component.
20. A kind of circuit containing inductance and capacitance.
23. All right.
24. Possessed by a burned-out power transformer.
25. Perform, as work.
27. The practical unit of electric current flow.
28. A kind of bridge.
30. Intermediate frequency. (Abbr.)
33. The unit of apparent power in an ac circuit containing reactance. (Abbr.)
35. The ratio of peak-pulse amplitude to the rms pulse amplitude. (2 wds.)
38. Type of wire. (Abbr.)
39. Afterthought.
40. Corrosion caused by the action of electric current.

DOWN

1. Type of undesired mechanical feedback.
2. The desired value minus the actual value of the loop output signal. (2wds.)
3. A special coupled oscillator. (Abbr.)
4. Common term for a receiving set.
5. Terms applied to one British version of television camera tube.
6. To send signals from one stage to another.
7. Bias which "prevents" plate current flow.
9. A line balance converter.
11. Cavity formed in the positive carbon electrode of an electric arc.
19. TV term for trouble due to a weak signal.
21. Opposite of the unit of conductance.
22. Paid notice. (Abbr.)
26. A wheel with teeth.
27. What TV characters do.
29. A pale yellow color.
31. A kind of electron not closely bound.
32. In radar, the portion of energy of the transmitted pulse which is reflected to a receiver.
34. Energy dissipated without accomplishing useful work.
36. Observe.
37. Obese.
39. Mathematical dessert.

SOLUTION TO CROSSWORD PUZZLE ON PAGE 32.

NOMINATIONS OPEN FOR NATIONAL OFFICES IN NRI ALUMNI ASSOCIATION FOR 1968

The great majority of us look forward to and enjoy the pursuits and activities of summer time. But members of the NRI Alumni Association also have the very pleasant task of honoring five outstanding members as National Officers for the following year. It is time now to begin the election campaign for these five officers -- a President and four Vice-Presidents -- for 1968.

As with all such campaigns, we start by nominating the candidates. We will select two candidates for President and eight for Vice-President. These nominating votes must be delivered to NRI by July 25, where they will be counted and the names of the winning nominees published in the September-October issue of the NRI Journal.

Only NRI Graduates who are members of the Alumni Association may vote and only members are eligible to serve as National Officers.

It is advisable to remind members about the limitations on re-election to these offices as provided in Article VI, Section II of our Constitution, which reads:

"The President shall not be eligible for re-election until after expiration of at least eight years following his last term of office and, further, may be a candidate for Vice-President only after expiration of at least a year following his term of office as President. Vice-Presidents may not serve more than two consecutive terms; when re-elected for a second consecutive term they shall not thereafter be candidates for Vice-President until after expiration of at least three years following their second term of office."

Because of the limitations on 1967 officers, Eugene De Caussin is not eligible to re-election either as President or Vice-President this year and only Harvey Morris is eligible to serve as a National Officer. Members are privileged to nominate whomever they wish, so long as they are members of the Alumni Association. A few members chosen on the basis of geographical location are listed under "Nomination Suggestions." Be sure to get your ballot to NRI by July 25.

NOMINATION SUGGESTIONS

Arthur C. Howard
Gadsden, Ala.
J. M. Warren, Jr.
Montgomery, Ala.
Winfred M. Hurst
Anchorage, Alaska
Alfred T. Hagen
Mesa, Ariz.
Leon Rains
Clifton, Ariz.
Veryl L. Dunn
Hot Springs, Ark.
Carl Werley
Searcy, Ark.
Robert Belew
Los Angeles, Calif.
Jerry Dougherty
Long Beach, Calif.
Peter Salvotti
San Francisco, Calif.
Arthur Ragsdale
San Francisco, Calif.
Phil Stearns
San Francisco, Calif.
Mieton S. Lundsten
Colo. Springs, Colo.
George H, Kettle
Alamosa, Colo.
Jack H. Low
Norwich, Conn.
James B. Shields
Bridgeport, Conn.
Francis H. Schweikert
Newark, Del.
William Daller
Claymont, Del.
J. J. Jenkins
Washington, D.C.
Arthur Will
Washington, D.C.
Alan D. Booton
Orlando, Fla.
Richard W. Osgood
Ocala, Fla.
A. H. Moorehead, Sr.
Atlanta, Ga.
Charlie E. Smith
Griffin, Ga.
Albert Y. C. Long
Honolulu, Hawaii
Edward W. Dorsey
Boise, Idaho
Carl E. Anderson
Coeur d'Alene, Idaho

Erwin Andrews
Batavia, Ill.
Henry Mittermayer
Chicago, Ill.
Walter Gerk
Decatur, Ill.
Vincent F. Azzarello
Alton, Ill.
Kurt M. Giesler
La Porte, Ind.
Dewight D. Smith
South Bend, Ind.
Raymond Hayes
Dubuque, Iowa
Glenn Kilbourn
Waterloo, Iowa
Cecil E. Kidd
Manhattan, Kans.
Joel O. Dillon
Independence, Kans.
Ellis Nance
Madisonville, Ky.
A. W. Johnson
Lexington, Ky.
Robert E. Maker
Metairie, La.
Calvin A. Rome
New Orleans, La.
Allan E. Lumsden
Portland, Maine
Thomas J. McDonough
Scar Boro, Maine
Earl Esque
Hillside, Md.
Aaron Grollman
Baltimore, Md.
Manuel Sousa
Tiverton, Mass.
Joseph Thibeault
Worcester, Mass.
Edward Struzinski
Everett, Mass.
Theodore J. Sobalo
Everett, Mass.
T. Milton Oliver
Harper Woods, Mich.
James J. Kelley
Detroit, Mich.
Stephen J. Avetta
Flint, Mich.
Berl K. Lee
Flint Mich.
H. C. Harmon
Paris, Miss.

Richard B. Harris, Jr.
Jackson, Miss.
E. J. Meyer
St. Louis, Mo.
Albert G. Campbell
St. Louis, Mo.
Elgin McNeill
Big Sandy, Mont.
Willis M. Coffman
Great Falls, Mont.
Valentine Obal
Omaha, Nebr.
Joe Grossart
Wolbach, Nebr.
Richart K. Miller
Reno, Nev.
George R. Squire
Las Vegas, Nev.
George Stylianos
Nashua, N. H.
Donald B. Irish
Concord, N. H.
Fred Pisano
Clifton, N. J.
Walter F. Kwiczola
Clifton, N. J.
William Whitely
Lincoln Park, N.J.
Stephen J. Gilbert
Pennsauken, N. J.
Howard Carlton
Carlsbad, N. Mex.
Billie L. Phillips
Albuquerque, N. Mex.
Samuel Antman
New York, N. Y.
Sylvester N. Carter
New York, N. Y.
Ontie Crowe
New York, N. Y.
Franklin Lucas
New York, N. Y.
Roy DaSilva
New York, N. Y.
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G. L. Kenny
Bismarck, N. Dak.
George R. Knudson
Leeds, N. Dak.
Fred Stieg
Hamilton, Ohio

Leno Leo Laner
Youngstown, Ohio
Virgil I. Turner
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Thomas R. Morrison
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William R. Channer
Portland, Oregon
Wesley E. Waite
Eugene, Oregon
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Howard F. Winner
Sharon, Pa.
Lester Stanton
Hazelton, Pa.
Joseph R. Boston
Middletown, Pa.
R. H. Seip
Morton, Pa.
Valdeman N. Cairrao
Warren, R. I.
Bernard L. Sicotte
Woonsocket, R. I.
Owens E. Davis
Columbia, S. C.
Ansel Orr
Mountain Rest, S. C.
Dale L. Ditzler
Mt. Vernon, S. Dak.
Alvin Hubbard
Clark, S. Dak.
General H. Cook
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Memphis, Tenn.
C. W. Hoffman
San Antonio, Tex.
Thomas B. Love
San Antonio, Tex.
Neldon A. Hanson
Nephi, Utah
Clarence L. Morriss
Ogden, Utah
Lt. Col. David A. Hedges
McLean, Va.
E. R. Hobbs
Petersburg, Va.
James O'Neil
White River Junction, Vt.
Glenn Batman
Windsor, Vt.
Donald L. Wellons
Yakima, Wash.

Eugene Golob
Seattle, Wash.
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Williams Mt., W. Va.
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Oshkosh, Wis.
William S. Berg
Park Falls, Wis.

Einar Ostman
Centennial, Wyo.
R. M. Person
Sheridan, Wyo.
Lawrence Thue
B.C., Canada
Ronald Marsden
Man., Canada
Robert Beange
N. B., Canada

Clifford Fifield
Nfld., Canada
Douglas Mullen
Nova Scotia, Canada
Daniel A. Baker
Ontario, Canada
Cpl. J. M. Vautour
Quebec, Canada

(BALLOT ON PAGE 22)

DIRECTORY OF ALUMNI CHAPTERS

Detroit Chapter meets 8:00 P.M., 2nd Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit. VI-1-4972.

Flint (Saginaw Valley) Chapter meets 8:00 P.M., 2nd Wednesday of each month at shop of Andrew Jobbagy, G-5507 S. Saginaw Rd., Flint. Chairman: Clyde Morrissett, 514 Gorton Ct., Flint. 235-3074.

Hagerstown (Cumberland Valley) Chapter meets 7:30 P.M., 2nd Thursday of each month at George Fulk's Radio-TV Service Shop, Boonsboro, Md. Chairman: Robert McHenry, RR2, Kearneysville, W.Va. 25430.

Los Angeles Chapter meets 8:00 P.M., 2nd and last Saturday of each month, at Chairman Eugene DeCaussin's Radio - TV Shop, 4912 Fountain Ave., L.A.

New Orleans Chapter meets 8:00 P.M., 2nd Tuesday of each month, at Galjour's TV, 809 N. Broad St., New Orleans. Chairman: Herman Blackford, 5301 Tschoupitoulas St., New Orleans.

New York City Chapter meets 8:30 P.M., 1st & 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Place, N.Y.C. Chairman: Samuel Antman, 1669 45th St., Brooklyn.

North Jersey Chapter meets 8:00 P.M., last Friday of each month, Players Club, Washington Square (1/2 block west of Washington & Kearney Avenues), Kearney. Chairman: George Schopmeier, 935-C River Road, New Milford.

Philadelphia-Camden Chapter meets 8:00 P.M., 2nd & 4th Monday of each month, K of C Hall, Tulip & Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Avenue, Philadelphia.

Pittsburgh Chapter meets 8:00 P.M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: Joseph Burnelis, 2268 Whited St., Pittsburgh.

San Antonio (Alamo) Chapter meets 7:00 P.M., 4th Friday of each month, Beethoven Home, 422 Pereida, San Antonio. Chairman: Sam Stinebaugh, 318 Early Trail, San Antonio.

San Francisco Chapter meets 8:00 P.M., 2nd Wednesday of each month, at home of J. Arthur Ragsdale, 1526 27th Ave., San Francisco. Chairman: Isaiah Randolph, 523 Ivy St., San Francisco.

Southeastern Massachusetts Chapter meets 8:00 P.M., last Wednesday of each month at home of John Alves, 57 Allen Blvd., Swansea. Chairman: Walter Adamiec, 109 Taunton St., Middleboro.

Springfield (Mass.) Chapter meets 7:00 P.M., last Saturday of each month at shop of Norman Charest, 74 Redfern Drive, Springfield. Chairman: Joseph Gaze, 68 Worthen St., Springfield.

How to get a charge out of your Battery

New York, N.Y. (ED)--A new era of portable power has dawned. Battery-operated appliances, machines and gadgets are getting a new charge out of life via a mere plug-in.

Through development of the nickel-cadmium rechargeable battery--the atomic age workhorse of portable power--we have been able to cut the cord between our electrical needs and the wall socket. It is revolutionizing everything from televiewing at picnics to women's fashions.

Modern as all this sounds and is, this type of portable power had its beginning almost 70 years ago. That was when an infuriated Thomas A. Edison suffered a minor setback in his laboratory work when a storage battery turned over, spilling its acid contents over important papers.

Lead-acid batteries, the old master decided, were not only troublesome--they were dangerous. Some 50,000 experiments followed (a nine year project), resulting in nickel and iron substitutes for the offending acid and lead.

But the real breakthrough came years later, during wartime. Necessity--that maternal force in the world of innovation--was rearing its head during World War II. German and American scientists were striving to solve the problem of operating heavy equipment in tropical and arctic climates.

When the Allied Intelligence dismantled a downed German fighter plane in France, a unique experimental battery was discovered. It had "sintered" plates in which thin sheets of porous nickel, formed by heating nickel powder, held the active materials for the battery. These produced rugged cells of exceptional power even at sub-zero temperatures. Nickel and cadmium became key elements in new batteries for new uses. When General Curtis LeMay, then head of Strategic Air Command, called for a new method for sending jets aloft faster, on-board nickel-cadmium batteries did the job.

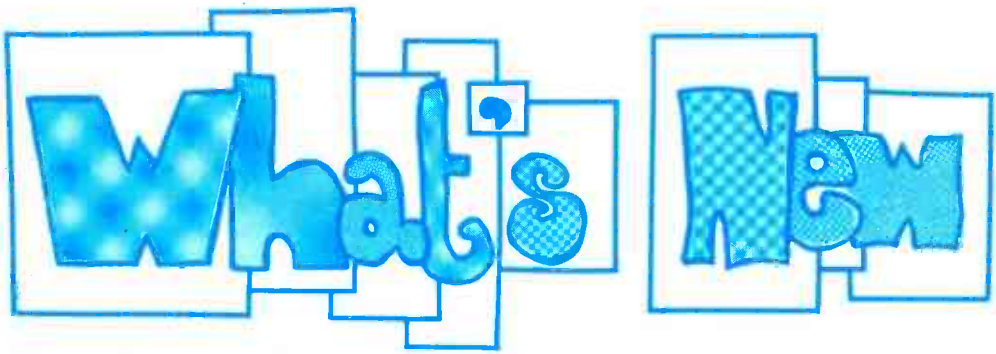
Later developments permitted sealing nickel-cadmium batteries so that they could be charged and used in all positions. One of the most remarkable uses for rechargeable batteries has been in artificial satellites such as Syncom III. When launched, it was powered by 22 nickel-cadmium batteries that were kept charged by the energy of the sun-through 3,840 solar cells.

The consumer, especially, is finding hundreds of uses for the rechargeable batteries. Through the miracle of portable power, hedges are being clipped, portable radio and tv sets, typewriters and dictation machines are being operated; turkeys are being carved; cakes are being mixed, rugs are being cleaned, cigarettes are being lit; even dresses, coats and slacks are being styled with glowing lights.

Rechargeable nickel-cadmium batteries also provide power for cordless tools, razors, movie cameras, and clothes and shoe brushes.

In all, some 400 modern products, powered by rechargeable nickel-cadmium batteries, are currently on the market. A large number are household appliances.

Interestingly enough, the world of electricity--which began with a long cord, a key and Benjamin Franklin--has taken a gigantic stride forward since another cord--the one leading to the wall socket--was cut..thanks to rechargeable nickel-cadmium batteries.



Wary of Weathermen? Buy a Frost Sensor

The Holley Carburetor Co. has announced the availability of a detector system that predicts frost and ice conditions before they occur. The detector system's unique transducers, which continually monitor the relative humidity and air temperature, can initiate a warning or de-icing device.

The humidity sensor consists of a humidity-sensitive film deposited on a conductive grid. As the humidity rises, the film conductance increases. This phenomena is then translated into voltage analogues in the electronic logic of an amplifier assembly. A similar phenomena occurs with changes in ambient temperature. When the humidity is low, an additional sensor measures the conductance between water and ice. If ice forms, a conductive imbalance in the sensor generates a warning system.

Electronic Dominoes Form Instant Circuits

Electronic dominoes that make child's play out of space age electronics have been introduced by Macalaster Scientific Corp. With a single set of dominoes, at least 90 different electronics experiments are possible, including radio receivers, electronic thermometers, fire alarms, directional signals, light measurements, a voltage divider, a rectifier, an amplifier, and a flash circuit.

Easy and quick to assemble, the individual units are held together by built-in magnets that assure proper electrical contact. Each domino contains a circuit element inside a clear plastic container for easy viewing. The symbol for the element is imprinted on the top of the domino, and a completed circuit thus displays on its top the appropriate circuit diagram.

A diagram in "domino format" of each circuit to be completed appears in an instruction book. Students are required to assemble the dominoes into identical configurations. After one experiment is completed, a flick of the hand disassembles a unit, and the dominoes are ready to be re-assembled into another instant circuit.

Microfilm Electrocardiograms -- Via the Telephone

Heart signals transmitted by telephone can now be recorded in minutes into microfilm electrocardiograms using a system developed by the 3M Co.

The system enables specialists to give a diagnosis quickly by telephone or by circuit television. This makes possible accurate diagnosis by heart specialists at points distant from the patient.

Enlarged copies of microfilm images can be made in seconds and the system works in the home, clinic or hospital. Data is transmitted to the "3M 1260 ECG recorder" over direct cable lines, standard phone lines or transmission units. This system signals a great advancement in the diagnosis of heart ailments.

Latest from the Army -- New Electromechanical Hand

A new electromechanical hand developed by the Army at Walter Reed Army Medical Center permits amputees to automatically control the pressure of its grasp. The new hand has a piezoelectric device or sensor in its thumb which senses the correct pressure.

By expanding a muscle on his abdomen or chest, the user activates a microswitch. A nickel cadmium battery then drives a 12-volt electric motor. If the object being handled begins to slip, the sensor in the thumb generates a signal which is relayed to the motor in the arm through an amplifier in the hand. The motor tightens the hand's grip so that the object can be held securely.

If the amputee releases the command microswitch, the hand locks and can hold an object for an indefinite period of time, without using any electric power and without any effort on the part of the user.

Expected to be on the market sometime next year, the device is ideally suited to amputees who lack the use of arm muscles needed to control conventional artificial devices.

Bothered by Allergies? Try 'Controlled Environment'

St. Vincent's Hospital and Medical Center in New York City has the first environmentally controlled diagnostic and treatment unit in the U.S. Built by Tenney Engineering, Inc., the controlled rooms are constructed so that pollen, dust, molds, and other irritants may be removed completely or introduced in regulated quantities to determine their allergic affect on patients. Temperature, humidity, even simulated altitudes can also be varied.

Similar units at Bethesda's NIH and Lankenau Hospital in Overbrook, Pa., also built by Tenney, are being used to study the effects on the human system of drugs, calories, various temperatures, and physical exertion.

Reaction of patients can be monitored around the clock by closed-circuit TV or one-way windows.

Intertech Multimeter, Model 101	$ 3.65
Intertech Multimeter, Model 210	$ 6.00
Intertech Multimeter, Model 1330	$ 12.00
Intertech Multimeter, Model 1220	$ 12.00
B & K Model 375 VTVM	$ 58.25
Anchor Model 475 Picture Tube Tester - Rejuvenator	$ 33.10
Vari Volt, Model 810	$ 27.30
B & K Model 850 Color Generator	$122.35
B & K Model 1074 TV Analyst	$150.65
B & K Model 1240 Color Generator	$ 85.45
Midland Model 103 Walkie Talkie	$ 10.40/pr.
Midland Model 404 Four-track Auto Stereo Cartridge Tape Player	$ 44.60
Draftette Model 9-B Drafting Machine	$ 10.50
Black and Decker Half-inch Utility Drill	$ 24.00
Terado Portable Power Supply, Model 160	$ 48.10
Blonder-Tongue Model 99 UHF Converter	$ 14.50
Hallicrafters Model 11 Walkie Talkie	$ 47.30/pr.
Two-watt Amplifier	$ 6.84
Midland Electronic Guitar Pickup	$ 1.35
Midland Ukelele	$ 5.25
Kenwood Model 550 Stereo Tuner	$ 95.00

NRI's CONAR Division announces a sale of discontinued stock test equipment. All equipment is brand new, in original factory cartons, and is being sold at or below cost to clear before inventory.

Many of these items are one or two of a kind, and interested NRI Alumni are advised to write to determine availability before ordering. All sales will be for cash and will be final. Interested Alumni are invited to address inquiries to C.B. Weschke, CONAR Merchandising Manager. Inquiries should be dated as they will be handled on a first-come, first-serve basis.

BY
STEVE
BAILEY

DEAR STEVE:

What is a crossover network? Also, what is meant by "half-section" and "quarter-section"?

D. S., Pa.

A crossover network is an L-C frequency divider connected between the output of an amplifier and its speakers. This is used to separate a signal into frequency ranges, and to feed these ranges of frequencies to speakers especially designed to handle them. High frequencies are fed to a speaker known as a "tweeter", mid-ranges are, naturally, fed to a speaker known as a "mid-range", and low frequencies are fed to a "woofer".

Each speaker in a system is connected to one section of a crossover. There are two types of sections, known as quarter-sections and half-sections. The quarter-section has only one reactive component for each speaker and has an attenuation rate of approximately 6 db per octave. The half-section contains two reactive components for each speaker and has an attenuation rate of approximately 12 db per octave.

The rate of attenuation means that the low and high frequencies will be attenuated at a certain rate starting at the crossover frequency. The crossover frequency is dependent upon the frequency response of the speakers.

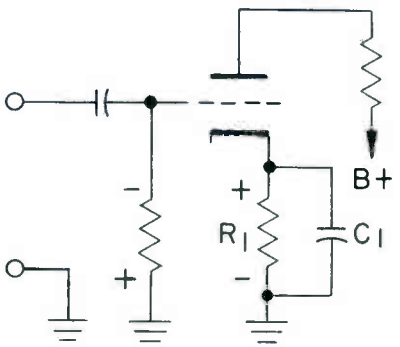
DEAR STEVE:

What does the term "signal ground potential" mean?

L. P., Md.

This term means that a point is at ground or zero potential as far as the ac signal is concerned. This same point is not at ground potential as far as dc is concerned.

One example of this is the cathode bypass capacitor (C_1) in the circuit shown below.



In this circuit, we want maximum signal voltage applied between the grid and cathode. R_1 is connected in the circuit so that the dc current flowing through it will develop a small voltage drop. This voltage drop will make the cathode positive with respect to ground, and the grid negative with respect to the cathode. However, without C_1 in the circuit, part of the signal voltage will be developed across R_1. The signal voltage will be 180° out-of-phase with the input signal, thus causing partial cancellation or degeneration.

To prevent this, we insert a capacitor across R_1. This capacitor value is chosen so that it acts as a short circuit to the ac signal. Since it is connected between the cathode and ground, the cathode is at "signal ground potential". All ac signals will be passed around R_1, but the dc will still flow through to develop the bias needed for the tube.

DEAR STEVE:

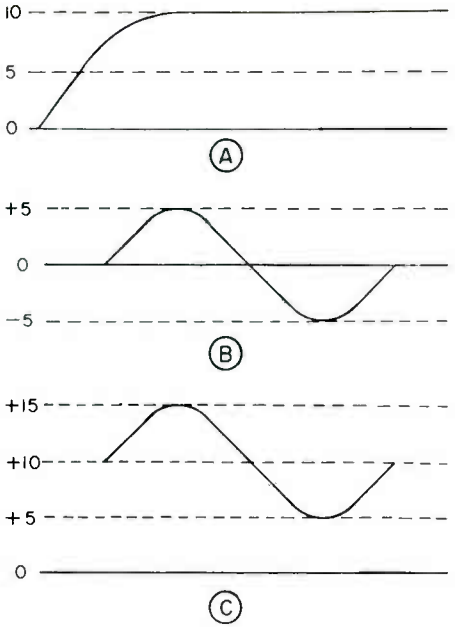
What is a pulsating dc voltage? I am currently studying Lesson B103.

A. B., Conn.

A pulsating dc voltage is one that contains an ac component or part, as well as a dc component. It has characteristics of both.

Fig. A illustrates a typical dc voltage. Notice that it begins at zero and rises to a maximum constant value. Fig. B shows a typical ac voltage. It begins at zero and rises to a maximum positive value, returns to zero, reaches a maximum negative value, and returns to zero again.

Now if these voltages were combined, they would appear as in Fig. C. Notice that we still have the ac sine wave, but it is on the positive side of zero. If we have a dc voltage of 10 volts and a maximum ac voltage of 5 volts, the ac and dc voltages will add during half the cycle and oppose during the other half cycle.



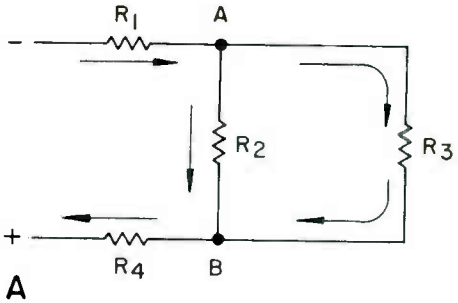
Thus when they add we will have a total of +15 volts, and when they oppose a total of +5 volts. From this we can see that a pulsating dc voltage exhibits the characteristics of both ac and dc. It resembles ac in that it varies. As a matter of interest, we could actually measure the separate components with a vacuum tube voltmeter.

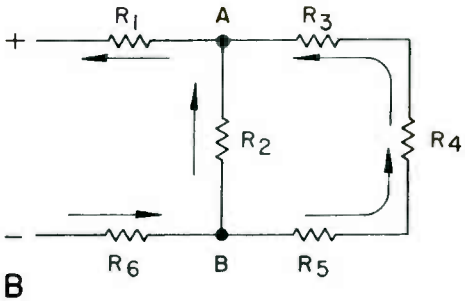
DEAR STEVE:

In my first five lessons I have learned to solve problems with the Ohm's Law formulas in circuits containing resistors. I have no trouble using the formulas, but my problem is in determining whether a circuit is series, parallel, or series-parallel. I would appreciate any suggestions you have.

T. K., Miss.

The best method I know of for solving this problem is to imagine how current will flow in the circuit you are working with. The way you have resistors connected together will determine the paths of current flow. Thus, by tracing the





probable path of current flow, you can determine whether resistors are connected in series, parallel, or series-parallel.

To illustrate this, two circuits are shown. Refer to Fig. A first.

Notice that one terminal of the circuit is designated as being negative and the other as being positive. Current will flow from the negative terminal. In doing so, it must flow first through R_1. Since the full circuit current will flow through here, it is a series resistor.

When the current reaches point A, it must divide with part flowing through R_2 and part through R_3. (The exact amount that flows through each will depend upon their respective values.) At point B, the currents will combine. Thus, R_2 and R_3 are connected in parallel with each other.

The full circuit current will be present at point B, so it will then flow through R_4 to reach the positive terminal. As you can see, R_4 is a series resistor.

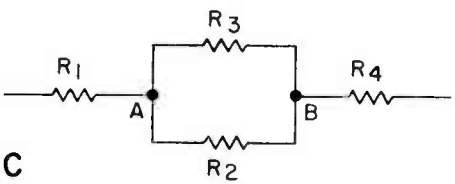
In summary, R_1 and R_4 in Fig. A are series resistors and R_2 and R_3 are parallel resistors.

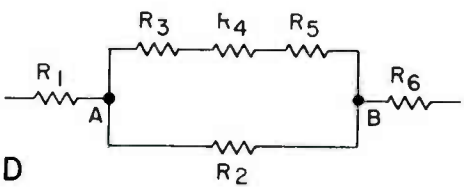
In Fig. B, the polarity of the terminals has been reversed and several additional resistors have been added. Again current will flow from the negative terminal. It will all flow through R_6, so R_6 is a series resistor.

At point B, the current will divide. Part will flow through R_2 and part through R_5. Notice that the current that flows through R_5 must travel through R_4 and R_3 to reach point A, whereas the current that flows through R_2 will reach point A directly. It flows through no other resistors to get there.

This means that R_3, R_4 and R_5 are connected in series with each other and in parallel with R_2. At point A, the full circuit current will recombine and flow through R_1. Thus, R_1 is a series resistor.

There is another method that can be used. Refer to Fig. A again; notice that the negative terminal is the top terminal and the positive terminal is the bottom terminal. If we mentally took the bottom portion of the circuit and rotated it around counterclockwise or to the right, it would appear as shown in Fig. C. Doing the same thing to Fig. B, it would appear as shown in Fig. D. By straightening the circuits out, you can easily see that we have a series-parallel circuit in each case.





To find the total resistance in Fig. C, you would first make a notation of the value of R_1. Next you would find the total resistance value of R_2 and R_3 in parallel. Then you would make a notation of the value of R_4. Finally, to find the total resistance, you would add the three values together.

In Fig. D, you would first make a notation of the value of R_1. Then, you would determine the total resistance of the top branch of the parallel circuit by adding R_3, R_4 and R_5 in formula to determine the total resistance value of the parallel circuit. Finally, you would make a notation of the value of R_6. By adding the three values together, you would have the total resistance of the circuit.

DEAR STEVE:

What is meant by the "alpha cut-off frequency" of a transistor?

P. J., Wis.

This term means that at a certain frequency, the current gain of a transistor will drop. The term "alpha" refers to the gain of a transistor used in a common base circuit.

Should the frequency of the signal applied to a transistor exceed the frequency range of the transistor, the current gain will drop to .707 of what it was at a lower frequency. For example, assume that the cut-off frequency of a certain transistor is 25 kc. At 1 kc, the value of alpha is .50. At frequencies equal to and exceeding 25 kc, the current gain will drop to .707 of what it was at 1 kc.

To find the new value of alpha, you multiply .707 of the gain at 1 kc or .707 × .50 which equals .3535. Thus, the current gain drops from .50 to approximately .35, a drop of about 30%, at the cut-off frequency.

T. E. Rose
Executive Secretary
NRI Alumni Association
3939 Wisconsin Avenue, N.W.
Washington, D.C. 20016

1968 NOMINATION BALLOT (Polls Close July 25)

I am submitting this Nomination Ballot for my choice of candidates for the coming election. The men below are those whom I would like to see elected officers for '68.

MY CHOICE FOR PRESIDENT IS _____

City _____ State _____

MY CHOICE FOR FOUR VICE-PRESIDENTS IS

1. _____ 3. _____

City _____ State _____ City _____ State _____

2. _____ 4. _____

City _____ State _____ City _____ State _____

Your Signature & Student Number _____

Your Address _____

30 Years Ago

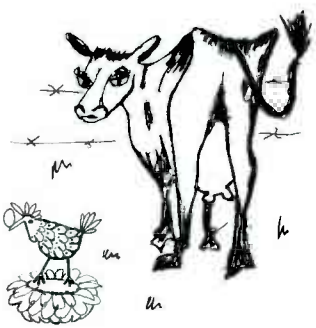
As Recorded in The National Radio News

Radio waves were used to cure ailing puppies! Shortwave diathermy treatments proved surprisingly successful in the treatment of distemper. Two special transmitting tubes connected to a 1000-volt power supply were enough to cure small dogs placed between flat metal electrodes. More power, of course, was necessary for larger dogs.

Mice were making "radio news" too. Nesting in the main power transformer of Oakland, California's station KROW, mice short-circuited the terminals and left the station voiceless for 83 minutes. While mice in the United States were trying to get rid of radio, a farmer in Denmark discovered a way to make radio get rid of mice. Loudspeakers in each barn operated night and day, and in a few days all the mice on his farm had disappeared.

Station WEEI, Boston, broadcast a special program of the buzzing of 50,000 bees. Beekeeper John Van de Poele accidentally stumbled while carrying a hive of 10,000 bees from the station after the broadcast, and vacuum cleaners and brooms were used to kill the escaping bees. Twenty-four hours and 300 bee stings later, Van de Poele had the station under control once again.

California Institute of Technology research worker Chao-Ying Ming claimed to have made the world's smallest radio tube. Generating ultra-high frequency waves with wavelengths of about one centimeter and having a plate about 1/50 of an inch in diameter, the radio tube was about the size of an ordinary marble. The world's smallest 45-volt B battery also made its appearance. Smaller than a flashlight cell and weighing less than 2 ounces, the battery had a layer-built construction which gave it a life of several hours -- more than enough time necessary for use in broadcasting weather data from balloons.



Radio was invading the farm. Loudspeakers operated all day in the henhouses of a Long Island farmer, who discovered that chickens who were used to radio programs lost all fear of noise and consequently laid more eggs. A radio receiver in a Nova Scotia dairy barn proved so popular that the failure of the set resulted in a sit-down milk strike by the purebred cows. The animals stamped, "bawled", and were extremely nervous until emergency repairs brought music to their ears once again.

HIGH POSITIONS OPENED TO NRI GRADUATES

GRADUATE BERNARD SMOLKOVICH
Armor & Engineer Board
Fort Knox, Kentucky

"Thanks largely to NRI and the diploma I hold from your school, I am a very successful and upcoming Communications Technician. I was reaching for a position with the USA Armor & Engineer Board and got it because of my NRI diploma. My future appears secure since my graduation and I highly recommend NRI. My deep thanks to all your fine staff for its unfailing assistance during my course."

GRADUATE JOHN EUBANK
202 Navajo St.
Fayetteville, North Carolina

"It is a great pleasure for me to report that NRI has already prepared me for a position as an Electronics Systems Inspector with IBM. I easily passed their written examination in electronics and was offered a position. They seem to place a high value on the merits of NRI training, and technicians are especially impressed with the nature and scope of your training.

"Not being a professional educator, I cannot adequately define the outstanding merits of your teaching methods but do feel qualified to describe another and equally important aspect of your school -- the warm, human and very personal relationship you maintain with each of your students."

A CORRECTION

Photographs of Messrs. John Eubank and Bernard Smolkovich were inadvertently transposed in the May/June issue of the NRI Journal. Hence they appear again, with our apologies to both gentlemen.

job-ops

--- HELP WANTED ---

Do You Have an FCC License?

Immediate openings in TV, Audio, 2-way radio, etc. at Communications Engineering Co., a division of Sylvan Electronics. Located at 306 Kennedy St. N.W., Washington, D.C. Call Mr. Brown, 451-5700.

Looking for a Chance For Advancement?

Weinschel Engineering Company Inc., Gaithersburg, Md. 20760, has immediate openings in Test, Engineering & Repair Departments.

PERMANENT POSITIONS
EXCELLENT ADVANCEMENT
EVENING & WEEKEND INTERVIEWS

Contact Mrs. Karen Syence, (301) 948-3434, or write to Weinschel Engineering, Inc.

TELEVISION SERVICEMAN

for bench or outside work. Experience to include color TV if possible.

Visit
Arfax Television Sales and Service, 1420 Chain Bridge Road, McLean, Va.
or
Call 356-3600 and ask for Mr. Lake or Mr. Onfrychuk

DON'T DELAY

--- HELP WANTED ---

Electronics Technicians
--- Positions Available ---

WESTERN UNION Telegraph Co., Write or phone B.L. Krise, Manager of Technical Services, 1405 G Street, N.W. Washington, D.C.

sun electric corporation
5708B frederick avenue
rockville, maryland

openings for electronic technicians

OPENINGS

Exchange Office, General Telephone of Indiana, Inc. 501 Tecumseh Street, P.O. Box 1201, Fort Wayne, Ind.

--- HELP WANTED ---

Looking for a New Job?

Polito Communications, Inc. 101 Walnut St., Rochester, New York needs 4 or 5 technicians to service two-way radio equipment. Minimum requirement: Second class radiotelephone license. Call or write Joseph Carl Polito.

STATION WKRZ, Oil City, Pa.
Needs several first-class engineers.

STATION WFMD, Frederick, Md.
Needs technicians with first-class licenses.

Technicians
Production Engineers
Development Engineers
***SIMPSON ELECTRIC CO.
5200 Kinzie St., Chicago, Ill. 60644

REPAIRMEN NEEDED
In Richmond and Roanoke offices of Audio Fidelity Corporation, 6521 West Broad, Richmond, Virginia.

RADIO TECHNICIANS
United Airlines, Washington, D.C., expects a continual need for radio technicians throughout its system in 1967. Graduates are invited to come in for an interview.

RCA SERVICE COMPANY,
Camden, New Jersey . . .

TV SERVICEMEN NEEDED IN MOST RCA FACTORY SERVICE BRANCHES. TECHNICAL SCHOOL TRAINING ESSENTIAL. WE PREFER BLACK/WHITE AND COLOR SERVICE EXPERIENCE. APPLY AT NEAREST RCA BRANCH OR WRITE TO

W. R. Speck
RCA Service Co.
Cherry Hill, New Jersey

NRI HONORS PROGRAM AWARDS

During the months of March and April, 1967, the following NRI graduates received, with their NRI electronics diplomas, Certificates of Distinction under the NRI Honors Program for outstanding grades throughout their NRI training. NRI's worldwide leadership in electronics training is represented by these outstanding graduates from almost every area of the United States, from Mexico, Canada, and other foreign countries. It's not surprising, either, to know that the Armed Forces, which place an emphasis on training and career planning, are also well-represented.

WITH
HIGHEST HONORS

Anthony C. Adams, Woodside, N.Y.
John Amick, Las Palmas Gran Canaria, Spain
Charles C. Chase, Arcadia, Calif.
Charles Stephen Clark, Paris, Tenn.
Richard Bruce Crawford, Reading, Pa.
Pedro N. Diaz, Caracus DF, Venezuela
Pope Fendley, Port St. Joe, Fla.
Ralph E. Fleenor, Torrance, Calif.
L.P. Gillentine, Memphis, Tenn.
E.L. Hunnicutt, Augusta, Ga.
Harrold C. Jones, Jr., Houston, Texas
Edward R. Kaczmarek, Wethersfield, Conn.
Richard C. Martinec, Johnstown, Pa.
David L. Phillips, Morrison, Tenn.
Alton P. Reed, Gardendale, Ala.
Donald Rowe, Huntsville, Ala.
Robert W. Silcott, Fairview, Okla.
Noel L. Thomas, Oklahoma City, Okla.
Wendell L. Weeks, Alexandria, Va.

WITH HIGH HONORS

Dennis T. Aldridge, Baltimore, Md.
Robert H. Allen, Cornwall, Ont., Canada
John M. Andrews, Nashville, Tenn.
Robert K. Arnett, Great Bend, Kans.
John G. Baker, Baltimore, Md.
William R. Batt, Cape Tormentine, N.B., Canada
Jimmie J. Blankenship, Tyndall AFB, Fla.
Barry D. Bonner, Robins AFB, Ga.
Gene Burns, Los Angeles, Calif.
Kenneth Burton Chase, Shilo, Man., Canada
R.M. Duncan, Georgetown, S.C.
John L. Earley, Baytown, Texas
Harrison P. Ford, Greenville, S.C.
Cecil A. Gamble, Detroit, Mich.
Michael Greene, Devon, Pa.
Sydney J. Hall, Washington, D.C.
Jerry A. Hand, APO San Francisco
Eldon W. Hawn, Juneau, Alaska
Keith Hayward, Belleville, Ont., Canada
George F. Hedden, Elizabethtown, Ky.
Gary A. Keasler, Yorkville, Ill.
Leo F. Kersten, St. Louis, Mo.
Harold V. Ketner, Winchester, Ind.
Paul E. Major, Richmond, Ind.
Darrel D. Mau, Donnelly, Minn.
Edgar L. McCart, Roswell, N. Mex.
Herbert Mitschan, Petaluma, Calif.
Walter C. Muth, Rock Hall, Md.
William A. Newton, Jr., Farmington, N.H.
Edmund Perkins, Paterson, N.J.
Ernest W. Pratt, K.I. Sawyer AFB, Mich.
Richard C. Price, McConnellsburg, Pa.
Avus C. Ramsey, Felicity, Ohio
William A. Roderick, Barbourville, Ky.
Kermit A. Roeder, Lompoc, Calif.
Walter B. Schaub, Sacramento, Calif.
Earl Schubert, Rantoul, Ill.
Charles A. Seils, Jr., Chicago, Ill.
George E. Side, Rochester, N.Y.
Gale Slemp, Jonesville, Va.
Alvin V. Smith, Brenton, W. Va.
Stanley F. Spanbauer, Mascoutah, Ill.
John G. Stanley, Pawtucket, R.I.
Jozsef Szabo, Longueuil, P.Q., Canada
Delbert S. Tapp, Midvale, Utah
Edward L. White, Honolulu, Hawaii
Richard A. White, Raynham, Mass.

WITH HONORS

A. Preston Atwood, Belchertown, Mass.
Harold Baca, Socorro, N. Mex.
Irving E. Bard, Tucson, Ariz.
W.P. Bartels, Jr., Connellsville, Pa.
Boyd A Bingaman, Folcroft, Pa.
Joseph Bolda, Detroit, Mich.
Thomas W. Bowman, Durham, N.C.
A. Alfred Brooks, New York, N.Y.
Bernard Lynn Brown, Fayetteville, Tenn.
David A. Burch, Hartselle, Ala.
Billy J. Butler, Duncan, Okla.
Lewis M. Carle, San Antonio, Texas
Joel K. Cole, Indianapolis, Ind.
Michael D. Crista, Ft. Huachuca, Ariz.
Lyndley L. Crumly, APO San Francisco
Sam C. D'Antonio, Newark, N.J.
Victor O. Del Prado, Brooklyn, N.Y.
Carl E. Doyle, Monterey Park, Calif.
James J. Duppins, Baltimore, Md.
Denny R. Exley, Jr., Eau Gallie, Fla.
Charles Farmer, North Newark, N.J.
Jeffrey D. Gilman, FPO New York
Mickey Giordano, Jr., Penns Grove, N.J.
Thomas Graydon, Vancouver, B.C., Canada
H.M. Gunter, Bostic, N.C.
Fred W. Haas, Jr., Cleveland, Ohio
Harold G. Haden, Littleton, Colo.
James B. Hakko, Waukegan, Ill.
Robert H. Haner, Scotia, N.Y.
Floyd Harmon, Jr., Sandia Base, N. Mex.
Eugene V. Henry, Martinsville, Ind.
Charles J. Houck, Jr., Walden, N.Y.
Thomas C. Iacona, E. St. Louis, Ill.
George W. Inabinet, Jr., Swansea, S.C.
Robert W. Jenkinson, Hudson, Wis.
James E. Johnston, Hammond, Ind.
Frank J. Karasiewicz, Belmont, Mich.
Larry B. Kerr, Oklahoma City, Okla.

E.G. Knippelberg, Merritt, B.C., Canada
Loren S. Lawson, Sparks, Nev.
Sam Leach, Kensington, Md.
F.A. Lee, Huntington, W. Va.
Howard O. Marsh, Watsonville, Calif.
George Maruscik, Philadelphia, Pa.
Jack W. McCreary, Houston, Texas
Phillip H. McGibney, Cincinnati, Ohio
Robert L. McLarren, State College, Pa.
Nehemiah Newsome, Washington, D.C.
Joseph A Onisto, Front Royal, Va.
Charles J. Pacinelli, Selden, N.Y.
Walter Pape, Collingswood, N.J.
Walter W. Patterson, Spokane, Wash.
Thomas E. Phillips, Petersburg, Va.
Melvin Reid, Trinity Bay, Nfld., Canada
William R. Ribbans, Pittsburgh, Pa.
Jerry A. Richardson, Seneca, S.C.
Fred A. Rosenau, Raymond, S. Dak.
Ernest L. Rutledge, Flintville, Tenn.
William J. Schwarza, Forreston, Ill.
Milton C. Seefeldt, Spokane, Wash.
J.B. Singleton, Odessa, Texas
Alfred L. Smith, Ashburn, Va.
Carl J. Smith, Vickery, Ohio
John F. Smith, FPO New York
Carl F. Snyder, Orlando, Fla.
Frank W. Stark, Leonardo, N.J.
Steven H. Strege, West Bend, Wis.
Joe Summers, Morgantown, W. Va.
Raymond R. Syverson, Mill City, Oreg.
Walter Turek, Hamilton, Ont., Canada
Vivid V. Vadakan, Silver Spring, Md.
Robert A. Welch, Foresthill, Calif.
J.B. Williams, Clarksville, Tenn.
Charles O. Wilson, Claymont, Del.
Arthur J. Wiltshire, Cleveland, Ohio
Wallace D. Youds, Sioux City, Iowa

CONAR EASY PAYMENT PLAN

IM

Note: Easy payment contracts cannot be accepted from persons under 21 years of age. If you are under 21, have this sheet filled in by a person of legal age and regularly employed.

Enclosed is a down payment of $_____ on the equipment I have listed on the reverse side. Beginning 30 days from the date of shipment I will pay you $_____ each month until the total payment price is paid. You will retain title of this equipment until this amount is fully paid. If I do not make the payments as agreed, you may declare the entire unpaid balance immediately due and payable, or at your option, repossess the equipment. Your acceptance of this will be effected by your shipment to me of the equipment I have listed.

Date _____ Your written signature _____

CREDIT APPLICATION

Print Full Name _____ Age _____

Home Address _____

City & State _____ How long at this address? _____

Previous Address _____

City & State _____ How long at this address? _____

Present Employer _____ Position _____ Monthly Income _____

Business Address _____ How Long Employed? _____

If in business for self, what business? _____ How Long? _____

Bank Account with _____ Savings ☐ Checking ☐

CREDIT REFERENCE (Give 2 Merchants, Firms or Finance Companies with whom you have or have had accounts.

Credit Acct. with _____ Highest Credit _____
(Name) (Address)

Credit Acct. with _____ Highest Credit _____
(Name) (Address)

Alumni News

Eugene de Caussin ..... President
Edward Bednarz....Vice President
Isaiah Randolph....Vice President
Joseph Bradley ....Vice President
Harvey Morris ....Vice President
Theodore E. Rose..Executive Sec.

NEW SERVICING HINTS HIGHLIGHT ALUMNI MEETINGS

DETROIT CHAPTER has been concentrating on a program emphasizing the theory and fundamentals of transistors. The second session in this program was called "Metering Data", and consisted of the measuring of leakage current and methods of determining the Alpha and Beta gain of transistors.

A demonstration board was constructed with switches and meters in the circuits. The board was an upright panel with the circuits drawn on white poster board, with the switches and meters right in the circuit instead of having symbols for them. Every one could plainly see which switch was used in which circuit.

The purpose of these demonstrations on fundamentals is to prepare members for the actual servicing of transistorized radio and TV sets.

John Nagy paid a visit to Jack Sellards, a former member of the chapter, in Barbourville, Ky.; Jack has built up a good business there and is an authorized service dealer for Admiral. Following John's visit, Jack sent the chapter an Admiral radio and an outdoor grill to be used as the chapter thought best.

The latest member to be admitted to the chapter is Raymond A. Berus. Congratulations, Raymond!

FLINT ADOPTS 'ON-THE-JOB' SERVICE

FLINT (SAGINAW VALLEY) CHAPTER'S report on the officers elected to serve the chapter for the current year reached NRI too late to be included in the last issue of the Journal. They are as follows: Clyde Morrissette, Chairman; Arthur Clapp, Vice-Chairman; James Windom, Jr., Secretary; Henry Hubbard, Treasurer; George Martin, Radio-Communications; Charles Wotring, Sergeant at Arms; Andrew Jobbagy, Goodwill Ambassador; Robert Poli, Information Director; Robert Newell, Finance Committee; Leslie Carlley and John Allen, Membership Committee. Our congratulations to these officers!

The chapter has adopted a new plan called "On-The-Job Service". Under this plan the members go in a group to the home of a customer (with the customer's permission, of course!) to answer a service call. Although one member does the actual servicing, the others have time to analyze the trouble. At the following meeting, the service call is discussed. This is a new idea, and the members hope it proves valuable in their service work.

SAN FRANCISCO OPERATES ON A TROUBLED TV

SAN FRANCISCO CHAPTER members had a lot of fun at one meeting when they worked on a TV set. The complaint was no raster due to a defective 6AU7 horizontal oscillator tube. After replacing the tube and adjusting the horizontal frequency, a very good picture was obtained.

At the next meeting troubleshooting of the vertical section was undertaken. A defect was introduced in the vertical oscillator and all joined in the discussion. It was obvious that everyone obtained real benefit from this work.

SOUTHEASTERN MASS. SETS A FINE EXAMPLE

SOUTHEASTERN MASSACHUSETTS CHAPTER has been enjoying unusually good attendance at its meetings since early in the year. In fact, the attendance is so good that the President and Secretary of a local radio and TV guild came to one of the meetings mostly to see why the meetings were so well attended. They admitted that by comparison attendance at their meetings was very poor.

One reason for the high attendance at the chapter's meetings has been the excellent job that chapter member Manny Sousa has been doing in his lectures and demonstrations on color TV. At one meeting, he spent the entire evening on demodulators and at the end of the session everyone had gained a good idea of how they worked in the circuits. At the April meeting, Manny covered the burst amplifier, phase detector, and color oscillator, doing his customary excellent job on these, too. The chapter's secretary, Ernest Grimes, said, "I thought I had a good idea of how the circuits worked, but Manny's explanations and some questions by John Alves and others made it much clearer."

Word has gotten around about these meetings and what can be learned from them. Because of this, the chapter has recently admitted more new members than at any time in the past. The new members are: Dennis Monig, Ray Labouliere, Gary Stern, Norman Ouellette, John Vieira, Romeo Poissant, Henry Silva, Ray Mullen, Douglas Crook. Welcome gentlemen! (And congratulations from National Headquarters to the chapter.)

SPRINGFIELD INVESTIGATES SOLID-STATE PLANT

SPRINGFIELD (MASS.) CHAPTER invited Mr. Albert Petersen to give a brief talk on his duties with Townsend Associates of Agawam, Mass., an engineering firm specializing in transmitting equipment for radio and TV stations. Mr. Petersen summarized his work in the field of research and development in all types of transistorized oscillators, how they doubled or tripled the frequency to achieve the desired frequency, their troubles with placement of wires, leakage, costs, etc.

An outgrowth of this talk was an invitation to the chapter members to make a tour of the Townsend Associates plant. Mr. David Baldyga, Vice-President, personally guided the group through the plant. He took the members right up to the equipment and explained every part. This company is the only one producing solid-state TV transmitters and a unique process of multiplexing by means of which either the visual or the aural amplifier can be deactivated and the other amplifier kept on the air in a linear amplifier operation or multiplexing. Of particular interest (and a "first" in the in-

dustry) was a unitized solid-state power supply mounted within a tub of air-cooled oil. The whole supply looks like a transformer, needs no cabinet and can be put indoors or outside. The drivers are completely solid-state. The members commented that all the work was extremely neat and precise. This was a fascinating tour of an electronics manufacturing company.

LOS ANGELES TROUBLESHOOTS WITH EYE ON CHAPTER PROFIT

LOS ANGELES CHAPTER was pleased to welcome new member George Smith to the chapter. Our congratulations to you, George!

Jim Law donated a G.E. 14" TV set to the chapter; the members agreed to permit Jerry Dougherty to work on the set at home for the experience it would give him. When the set is in proper working order, it will be sold and the proceeds will go into the chapter's treasury.

Chairman Gene DeCaussin and Bob Belew bought color-bar generators. The two instruments were discussed in detail. The discussion included the use of the book "Trouble Shooting Pict O'Guide". This meeting closed with two entertaining movies, "Let's Go To The Movies", an old-time moving picture, and "Destination - Safety", an educational film.

NORTH JERSEY FINDS AN 'ACE' UP ITS SLEEVE

NORTH JERSEY CHAPTER members were set back on their heels when Millard Ace, a student, proved what valuable assistance a student can lend to a chapter. He sprang a new type of lecture on the chapter, which might be called a Question-and-Answer Game. It was an eye-opener to everyone because it dealt with questions often asked radio-TV servicemen by their customers. Taking the role of a dissatisfied customer, he confronted each member with a question. The members present all agreed that they got a lot of new ideas from this session, as well as an idea of what to expect in dealing with the public.

The next meeting, which was attended by J. B. Straughn and Ted Rose of the NRI Staff, featured a film entitled "The Language of Electronics" purchased by Secretary Frank Lucas.

PHILADELPHIA-CAMDEN GREETS NEW MEMBERS

PHILADELPHIA-CAMDEN CHAPTER has reported the admission of two new members, Student Walter Cuirle and Graduate Edward Fratelli, both from Philadelphia.

The representative of a well-known manufacturer of radio and TV receivers failed to show up as guest speaker as planned. The chapter then called on Bernie Bycer, RCA Design Engineer, to pinch-hit. Mr. Bycer delivered an excellent talk on vertical circuits and transistors. The chapter feels, and rightly so, that it is very fortunate in having such a loyal friend and fine speaker to call upon in an emergency of this sort.

SAN ANTONIO TRAVELS TO STATE LEGISLATURE

SAN ANTONIO ALAMO CHAPTER is a good example of how the local chapters of the NRI Alumni Association can serve the radio-TV industry, the community, and the state. In connection with proposed legislation affecting the radio-TV industry, a 10-man delegation travelled from San Antonio to Austin. Most of them were NRI graduates. Two of them, Sam Dentler and R. E. Bonge, spoke before the committee of the state legislature about the proposed bill. Such duties have been performed by other chapters.

Sam Stinebaugh was appointed Program Chairman and Thomas Love Chairman of the Membership Committee. An executive committee consisting of the elected officers and committee chairmen will meet separately once a month, at the direction of the chapter chairman.

NEW YORK ENJOYS LIVELY DISCUSSIONS

NEW YORK CITY CHAPTER'S Peter Carter brought in a Knightkit Color-Bar Generator he had assembled and demonstrated its patterns on the chapter's black and white set while relating his experience in assembling it. It appears to have many capabilities and to be ruggedly constructed with great stability offered by the crystal control and the unijunction frequency dividers.

The waveforms of the various adjustments were shown on an NRI scope equipped with a trigger sweep attachment according to a design by Fairchild which appeared in Radio-Electronics magazine. On this occasion the chapter welcomed a very special guest, Forest H. Belt, an NRI graduate and now Editor of Radio-Electronics.

The members also enjoyed a continuance of the series "Sam Antman Discovers N and P Materials," and an informative discussion of "High Voltage and its Troubles" by David Spitzer.

Lionel Williams gave an excellent introduction to the subject of binary numbers, the language of computers, giving examples of conversion from the decimal system and ending with a mention of the four common types of gates and their general applications.

At the following meeting Sam gave a lengthy and very worthwhile talke on tracing troubles in a transistorized radio set using the chapter's RCA Demonstration Board and a Conar Tuned Signal Generator. Even though the collector of the first i-f was shorted to ground, a signal was picked up at least as far as the detector. This caused quite a bit of discussion which has not been resolved. ("The short charged the common emitter circuit to a common base type circuit! Open C4 and the signal disappears - how about that?"...JBS)

Aided by Willie Foggie, Jim Eaddy, who had just completed a six-week course in color TV given by the New York School System, explained some of the things he had learned in the course. Since the chapter does not own a color TV receiver, the discussion was necessarily limited to theory but was nevertheless most welcome.

The chapter had another honored guest at this meeting from Radio-Electronics. He was Mr. Thomas Haskett, Associate Editor, and it was a real pleasure to the members to have him join them for the evening.

In Memoriam

Since the last issue of the Journal we have received word that the following members of the Alumni Association have passed away. We extend the sympathy of the Alumni Association to their families.

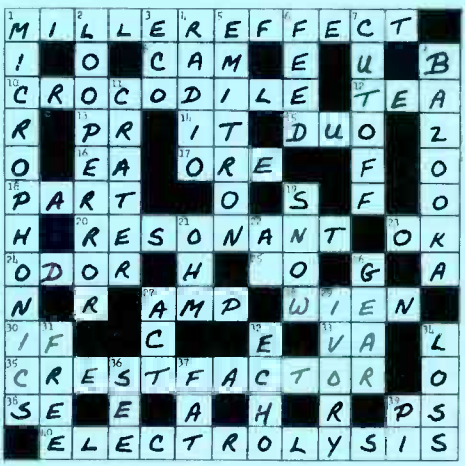
Mr. Raleigh Council

Mr. John G. Baise

Mr. Edward J. Ziemba

Mr. John G. Gwyn

Mr. Johannes Northrop



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$11 DOWN - $5 PER MONTH

Tests: capacitors for "shorts," "opens," and "leakage," as well as capacitor value and electrolytic capacitors (out of circuit only). A rugged and easily portable instrument which weighs only 8¾ pounds and is only 5½ inches high by 12¾ inches wide by 6¾ inches deep. Features simplified internal engineering design in an attractive metal case. For operation on 105-125 volts 60 cycle AC, but pre-tested to operate properly from 90 to 140 VAC. All tests made with same cable assembly. One knob for both function and range.

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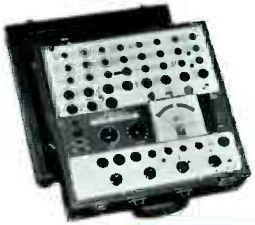

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Tests: New and old types including Nuvistors, Novars, 10-pin tubes, 12-pin Compactrons, European Hi-Fi tubes, voltage regulators, and most industrial types. Makes tests under actual set operating conditions. Provisions for future sockets. Checks each section of multi-section tubes for all shorts grid emission, leakage and gas. The adjustable grid emission test provides sensitivity to over 100 megohms. Makes a quick "life" test. Tests more color TV tubes faster than any equipment previously available.

B & K COLOR GENERATOR

1245 WT
6 lbs.
Par. Post. Ins.

$134.95

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Small, lightweight solid-state. Checks and adjusts: convergence, demodulator alignment, color sync, color fit, horizontal and vertical size, linearity and overscan. Dots only one raster line high and .25 usec. wide for most accurate convergence. Free of retrace lines. Precise waveforms permit accurate setting color killer control with a B&W telecast. Built-in gun killer works on any picture tube. Station quality waveforms. All transistor design.

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