

PLAINTIFF'S  
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Ethyl

ETHYL  
MAGAZINE

1968-1970

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# Ethyl

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ONE / 1968



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MAGAZINE

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Stanley M. Siegel, coordinator-Publications.

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The cover photo, by Irving J. Olson, is entitled *Searching Upwards*. In addition to its appropriateness to the feature article "A Burning Issue" on page 4, its theme is indicative of the guiding force of Ethyl Corporation—searching upward and onward to better serve a better world.

## ETHYL CORPORATION/1968

The sum total of a paper company founded in 1887, and a then 'one product' antiknock compound company formed in 1924.

Much has happened during the years passed—since the beginning, through the merger of Albe-marle Paper Company and Ethyl Corporation in 1962, and even today as we look to tomorrow.

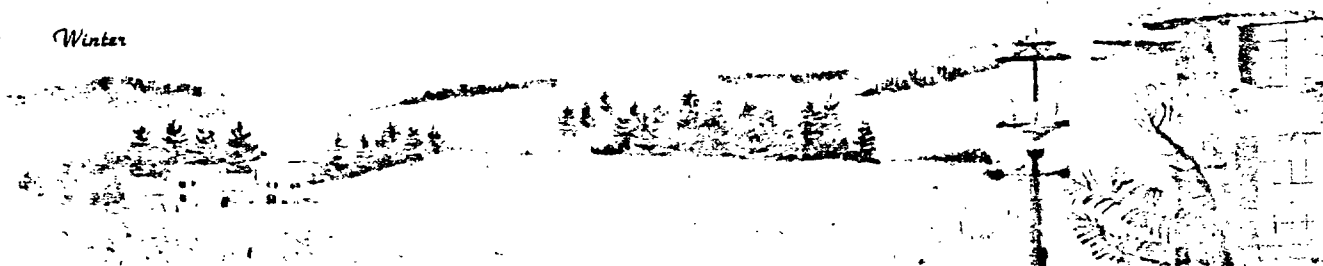
What has happened?

In a word—**change**.

Change, as reflected by the continuing diversification of corporate interests—from petroleum chemicals and kraft paper, to plastics, packaging, industrial chemicals, aluminum extrusions, fine papers, and intensive 'where will Ethyl turn up next' pioneering research and development.

This first issue of *Ethyl Magazine* is another reflection of this continuing change. Its purpose is to promote better and fuller understanding of and between Ethyl Corporation and its many publics—a magazine of change.

Winter



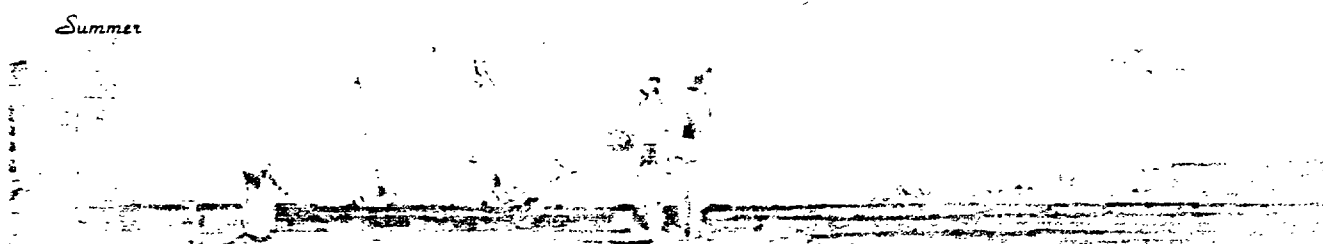
Spring



**"No business of any kind can keep on indefinitely doing what it is doing now. It must change. I am not pleading with you to make changes. I am telling you you've got to make them—not because I say so, but because old Father Time will take care of you if you don't change. Advancing waves of other people's progress sweep over the unchanging man and wash him out."**

**Charles F. Kettering**

Summer



Fall



**ETHYL CORPORATION**

***Changing . . . to Serve a Changing World***

# A BURNING ISSUE



As far back in time as 190 B.C. (and probably even before that), the subject of fire was treated in the proverbs and adages of the day. "A small spark neglected has often kindled a mighty conflagration."

The hypothesis is certainly still true today as the records and experiences of the federal and state fire protection agencies prove.

In a recent extensive study, conducted by the Office of Emergency Planning, which covered the years 1956-1965, approximately 1,141,000 forest and grass fires were reported in the United States—an average of 313 each day burning 4.8 million acres each year.

Harking back to the proverb, the study noted: "Any small fires in the Nation's wildlands, if not quickly detected and suppressed, can get out of control. An uncontrolled fire is one of the most destructive forces caused by man . . . It is a multiple killer of people, livestock, fish, and wildlife. It destroys personal and real property, valuable timber, forage, watersheds and inestimable scenic and recreational values. Severe soil erosion, silting of stream beds and reservoirs, and flooding often are serious aftermath of fires. No formula has yet been developed which would accurately assess all of the damage and suffering caused by fire."

The United States includes a total geographical area of more than 2 billion acres—more than half of which is forest and grassland.

### The Human Factor

The destructive force of forest fires has occurred throughout the history of mankind. There are three basic causes of forest fires—natural causes, such as lightning; human carelessness; and incendiarism, or to put it another way, arson. Contrary to popular belief, it is known that man is responsible for the greatest number of forest fires caused, in addition to carelessness, by ignorance and maliciousness. Smokers and debris burners start almost half the fires reported in the Nation while incendiarism is the cause of one-fourth of the total. While lightning fires are most prevalent in parts of the mountainous West, on a nationwide basis, they represent less than 10 percent of the total. Man-caused miscellaneous causes account for the remainder.

For every action there must be a reaction, and, in the case of forest fire prevention and suppression, responsibility for forest and grassland protection falls into two main categories: Federal agencies protect over 650 million acres of government-owned wildlands, while state and local agencies protected an additional 480 million acres of state and private lands—it is estimated that some 420 million additional acres of rural farm and forest lands are without, or have inadequate, organized protection.

The first line of defense against any condition caused by man's carelessness or ignorance is education. This then is the principal weapon used to reduce the incidence of forest fires.

In a recent speech before a Foresters association meeting, Merle S. Lowden, director, Division of Fire Control of the U.S. Forest Service, noted: "When people think of fire prevention, they usually have in mind posters, signs, radio and TV appeals or other public information media of the Smokey Bear type. Such efforts are an important part of any comprehensive fire prevention effort. However, there are many other phases of

Just one other shameful result of forest fire—besides the countless animals, birds and other woodland creatures is the effect on the delicate balance of nature. Until the forest is restored—over a period of many years—the burned tract lies as a barren wasteland.



The suppression of a forest fire is a tedious task requiring enormous energy and unparalleled courage. As the human factor is the cause of the greatest percentage of fires, it coincidentally befalls man to be fire's most efficient deterrent.

prevention that need to be included in a well-designed program . . . For ease of consideration I have classified other prevention work into several general fields including risk engineering, hazard engineering, exposure controls, industrial user controls, and law enforcement."

These prevention methods rely on the scientific approach of study, analysis, and application.

Risk engineering, for example, refers to the elimination of all sparks that can cause forest fires—research into what carbon sizes and types cause fires, how they are emitted and how to eliminate them. A case in point? Mr. Lowden explains: "We know changing to diesel engines did not stop railroad engine fires or fires from diesel tractors . . . We know some diesel oils as well as other fuels are worse offenders than others. We know additives can be put with fuels to keep carbon particles from being so likely to start fires." Many other things can be done to prevent "engine" fires—effective spark arresters fitted to exhaust ports for example.

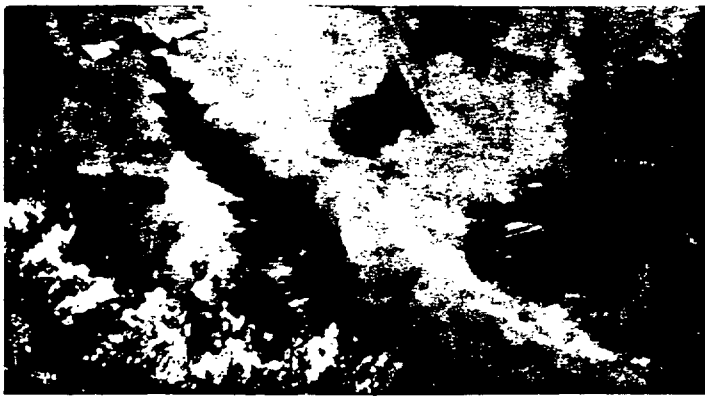
Although exhaust sparks seem an obvious cause of forest fires, such other causes include fires caused by the heat from railroad brake shoes, and sparks from pulleys and cables. Community "dumps" have been a fire risk for many years—legislation concerning location and standards have been somewhat helpful.

What of hazard engineering? This is the fire prevention effort that deals with the reduction and elimination of natural vegetation and other materials that burn—the tinder for the spark. A prime effort toward this end is the clearing back of road edges for ten feet or so on highways and roads. In the San Bernardino National Forest in California, this method reduced roadside fires from 52 percent to 11 percent of the total.

Highway fire prevention hazard engineering also contributes to roadside beauty.

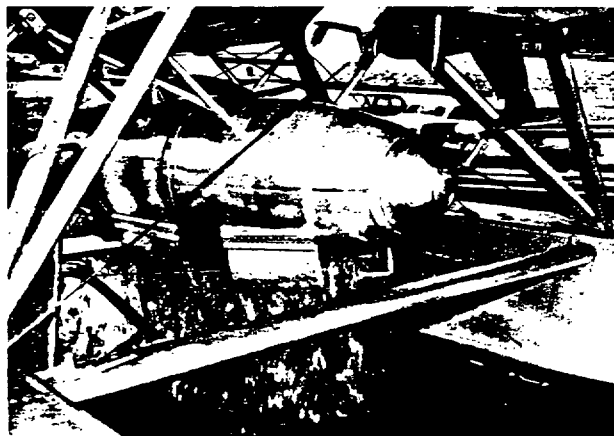
A theoretical solution in high risk areas is the spraying of a fire-retardant chemical to keep the tinder from igniting. Tests have shown effective results. However, the effect has not been long-lasting—rains have washed away the good effect of the chemical. Research is going on in this area.

Standards and controls regarding the burning of wastes, trash and debris is an important aspect of fire prevention. In this area, both hazard and risk engineering is involved. When better methods of disposing of debris than by burning is found, many forest fires will be prevented. Some National Forests require the burying of debris on road construction



above—With water and chemicals, large expanses of burning forests are doused by low-flying planes to help extinguish the flames and restrict its spread.

below—The specially built 'tank' affixed to the underside of the plane holds some 100 to 300 gallons of liquid extinguisher.

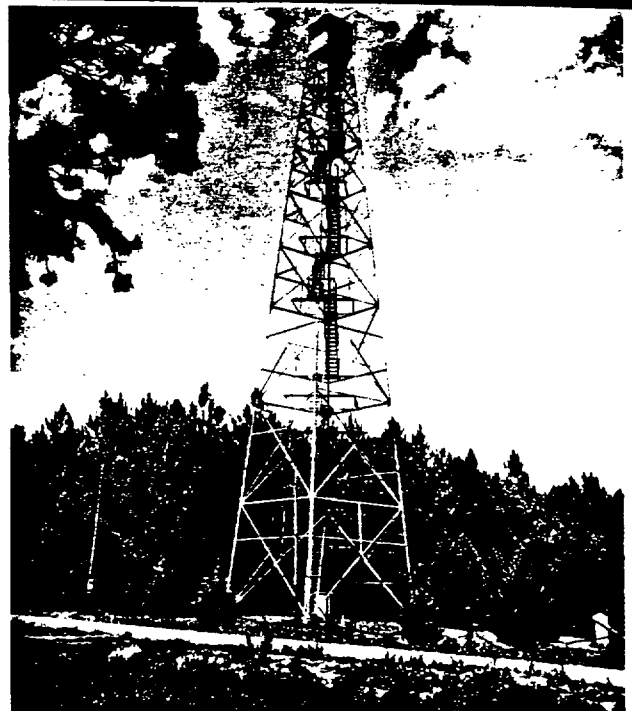


projects. Chemical and bacteriological decomposition agents have been tried—none so far with any dramatic result. A subsidiary benefit to the elimination of burning as a fire preventive is the lessening of air pollution—this too is a most important objective.

*Exposure controls* include limiting the use of the forests to the public. This however is in opposition to the basic objectives of the Forest Service—that is to make the National Forests available for use as much as possible. An application of compromising regulations are often put into effect to reduce the probability of forest fire by campers, hunters, and vacationers. Therefore, instead of absolute closure of the forest area, requirements are set to limit smoking, the lighting of campfires and the use of fire tools in certain areas during certain extremely hazardous times of the year as an example, hunting seasons are sometimes changed thereby reducing the risk of man-caused forest fires.

Industrial use of forests is treated differently—that is, the work done is almost always under some kind of permit, contract or special regulation. This allows prior determination of necessary restrictions according to the "fire danger rating" of the particular area at the time work is in progress. The obligation then is upon the forest-user to work under prescribed methods according to the particular fire hazard which prevails.

*Law enforcement* then is the last point to be discussed with regard to fire prevention. It should be noted that law enforcement is applied as a fire preventive only when the law is designed to prevent fires, not to be arbitrary, vindictive or as a show of authority. Akin to the preventive purposes of certain



This modern fire-control station is located on the Hofmann Forest lands of Albemarle Paper Company. Affording a view that encompasses many hundreds of acres, the tower is equipped with wind and weather instruments and radio-communication devices.

laws, is the inclusion of the recovery of costs and resource losses from those persons responsible for starting fires. Also related is enforcement of the laws much the same as a policeman on the "beat." People are much more careful when they are watched.

## When Prevention Fails

Let's suppose however, and unfortunately it doesn't take much imagination, a forest fire occurs—what then?

From *prevention*, the spotlight turns to *suppression*. And, *initial attack* is the key to successful fire-fighting. The first requisite though is to know a fire exists. Locating a fire in its early stages is of utmost importance to successful fire control. *Primary lookouts*—the familiar Ranger towers that dot the woodlands—are situated on mountain peaks and highlands. In addition, patrols are made by both aircraft and by patrolmen on the ground. Most often it is these same "scouts" that are the first to begin man's attack against the fire. Communication is the key to a planned attack and radio communication systems as well as other electronic apparatus are invaluable aids in the implementation of the *initial attack*.

When smoke is discovered, the location is plotted according to azimuth, distance and other landmarks from the fire station. This information is communicated to a central dispatcher. With the necessary information as to location, size of fire, and fuel type being burned, an initial suppression crew is dispatched.

Of utmost importance in fighting forest fires, the following "inventory" is required: quick arrival at the fire; an adequate manpower force; proper equipment; organization of the crew; and skill and knowledge of fire fighting methods.

No two forest fires are alike—a small fire may be put out by one to five men while large fires may require several hundred to a thousand or more men and take several days to control.

When it comes to fire fighting, a whole new lexicon of words

comes into use. *Attack time*: time of discovery to time of first attack made on fire. *Backfire*: fire set along the inner edge of a fire control line to stop spreading. *Class E*: a fire of 1,000 to 5,000 acres. *Smokejumper*: a firefighter who travels to fires by aircraft and parachute. *Towerman*: a lookout man stationed on a tower.

Modern fire fighting methods are similar to modern warfare—with fire being the enemy. In remote sections of the Western mountains, smokejumpers parachute from aircraft to achieve fast, aggressive attack. Aircraft is also used to cascade water and fire-retardant chemicals on fuels near the fires. Helicopters too are used to scout a fire, to transport men, to deliver urgently needed supplies to the firefighters and to drop water and chemicals on spot fires in critical sections of the fire line. Airplanes, helicopters, trucks, buses, bulldozers; these and more provide support for the fire-fighter. But, like soldiers in battle, it is the fire-fighter who completes the fire line and controls the distribution. As previously mentioned, electronic communication methods of the latest design are the vital ingredients that ties this complicated operation together.

### Sharing Responsibilities

Considering the magnitude of the forest lands in the United States (and Canada is considered too since a forest fire out of control knows no international boundary) it is a complex and highly efficient combination of federal, local and private inter-relationships which are involved in the total prevention-suppression effort.

As noted, the Department of Agriculture, Forestry Service, bears the responsibility for the National Forests. Nearly 403 million acres of unappropriated and unreserved public domain land of the United States (including 147 million acres of grazing districts) is managed by the Department of the Interior, Bureau of Land Management. Although much of this land is desert or semidesert, or range and watershed land, about 160 million acres are classed as timber or woodland.

Since the establishment of the Clarke-McNary Act of 1924, the Forest Service cooperates with state agencies in providing protection and combatting forest fires. This cooperative protection covers approximately 480 million acres. The state forestry agencies and the federal Forestry Service organize protection systems along similar lines, using the same types of equipment and fire fighting techniques.

In addition to the Federal-State cooperative efforts, many states with mutual borders and geographical locations have formed compacts enabling them to help one another during fire emergencies—an example of which is the Northeastern Interstate Forest Fire Protection Compact which includes the six New England states and New York. Similar compacts have been organized for the Southeastern and Central regions of the country.

### Use To Good Advantage

Is fire all bad? As a wild forest fire, yes! But, when controlled, and scientifically applied, certain fires are beneficial to the forest. This type of good fire is called a *prescribed fire*.

Various reasons exist for setting prescribed fires, among which are reducing hazardous excessive fuels, controlling certain vegetation diseases, controlling poor-quality hardwoods, preparing seedbeds, preparing planting sites, and improving wildlife habitat.

In attempting prescribed burning, utmost care in planning is required. It is a matter of expertise developed from extensive training, knowledge and experience—anything less is like

letting a child play with matches.

Of utmost importance in considering a prescribed burn is full and complete information of the weather. Winds are a fire's vehicle. Relative humidity is an important factor regarding the controllability of the fire as is the ambient temperature. It's interesting to know that, as an example, temperatures from 20 to 50 degrees are desirable for winter burning. Temperatures above 50 degrees creates a possibility that the fire will harm the growth or even kill small desirable trees.

What of the result of the fire protection given the woodlands by the federal and state organizations charged with the responsibility? An interesting, and provocative, statistic comes to light. In 1966, of the total listed forest area of 4,574,389 acres, 69.37 percent was protected—the balance, 30.63 percent, unprotected. Of this total, the burned portion of the protected area amounted to 0.28 percent—the unprotected area had 2.99 percent burned.

### Industry's Concern

Typical of the interest that paper manufacturers, lumber mills and other principal woodland users have in the prevention and suppression of forest fires is the activity of the Oxford Albemarle Paper division of Ethyl Corporation.

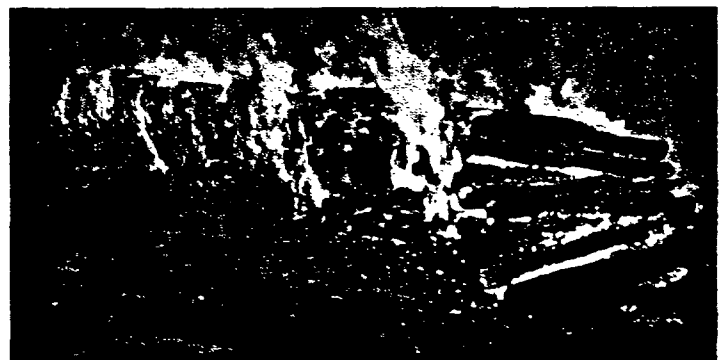
The Division owns and leases approximately 500,000 acres of timberlands—principally in the states of North Carolina, Virginia, and Maine. These lands are managed mostly for future pulpwood supplies as the greatest percent of the pulpwood required at the various mills is purchased from nearby suppliers—at a cost of more than \$25 million each year.

Oxford-Albemarle has been comparatively fortunate over the years with regard to forest fires on its lands—this credited to its keen interest and dedication to the principles of fire prevention and immediate suppression. During the past 25 years, Oxford Paper Company experienced just three fires on Company lands with a total burned area of merely 15 acres—the cause of each fire attributed to human carelessness.

The effectiveness of the fire control program is due to the close cooperation engendered between the Company and the state and local municipal organizations. Within this cooperative framework, Albemarle, for example, maintains a veritable stable of fire fighting equipment at its 80,000-acre Hofmann Forest in North Carolina. Also, in cooperation with the State Forest Service, a 3,800-foot runway is maintained for launching and servicing aerial fire-control planes. At the airstrip a plant has been built to mix, store and pump chemical retardants used by the airborne fire fighters.

In Maine, where Oxford Paper Company has its largest facility at Rumford, the Company has been most active in the statewide fire prevention program—"Keep Maine Green"—as part of a national organization. Since 1955, the chairmanship of this effective Maine group has been voted to a member of the Oxford Wood department. In the Southeast,

In addition to countless 'unharvested' trees, cords of pulpwood ready for transportation to the mill are consumed by the ravaging flames of a forest fire.



Albemarle has been recognized as one of the leaders in fire research and suppression activities. At the present time one of its Wood department members is a vice chairman, and will be chairman in 1969, of the Division of Fire of the Society of American Foresters.

Industry's efforts parallel the "ground rules" based upon the experience of federal and state Forestry departments regarding—it cannot be emphasized too often—fire prevention and fire suppression.

It is the concept of cooperation which has the greatest effect in keeping potentially dangerous fire situations down to controllable minimums. Oxford-Albemarle's programs are based upon the concept of *initial attack and hold* until the arrival of the local state units which, according to regulations immediately assume the direction of the suppression effort including all personnel and equipment if necessary.

Although the Company's primary intent is to maintain an organization to prevent and suppress fire on its own land, response is made immediately to fires on adjacent lands as well as on other areas when called.

### Inconceivable Damage

The full force and damaging effect of forest fires can perhaps be best exemplified by the comparison of a particular forest fire and the great Chicago fire. Coincidentally, each began on the same day. The Peshtigo fire which raged through Wisconsin in October of 1871, consumed 1,280,000 acres of woodland, destroyed entire towns and villages and cost the lives of 1,500 persons—five times as many people as were lost in the great Chicago fire.

It was the fires that raged through Montana and Idaho in 1910 that spurred public interest in the problem. A regard for the conservation of natural resources took hold of the government's attention—both federal and local—and led to implementation of laws, rules and regulations and organizations of the agencies, groups and procedures which are synonymous with the forests of today.

From prevention methods then, comes progress towards less damage from wildfires. Real trouble comes when one starts and escapes initial attack and threatens to become a large fire. Today there is no fully effective counterforce to a large fire that's up and running. Steps can be taken however, to further reduce the incidence of these large fires by burning up continuous bodies of fire-causing fuels—a hardwood strip through a pine forest, a slow burning grass strip through a brush field, a fuel break through a plantation. These sort of measures, when planned with fire control in mind, gives the fire control officials a chance to overcome the big fire before it becomes a resource-damaging demon.

The situation today—concerning forest fires—is much improved from the early 1900's (18.7 million acres burned in

1917, 4.6 million burned in 1966). Two activities in particular offer the best opportunities to reduce this loss even further: man-caused fire prevention, and converting flammable forest fuels to less flammable conditions. Some day research may show feasible ways to reduce both frequency and potency of lightning strikes. But that reversal of natural phenomena will take time. Meanwhile efforts concentrated on educating the public how to use forests in a fire-safe way is the best method to help reduce fire starts.

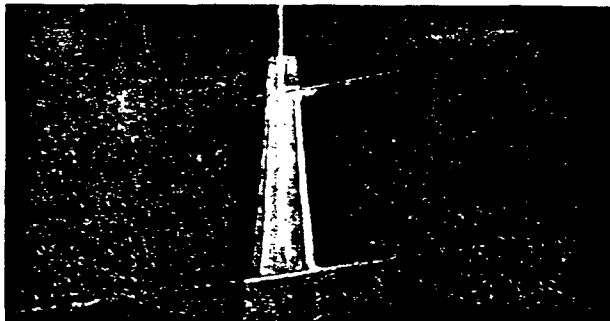


Fire lanes are constructed along the edges of fires and as a necessary measure to help prevent one tract from becoming ablaze as the result of an adjacent fire.



Although a picture may be worth "a thousand words," none can truly illustrate the vast destruction caused by forest fires—the loss of trees, soil, wildlife, other natural resources and recreational areas defies complete description.

The landing strip and fire-retardant chemical plant at the 80,000 acre Hofmann Forest located in North Carolina. The original 2,800-foot runway is being extended an additional 1,000 feet.



See America first:

enroute to Mexico City

This fall the Olympic Games, a World's Fair, and a tour of two nations will be right down the highway for thousands of American motorists and their families.

The automobile can be the passport to an international month-long holiday for the typical driver from almost every point in the continental United States. The highlight of the trip will, of course, be the Summer Games of the 19th modern Olympiad to be held in Mexico City—October 13 to 26 (The rainy season, which ends in early September, is the reason for the late start).

Enroute, the vacationer can pass through San Antonio, Texas, and, as a bonus attend HemisFair '68, the third World's Fair in North America this decade. The San Antonio, Texas, fair combines the international flavor of Canada's Expo '67 (more than 30 nations have exhibits or pavilions) with the breath-taking industrial exhibits of the New York fair.

The Federal District of Mexico with a population of more than two and a half million, is the oldest and perhaps most cosmopolitan city in North America. Its mile high altitude keeps the temperature pleasant all-year-round—however, sweaters and light topcoats will feel good in the evening.

*continued*





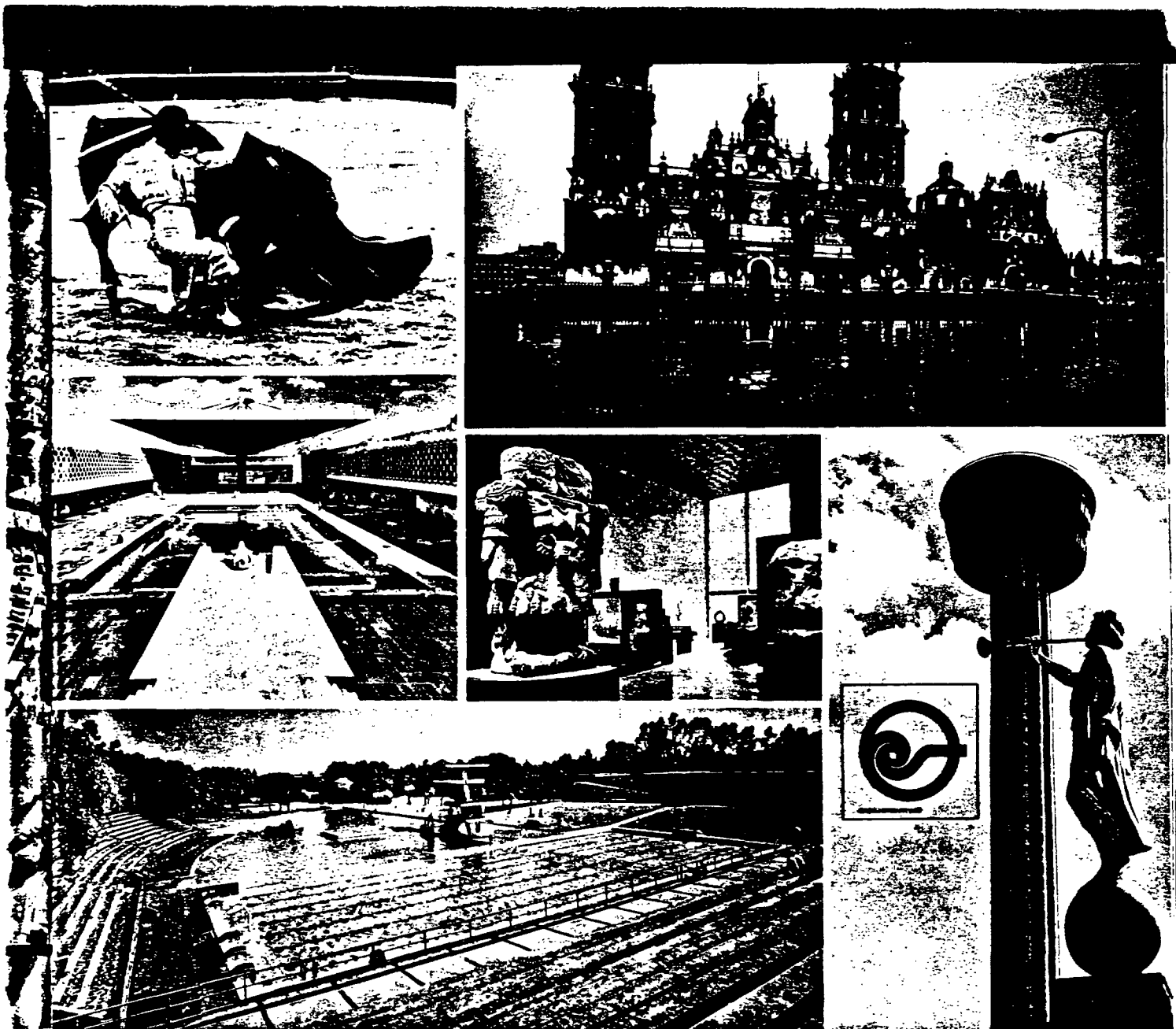
Sports fans have more than the Olympics at their fingertips in Mexico City. October is also the start of the professional bull fighting season held every Sunday at 4 P.M., and you can count on it starting on time. If you want to enjoy the spectacle without sweltering and eye strain make sure that your ticket is on the somber (shady side).

As of this writing there are still plenty of hotel rooms available, and the Mexican government has set up a bureau to guard against gouging. The Accommodations Control Office (OCA) establishes

and enforces rates and is also the clearing house for individual hotel reservations and tickets for Olympic events. Accommodations at private homes are also available at rates ranging from \$10 to \$16 a day. Olympic tickets can be purchased through the OCA for single events or selected groups of events. However, such tickets will only be issued to persons with confirmed room reservations.

The Olympics continue to be the greatest spectacle in the world of sports—where the best of the world's athletes

compete in friendship for the glory of amateur sports. However, since 1936 when the Olympic games were held in a swastika-draped stadium in Hitler's Berlin, international politics have spiced the competition. In the past two decades, for example, much interest has centered on the unofficial point battle for Olympic supremacy between the United States and the Soviet Union. Nevertheless, rivalry between nations still takes a back seat to individual and team performances on the field. Fans from all countries have thrilled to the



record breaking broad jumps of America's Jessie Owen, the graceful long distance running of Czechoslovakia's Emil Zatopek, the coordination of Russia's gymnastic teams—the world's finest athletes vying for the ultimate gold medal in so many kinds of contests including the ultimate test of all around ability; the ten-event decathlon.

The Olympic concept of brotherhood-in-sports dates back to ancient Greece where the games originated in 776 BC and continued uninterrupted for more than ten centuries. The modern Olympic

era, as we know it today, began in 1896 at the very site of the ancient games in Athens.

This year's summer games at Mexico City will be the first time that the Olympics have been hosted by a Latin American nation—but Mexico itself has an ancient "Olympic" history of a sort. Long before the Conquistadores set foot on the new world, Aztec tribes and villages periodically battled one another in sacred games of skill. Their sport resembled a combination of soccer and basketball—the object being to place

a ball inside of a ring using only knees and hips. Opening ceremonies were just as colorful as in any Olympic games—albeit a good deal more drastic. The opposing teams lined up at mid-court and a magnificently dressed representative of each side came forward, kneeled, and promptly lost his head—*literally*. The gods were satisfied and the games began.

Only a few miles from the site where Aztec royalty watched these early games, soccer teams from the nations of the world will battle for Olympic medals at the mammoth new 100,000-

seat Azteca Stadium.

Motorists from the three largest regional-population focal points of the United States (New York, Chicago and Los Angeles) can drive to the Olympics via excellent scenic highways. The routes and suggested stopover cities were selected—as suggested by the American Automobile Association—because of:

- Optimum driving time between stopovers . . .
- Good accommodations . . .
- Interesting sightseeing . . .
- Adequate gasoline and car-service facilities . . .

Motorists who wish extensive touring at any city along the way should plan to extend their trip by one day for each day of sightseeing. *Join the trip at the location nearest your home and plan on an unforgettable vacation-on-wheels, arriving in Mexico City for the opening of the 1968 Summer Olympics.*

## THE OLYMPIC GAMES AND MEXICO CITY

Mexico City was a metropolis of some 60,000 homes at a time when Manhattan was still an uninhabited island. It was founded by the Aztec Indians in 1325. Legend has it that a wandering tribe saw an eagle with a serpent in its mouth and took it as a sign from heaven to build the city. Today's Mexico City is a tourist's delight. Some top attractions are the Floating Gardens of Xochimilco, which is also the site of the Olympic rowing events, and the famed pyramids of the sun and the moon which tower more than 200 feet in the air. Many historians believe that these structures predate the birth of Christ. Also, see the University of Mexico with its large exterior murals on many of the buildings and the front of the stadium. These brilliant and bold facadal murals were done by the most famous artists of Mexico and often cover a complete wall of large buildings. ■



# TO MEXICO CITY AND RETURN...

## FIRST DAY

Be on your way before the rush hour traffic. Cross the George Washington Bridge onto the New Jersey Turnpike, continuing on to Richmond, Virginia, via scenic limited-access highway all the way. Richmond is both an important industrial city and a cultural and historical focal point of the New South. Gamble's Hill Park, offers a breathtaking view of Richmond's James River. At this site, at the foot of South Fourth Street, is the stately—Great Georgia style—headquarters-complex of Ethyl Corporation.

## SECOND DAY

Drive along excellent Interstate and limited-access four-lane highways that cross fertile tobacco, pine forest, and cotton farming country—passing Roanoke Rapids, and Raleigh, North Carolina—to Greenville, South Carolina. Greenville is a typical Piedmont-area city known for its good fishing waters.

## THIRD DAY

Take Interstate Highway 85 all the way to Montgomery, Alabama, broken only by a short stretch of two-lane highway in Georgia. Montgomery, known as "The Cradle of the Confederacy" retains its old southern charm and character despite growing industrialization.

## FOURTH DAY

Good two- and four-lane highways bisect Alabama and then turn westward along the gulf coast to New Orleans, Louisiana. New Orleans, of course, is world famous for its dixieland jazz, creole cooking and iron-grillwork French Quarter highlife. The 31-mile long Lake Pontchartrain Causeway at the gateway to the Crescent City is one of the world's largest over-water spans—so long that design engineers had to account for the curvature of the earth in its construction.

## FIFTH DAY

Drive past Baton Rouge, the petrochemical capital of the South, whose many industrial complexes includes a 200-acre manufacturing facility of Ethyl Corporation, through the oil-lands of western Louisiana and eastern Texas on to Houston. This bustling metropolis is the home of the famed Astrodome—the world's first domed stadium—and NASA's Manned Spacecraft Center. Nearby in Pasadena, Ethyl maintains another major chemical-producing plant.

## SIXTH DAY

Leaving Houston before the morning rush hours, you can be in San Antonio by noon in time for a visit to HemisFair '68. The fair grounds can be best seen from the top of the Tower of the Americas. Exotic foods can be sampled at the international village (Las Plazas del Mundo). The exposition's events provides varied programs of music, sports, art, water shows and drama.

## SEVENTH DAY

Via Interstate Highway 35, you should reach the Mexican border by lunch time. Caution, your American automobile insurance is not valid in Mexico. However, you can purchase a Mexican policy in Laredo, Texas—for the length of your stay—at a cost of about 30 cents a day. Once you have crossed the border it is advisable not to drink unbottled water, or eat fruits or leafy vegetables anywhere but at reputable hotels and restaurants. Driving south, Mexican Route 85—the Pan-American Highway—is a two-lane road passing through largely uninhabited plains. By late afternoon you should reach Monterey, Mexico's leading industrial city.

## EIGHTH DAY

The roads through this next stretch of Mexico range from poor to very good two-lane highways. Check your fuel gauge when you pass larger towns, since it can be a long way between gasoline pumps. Stop overnight at San Luis Potosi, which was the seat of the Mexican government in the days of Juarez. Here the markets offer good buys in natural silk and pottery.

## NINTH DAY

Good two-lane and toll highways bring you into Mexico City by late afternoon.

## RETURNING

The return trip can be accomplished via a quicker route which will take the motorist through: San Luis Potosi, then Monterey, on to Austin, Texas, continuing, through McAlester, Oklahoma; Springfield, Illinois; through Zanesville, Ohio, and finally, home.

## TOTAL MILES

5,550

## ESTIMATED COST

Costing, approximately, an average of \$30 a day for a husband and wife, and \$7 a day for each child.

## (WITH A SPECIAL STOPOVER IN SAN ANTONIO, TEXAS):

Famous Route 66—which is now Interstate Highway 55 in most places—provides a fast pleasant ride through rich farming country to St. Louis, Missouri, one of the oldest settlements on the Mississippi River. The new Gateway Arch soars 640 feet over the mall into the heart of the city. Gaslight Square—a huge entertainment complex built to resemble St. Louis of the Gay Nineties—provides after-dark fun. Daytime attractions include the St. Louis Art Museum, the Missouri Botanical Gardens and the McDonnell Planetarium.

The drive from Los Angeles to Phoenix, Arizona, is fast and interesting, passing through picturesque scenery ranging from the rich Imperial Valley of California to rugged desert east of Yuma. Caution, the trip from Yuma to Phoenix can be hot and uncomfortable. Phoenix is one of America's fastest growing cities and it is now the electronics capital of the Far West.

Interstate Highway 44 passes through hilly country-side to Joplin, Missouri. This industrial city, which owes its early growth to the discovery of lead is now the sportsman's capital of Southern Missouri, with scores of spring-fed fishing holes.

Take Interstate Highway 10 all the way to Las Cruces, New Mexico. The area around Las Cruces—once a barren desert—thrives on cotton harvested from the fertile Mesilla Valley of the Rio Grande River. The region was developed by the government's Elephant Butte Dam irrigation project.

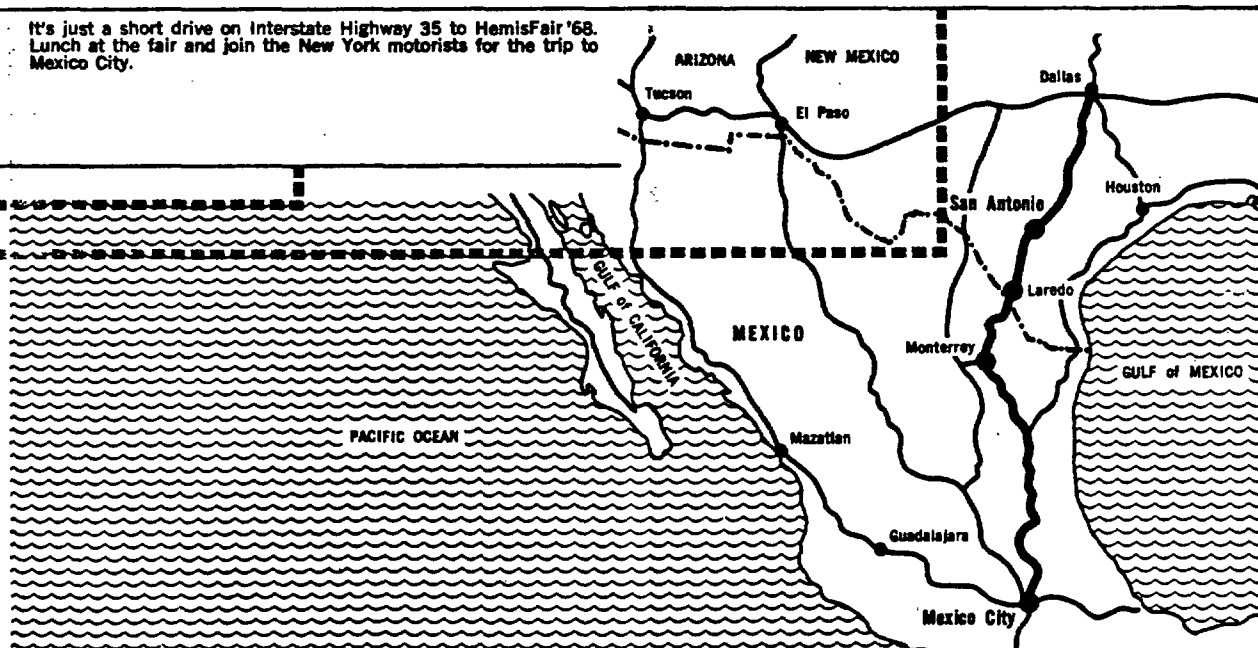
A morning's ride on the Will Rogers Turnpike and an afternoon's drive on two-lane U.S. Route 69 brings you to McAlester, Oklahoma—a cattle center in the Ozark Lake area. The city is known for water sports and rodeos, the most famous of which is held at the Oklahoma State Penitentiary every summer.

Follow the Rio Grande River past El Paso, the largest city on the Mexican border, to Del Rio, Texas. Lake Walk and Devil's Lake, a few miles from town, offer excellent water sports.

Good two- and four-lane roads go through the outskirts of Dallas then south to Austin, Texas. This city, once the capital of the Republic of Texas and still the capital of the state, is illuminated at night by artificial moonlight from mercury-vapor lamps atop 27-foot towers. Austin is also the site of the University of Texas and the Texas Memorial Museum.

With an early start you can arrive at San Antonio by lunch-time. Join the New York Motorists for a tour of HemisFair '68, and on to Mexico City.

It's just a short drive on Interstate Highway 35 to HemisFair '68. Lunch at the fair and join the New York motorists for the trip to Mexico City.



The return trip is best accomplished via the same route.

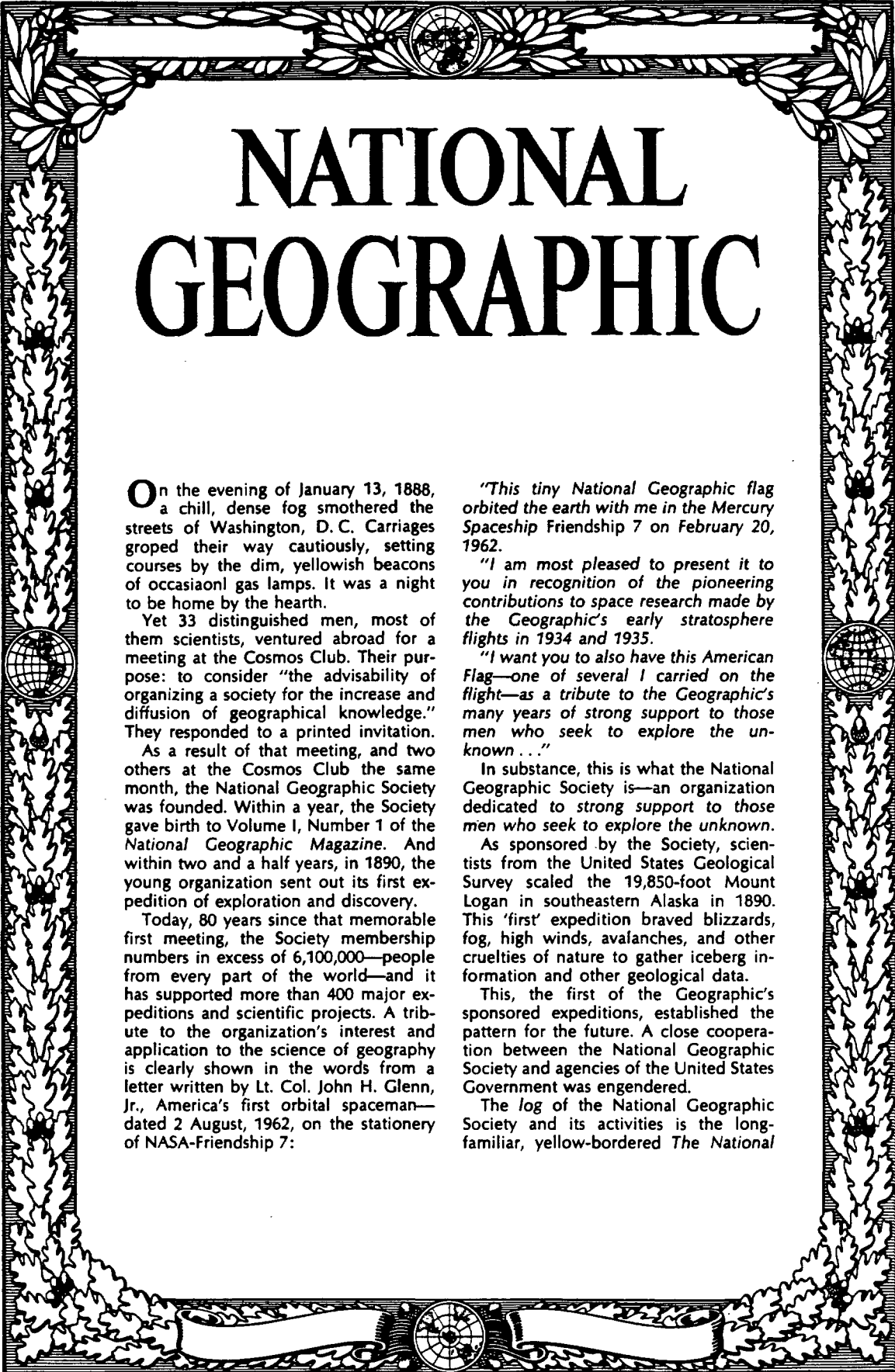
The return trip is recommended via the scenic and shorter Mexican Pacific route—passing through Guadalajara, the home of the mariachis, wandering guitar playing bands; Mazatlan; and Guaymas; Tucson, Arizona, and Old Tucson, an 1860 version of the present city; and Wickenburg, California, where, if you have energy left, this city is the heart of dude ranch country.

4,250

4,475

Costing, approximately, an average of \$30 a day for a husband and wife, and \$7 a day for each child.

Costing, approximately, an average of \$30 a day for a husband and wife, and \$7 a day for each child.



# NATIONAL GEOGRAPHIC

On the evening of January 13, 1888, a chill, dense fog smothered the streets of Washington, D.C. Carriages groped their way cautiously, setting courses by the dim, yellowish beacons of occasional gas lamps. It was a night to be home by the hearth.

Yet 33 distinguished men, most of them scientists, ventured abroad for a meeting at the Cosmos Club. Their purpose: to consider "the advisability of organizing a society for the increase and diffusion of geographical knowledge." They responded to a printed invitation.

As a result of that meeting, and two others at the Cosmos Club the same month, the National Geographic Society was founded. Within a year, the Society gave birth to Volume I, Number 1 of the *National Geographic Magazine*. And within two and a half years, in 1890, the young organization sent out its first expedition of exploration and discovery.

Today, 80 years since that memorable first meeting, the Society membership numbers in excess of 6,100,000—people from every part of the world—and it has supported more than 400 major expeditions and scientific projects. A tribute to the organization's interest and application to the science of geography is clearly shown in the words from a letter written by Lt. Col. John H. Glenn, Jr., America's first orbital spaceman—dated 2 August, 1962, on the stationery of NASA-Friendship 7:

*"This tiny National Geographic flag orbited the earth with me in the Mercury Spaceship Friendship 7 on February 20, 1962.*

*"I am most pleased to present it to you in recognition of the pioneering contributions to space research made by the Geographic's early stratosphere flights in 1934 and 1935.*

*"I want you to also have this American Flag—one of several I carried on the flight—as a tribute to the Geographic's many years of strong support to those men who seek to explore the unknown..."*

In substance, this is what the National Geographic Society is—an organization dedicated to strong support to those men who seek to explore the unknown.

As sponsored by the Society, scientists from the United States Geological Survey scaled the 19,850-foot Mount Logan in southeastern Alaska in 1890. This 'first' expedition braved blizzards, fog, high winds, avalanches, and other cruelties of nature to gather iceberg information and other geological data.

This, the first of the Geographic's sponsored expeditions, established the pattern for the future. A close cooperation between the National Geographic Society and agencies of the United States Government was engendered.

The log of the National Geographic Society and its activities is the long-familiar, yellow-bordered *The National*

*Geographic Magazine*. More about this later—first, about the Society's early beginnings.

### Founding Fathers

It was largely through the efforts of Gardiner Greene Hubbard that the Society was formed. Mr. Hubbard—a Boston attorney and philanthropist who helped form the first telephone company for his son-in-law, Dr. Alexander Graham Bell. Mr. Hubbard was the Society's first president.

As today, the roster of members and founders of the Society in 1888 reads like a "Who's Who" in the world of science, professionalism, and intellect.

Perhaps these names are familiar: Commodore George W. Melville, U.S.N.; Edward E. Hayden, meteorologist; Grove Karl Gilbert, geologist; Henry Gannett, geographer; William H. Dall, naturalist; James Howard Gore, educator; O. H. Tittman, geodesist; James C. Welling, journalist; C. Hart Merriam, Chief, United States Biological Survey—just some of the 33 eminent men who founded the National Geographic Society.

The Society, chartered in Washington, D.C., according to the laws of the United States as a nonprofit scientific and

educational institution, is directed by a Board of Trustees—24 members, each elected for life. Vacancies are chosen by a majority vote—in addition, the trustees elect the president and other principal officers of the Society and the editor of the Magazine.

The Trustee body is comprised of leaders in the fields of science, education, law, business, finance, government, the armed services, and aviation.

Included in the list of distinguished Trustees is Dr. Thomas W. McKnew, advisory chairman of the Society board, and director of Ethyl Corporation.

In 1888, the Society's members were all "neighbors." Today the membership includes inhabitants from every part of the globe—from A, Afghanistan to Z, Zanzibar. On each side of every political "curtain."

It is interesting that nearly 90 percent of the members renew their membership each year—a phenomenal record.

Just what is the National Geographic Society to its membership?

An eight-year-old boy wrote to the Society: "Some other boys and I were thinking about going to Africa to explore. We haven't got very much money in the bank, so we would like very much if

the *National Geographic* would send us. I was thinking of going when we are 21 years old... that would be 13 years from now, thank you very much."

Certainly very few, if any, members as such partake in actual expeditions. Unfortunately too, all too few do not even get the opportunity to visit Washington and the Society's headquarters there.

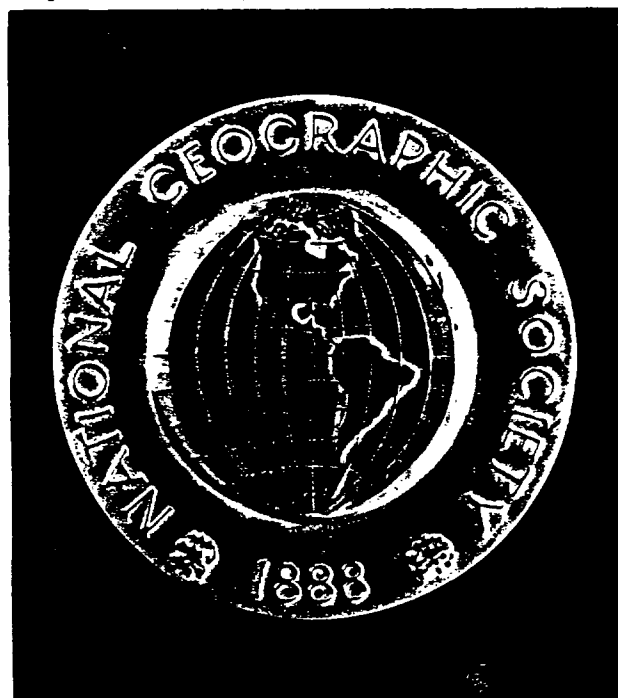
There is however the satisfaction of participating in and jointly owning (the Society is a membership organization) a world-wide cooperative endeavor devoted exclusively to education and scientific research.

The business of the Society is conducted by a staff of nearly 2,000 persons gathered in a complex of buildings in Washington.

The activities of the Society—its monthly issues of the *National Geographic Magazine*, numerous scientific expeditions, researches and educational facilities—are paid for by the comparatively modest dues charged to its members. The pride in the ability to be self-sustained was illustrated by Alexander Graham Bell, the Society's second president, when he said, "We have never had to take our hats off to any multimillion-

The Hubbard Medal—bearing the name of the principal founder and first president—is awarded annually, since 1906, by the Society in recognition of extraordinary achievements in the areas of the National

Geographic's interests. The 1967 medal was awarded to Juan T. Trippe, aviation pioneer, recently retired chairman and chief executive officer of Pan American World Airways.





Architect Edward Durell Stone designed the new National Geographic Society headquarters to be as beautiful at night as it is in the day. The freestanding 10-story building, located in Washington, D.C., was dedicated on January 18, 1964.

aire for having endowed the Society with a million dollars; we have done it all ourselves."

The membership dues are certainly spread far in the accomplishment of the organization's basic purposes—exploration, research and education.

From its first expedition in 1890, The Society has sponsored, supported, and participated in hundreds-more similar ventures: Its financial help to the 1908-09 expedition of Robert E. Peary, first to reach the North Pole; Discovered, named, and explored Valley of Ten Thousand Smokes, Mt. Katmai, Alaska, 1915-19. This led to the establishment of Katmai National Monument; Central China Expedition collected botanical and zoological specimens in Inner Mongolia; Willis T. Lee mapped and photographed the Carlsbad Caverns, New Mexico, 1924, leading to preservation as National Park; Helped Dr. C. G. Abbot of Smithsonian erect and operate solar radiation observatory on Mt. Brukkaros, South-West Africa, 1925-29; Encouraged and helped finance Byrd Antarctic Expedition over the South Pole 1928-30.

Those were early events—and through the subsequent years the activities continued.

#### Many Other Services

As maps play an important part in man's desire and need to travel, so is mapmaking itself an important part of the Society's work. Each year National Geographic cartographers design and

produce new maps of areas of the world as supplements to the Magazine articles. In 1957, the large staff of expert map makers began charting the entire world—fresh maps to bring into focus the many changes that have taken place in the political face of the earth. This much needed *Atlas of the World* appeared in 1963—revised and enlarged in 1966.

Aids to education are important aspects of other Society contributions. Filmstrips, *Geographic School Bulletins* and similar services are prepared by the Geographic staff.

In addition the Society operates the *National Geographic News Service*—bringing into focus the background information concerning prominent occurrences which involves any place on earth.

The *National Geographic Television Service* produces four color specials each year—perhaps you viewed the recent story of "The Amazon."

The *Book Service* and *Special Publications Division* prepare color-illustrated books covering a broad range of subjects.

However, the most popular aspect of the organization's services to its membership is the monthly, four-color *The National Geographic Magazine*.

#### 80 Years Ago

As originally issued in October, 1888, the publication was a gloomily-bound, highly technical magazine.

A group of the charter members were opposed to any change—they hoped to keep the magazine technical in content.

Typical of the expeditions sponsored by the Society is that of Dr. and Mrs. Louis S. B. Leakey, examining a campsite of the oldest known manlike creature—*Zinjanthropus*, in Africa.

When Alexander Graham Bell became president in 1898, he accepted the position with an eye to making the *National Geographic* a livelier journal.

The first editor hired was Gilbert Grosvenor—the 23-year-old youth began his job on April 1, 1899. (As an interesting sidelight, Geographic historians note the fact that Mr. Grosvenor wed in October of the following year—his wife was Elsie May Bell, the charming daughter of Dr. Bell.) During the early days a tug-of-war developed between Society executives concerning the Magazine's format and method of circulation. Dr. Bell took the position, "A combination of membership and magazine will be a stronger attraction than a mere subscription to a magazine. Where many persons will not subscribe for *The Magazine* alone, they will become members because they get two things, the distinction of membership in a well-known society and also a good monthly journal... Neither the Magazine nor the Society can stand alone, for each helps the other."

In November, 1910, National Geographic printed its first series of color photographs.

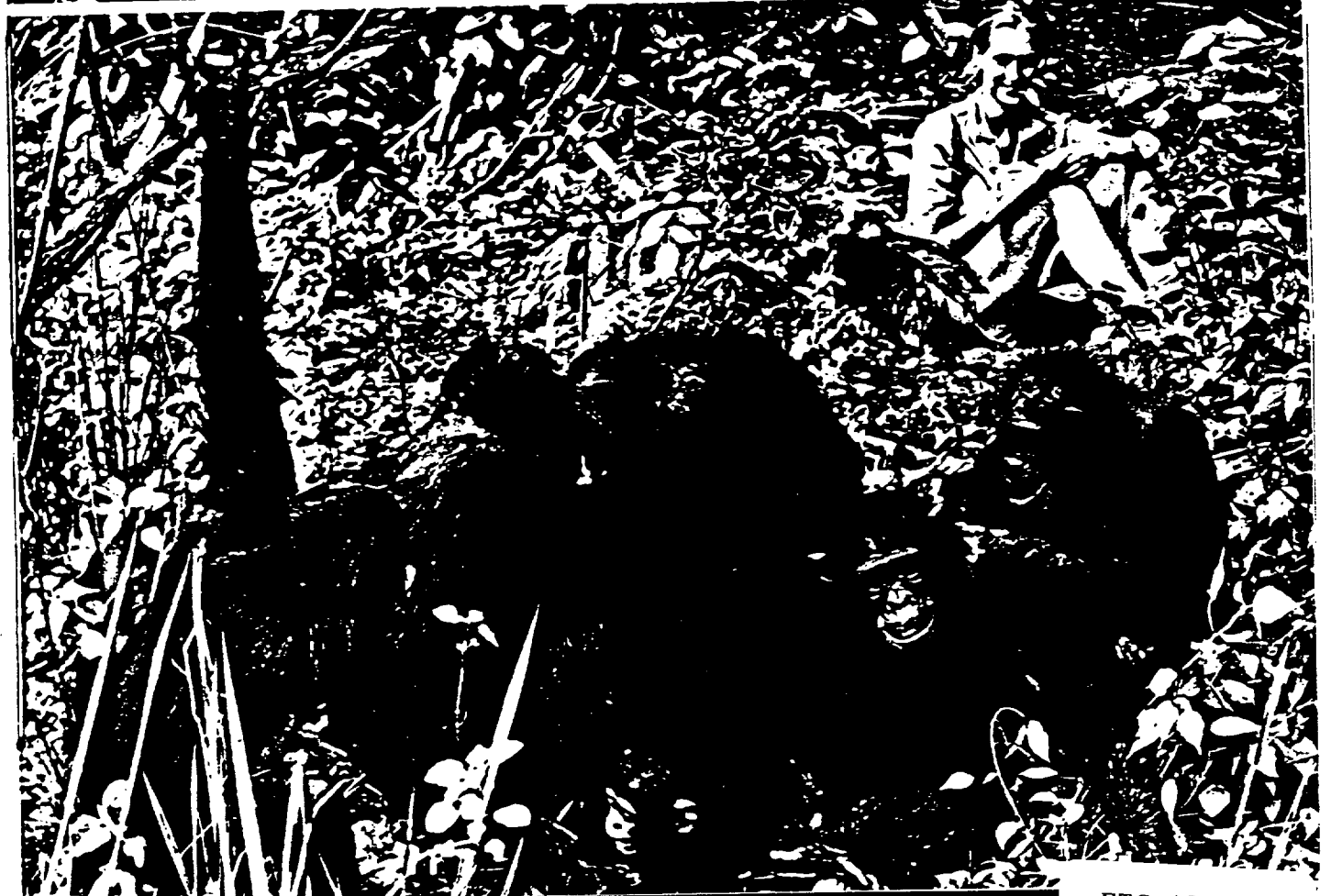
The effect, content and usefulness of *The National Geographic Magazine* is well known—little known however is the 'mystique' of such an accomplishment.

#### Printing and Paper

It was in 1960 that a new high in Society memberships required a re-evaluation of the production capabilities of existing printing facilities. In the words of Dr. Melville Bell Grosvenor, president and editor of the National Geographic Society, "New presses became vital this year. Our growing membership outstripped the capacity of old, slow, sheet-fed presses. But we had foreseen this and long ago consulted the Nation's foremost printing engineers.

"The Society needs high-speed presses, we told them. But we must also have better quality in our color illustrations.

The Baroness Jane van Lawick-Goodall has been studying the great apes in Tanzania's Gombe Stream Game Preserve since 1960. Here, the Baroness observes a 'favorite pastime—mutual grooming.



ETC 17903

"These demands started an industrial adventure story. Brilliant engineers and executives of the R. R. Donnelly & Sons Company, in Chicago, the Society's new printers, helped us plan the presses. The Cottrell Company in Westerly, Rhode Island, custom-built the precision machines.

"Not everyone was optimistic... Temporarily the pessimists were right:

No manufacturer then produced a coated paper having sufficient smoothness, strength, and other qualities to meet Geographic standards.

"The Oxford Paper Company solved the paper problem by developing a radically new coating process with their North Star Coater."

Picture the printing of more than 6 million copies of The National Geogra-

phic Magazine—running through the presses (there are four presses) at the rate of 40,000 pages a minute. As with anything else, a chain is only as strong as its weakest link, so the successful production of the famed Magazine is highly dependent upon the ingenuity of the engineering of the presses and the exceptional quality of the paper.

This however, is another story. ■

The web of specially prepared paper-manufactured by Oxford Paper Company, a division of Ethyl Corporation—is inked with as many as six colors as it passes through the National Geographic Society's high speed presses at the rate of more than 10,000 pages a minute.



# WATERWAYS

## VACATION-TIME HIGHWAYS...

Like television sets, vacations in Florida, and two cars to a family, power boats are status symbols no longer. They have run the gamut from toys of the affluent, to expensive middle class luxuries to common-place family fun.

This is not to say that snob appeal has vanished from pleasure boating. Far from it. Luxury cruisers this year offer as standard equipment: built in hi-fi stereo, wall-to-wall carpeting, drapes, electric freezers and refrigerators, rotisserie ovens and even tile showers. However, the emphasis in the three-billion dollar boating

and accessories industry, is on motor craft that can co-exist with the typical family budget.

Presently, there are close to 8.5 million recreational boats in use on all the waters of the United States. Power boats account for two thirds of this total, with outboard motor boats outnumbering their inboard counterparts by some eight to one.

According to a survey prepared by the National Association of Engine and Boat Manufacturers, only 22 percent of outboard motor purchases are made by

*continued*



persons classified as professional men, managers and business owners. This is actually slightly less than their percentage among total employed persons in the United States. The vast majority—two thirds—of the buyers are clerical people, salesmen and semi-skilled and skilled workers.

Last year more than 41 million persons were active participants in recreational boating. Perhaps the two principal reasons for this marine "population explosion" are due to the parallel growth of service industries and the improved technology that has taken so many of the headaches out of boating—an example of which is that the fuel requirements for today's pleasure crafts are far less restrictive than even a few years ago. One industry spokesman estimates that far more gasoline for motor boats is sold out of the same pump that services the owner's automobile, than from special marine-fuel sources. In the past, boat owners had to plan carefully to be assured of their supply of marine gasoline before starting out on a day afloat. This often meant time-consuming side trips to locate a marina with required service facilities. This is no longer necessary. The most readily available gasoline—leaded regular automotive type—can be used in every marine engine. Most marine engine manufacturers recommend the use of automotive-type fuel. This convenience goes hand-in-hand with increased power and reliability of both inboard marine engines and outboard motors. The higher engine performance, coupled with better fuel economy is a significant factor in the growth of the boating "hobby." This, due to the better fuels and lubricants developed by the petroleum industry and the design of the engine by the manufacturers to perform with the most popular automotive-gasoline grades.

#### A Family "Watermobile"

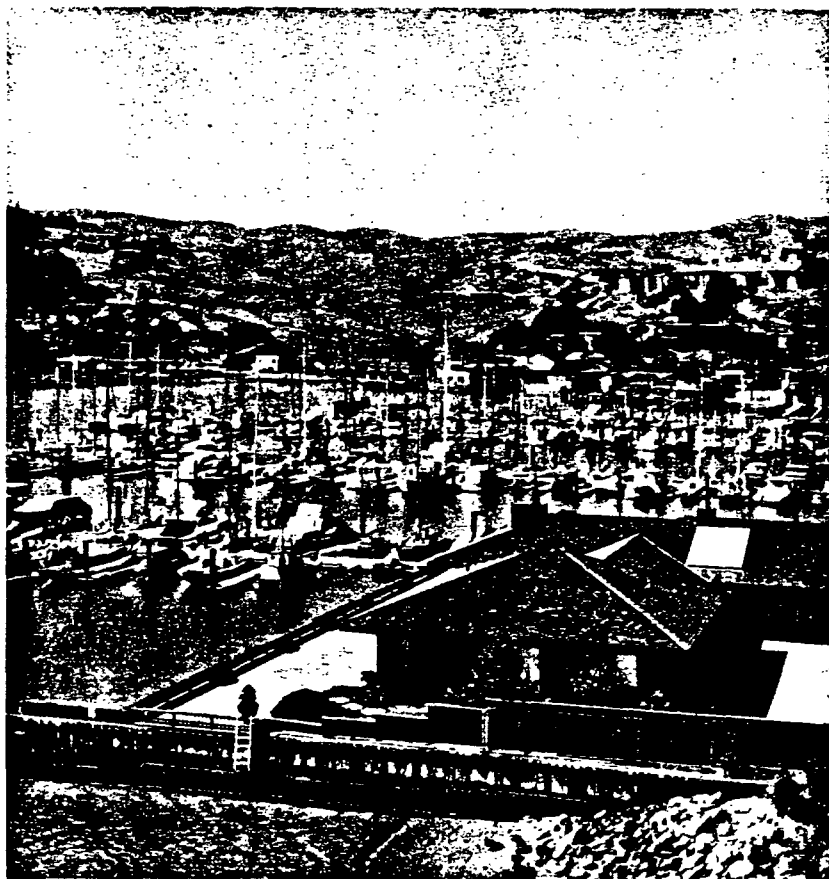
Today's motorboat is a partner of the automobile in far more ways than just sharing the same gasoline. Two-thirds of the 260,000 outboard pleasure crafts sold in the United States last year were purchased together with a boat-trailer. This means that the continuing boating boom adds, rather than detracts, from vacation and holiday driving. Even the relatively easy job of hooking and unhooking the small boat-trailer from the car can be eliminated—for a price. As an example there is a *self-launcher* for cartop fishing-boat owners. It is a combination hoist and carrier that fits on top of any car from the smallest compact up. It just takes one person a

few seconds to hook the sling, crank away at the 250 pound capacity winch, and swing the boat onto the rack atop the car. All that's left is to snap the tie-down and all is ready for the highway.

Among the other innovations to make boating easier and more fun this year is the first non-metallic propeller for outboards. The unit, made of polycarbonate resin, is said to be extremely strong—

aluminum and Fiberglas boats. The paint, which does not contain copper, will not corrode metal. Touching up nicks is a simple matter with a new aerosol spray paint.

To be really self-sufficient while aboard a boat, seawater conversion evaporators are on the market. There is, for example, a solid state control unit for a 30-pound system that will convert up to 10 gallons



in fact it carries a lifetime warranty against blade breakage. The plastic propeller deflects slightly for greater efficiency under start-up or heavy loading conditions, and then returns to required pitch for regular cruising.

New aluminum and bronze propellers this year feature a special pitch generation—the center of the pitch does not coincide with the center of rotation and this produces a concave blade section for greater efficiency.

Maintenance of pleasure craft is simpler with new anti-fouling bottom-paint formulations for all types of hulls and an organotin-type, particularly effective for

of drinking water each hour from the sea.

#### Comfort and Safety

Just a few years ago, typical outboard runabouts were plain, open utilities. Not so today. Outboard motorboats themselves have undergone a beauty and comfort treatment—comfortable seats, glove compartments and folding bunk-seats have replaced the old wooden seats. Speaking of wood, it continues to take even more of a back seat to Fiberglas and aluminum, each of which requires much less maintenance.

Today's boats stress safety first of all.



With the advent of anodizing—a special electro-chemical treatment—aluminum has been put to extensive use aboard modern pleasure craft. Virtually impervious to the effects of weather and water—salt or fresh—anodized aluminum shapes and trim are manufactured to customer specification and supplied in stock shapes by The William L. Bonnell Company, an Ethyl Corporation subsidiary. At Bonnell's Newnan, Georgia, plant "The Bon Voyage Line" of marine-use products includes the custom manufacture of window and porthole frames—including the fitting of the glass or plastic. Other uses for the Bonnell product includes fabrication into handrails, and protective and decorative edging and trim.

There has been increasing emphasis on good mechanical steering devices and fixed gasoline tanks—firmly secured to the hull. In almost all cases strong attention is on adequate flotation. Boats are also fitted with rating plates showing safe load-carrying capacity, and maximum allowable outboard horsepower. Most family runabouts are now fitted with windshields, and an increasing percentage of larger outboard boats have forward cabins equipped with a marine toilet and a small basin. Some even have bunks and a small galley.

Since America's coastal and inland waters can become as crowded as a

California Freeway or New York's Long Island Expressway on a Sunday in July, state and local governments are taking a role in assuring optimum safety.

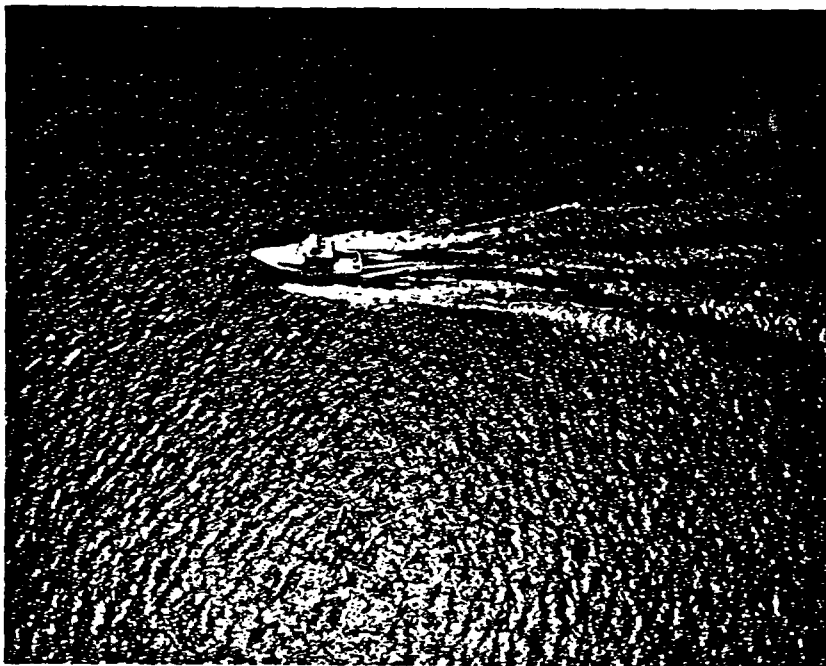
The United States Coast Guard has inspection and law enforcement powers, while its civilian affiliate, the Coast Guard Auxiliary, promotes safety through education.

The federal government enforces two important pleasure-boating statutes—and has another one before congress—setting safe operating and equipment standards. The Coast Guard can board any craft that is found in violation of the law. Frequently-found violations are

the lack of proper engine and fuel-area ventilation, the lack of life saving equipment, and improper use of lights at night. Violators are issued summonses.

The Coast Guard Auxiliary—with its 30,000 volunteer civilian members—conducts free courses for fledgling skippers. There is an 8 to 12-lesson course on basic seamanship and navigation. The Auxiliary also offers a three-lesson condensed version of the course. In addition, a single-lesson course on operating an outboard motor-boat is available.

The Auxiliary also posts members at many marinas and boating clubs to offer free voluntary inspections at the boat-



Dockside and "floating" gasoline stations dot the inlets and ports-of-call of the Nation's waterways affording convenient and carefree motorboating to the ever-increasing fraternity of pleasure-craft owners.



owners request. These inspections go further than simply checking adherence to federal regulations—boats that pass the test are awarded a special decal. According to a Coast Guard spokesman this decal will usually assure that the craft will not be stopped for another inspection.

Under the Boating Act of 1958, all the States may obtain the right to register boats (of which 47 have already done so). States also have certain rights to create boating regulations and enforce them, although the basic Coast Guard regulations for safety equipment and ventilation must be followed by boats on federal waters. Current various state boating laws cover boat-trailers, water pollution, age limitation on boat operators, boat capacity, horsepower limitations, and local speed limits. However, state laws differ, requiring boat owners to be familiar with the law of home states and those states sharing their waters.

The United States Power Squadron, a non-profit private organization with 75,000 members, also makes important contributions to boating safety. It sponsors a 12-week course, free to the public—usually one night a week for two to three hours—stressing safety, seamanship and navigation. The course is given by each of its 369 Squadrons which are located throughout the nation—including two, for military personnel, in Japan and Okinawa.

Similar organizations have been established in Canada, New Zealand, Australia, and The Bahamas by nationals of these countries. All boating authorities recommend that boat owners avail themselves of either Coast Guard Auxiliary or Power Squadron courses before taking to the water.

#### World-Wide Interest

The boating boom in the United States is about as old as the launching of the first space satellite, but is only now beginning to spread overseas. There is keen inter-club competition in motorboat racing in Europe and, on a smaller scale, in South America. Income levels in most parts of the world precludes a boom approaching that in the United States and Canada. However, European boating-industry interests have embraced an active institutional approach to promotion which should begin to show practical results in three to five years.

Pleasure boating has become more than a hobby; it's a way of life for an increasing number of Americans of all income levels. It too is a multi-billion dollar industry that caters to the spirit of adventure that is part of the heritage of this nation. ■

water

**plas·tic** /'plas-tik/ *adj.* [L *plasticus* molding, fr. Gk *plastikos*, fr. *plassein* to mold, to form] **1** : FORMATIVE, CREATIVE (such as forces in) **2 a** : capable of being molded or modeled (such as clay) **b** : capable of adapting ; **PLIABLE** (ecologically such as animals) **3** : characterized by or using modeling (such as arts) **4** : SCULPTURAL **5** : made or consisting of a plastic **6** : capable of being deformed continuously and permanently in any direction without rupture

**syn** **PLIABLE**, **PLIANT**, **DUCTILE**, **MALLEABLE**, **ADAPTABLE**: **PLASTIC** applies to substances soft enough to be molded while capable of hardening into the desired fixed form; **PLIABLE** suggests something easily bent, folded, twisted, or manipulated; **PLIANT** stresses flexibility and sometimes springiness and so lacks some of the suggestion of submissiveness found in **PLIABLE**; **DUCTILE** applies to what can be drawn out and therefore suggests being easily led or influenced; **MALLEABLE** applies to what may be beaten into shape and may suggest lack of independent will or firm character; **ADAPTABLE** implies the capability of being easily modified to other conditions

# plastics

## THE SECOND HUNDRED YEARS

Exactly one century ago, the diminishing elephant population in Africa rapidly changed ivory from a luxury to a very expensive luxury. This led John Hyatt—a full time printer and erstwhile inventor—to mix pyroxyline (made from cotton and nitric acid) with solid camphor, to find a replacement for the vanishing ivory billiard ball. This, in one way, was the start of the seven-billion-dollar plastics industry.

Hyatt's discovery—celluloid—was more than just a pool-room curiosity. Pink in color, it was quickly adopted by dentists as a replacement for uncomfortable hard rubber in denture plates. Soon it was being used to make combs, shoe horns, toys, and even stiff collars, cuffs and shirtfronts. Its use as a roll-

film base turned photography into a family hobby and made possible the first motion picture film. Even the window curtains in early-vintage automobiles were made of celluloid.

In the years that followed, the plastic industry has boomed into the fastest growing segment of the American economy. Plastic, which lined the wings of the Wright brothers first airplane will be a major component of the spacecraft that will carry astronauts to the moon. The last World War proved the military capabilities of the man-made material. Plastics have high tensile and impact strength, lightness of weight, low moisture absorption, high resistance to salt water and many chemicals, transparency, adaptability to varied climatic

conditions and flexibility even at extremely low temperatures.

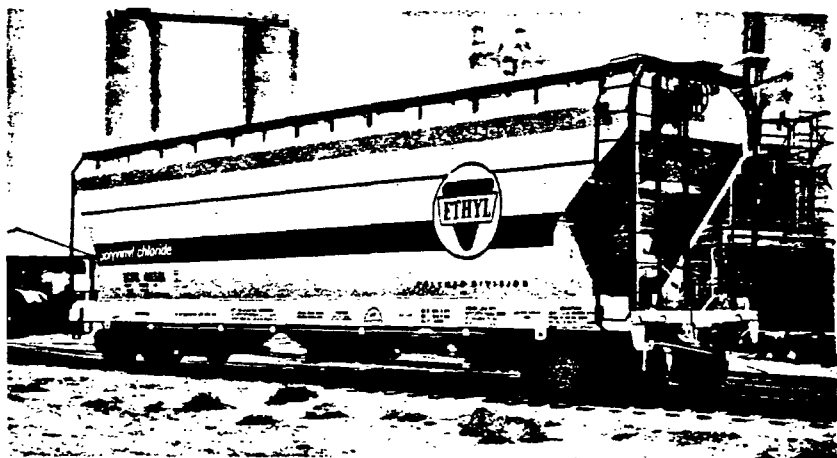
Today about 6,000 companies—employing nearly 200,000 workers, with sales totalling some \$7 billion—are engaged in some aspect of the plastics industry. During the past decade, the industry has been growing at a rate three times faster than the gross national product. In 1960 the average citizen of the United States used 32.7 pounds of plastic; by 1966 that figure jumped to 68.6 pounds.

On its 100th birthday, the plastics industry is still but a healthy toddler, with its most phenomenal growth-years still ahead. The McGraw Hill department of Economics estimates that by 1980 the plastics industry will have grown to

*continued*

PVC resins, and rigid and flexible polyvinyl chloride compounds are produced by the Polymer division of Ethyl Corporation.

A cardboard container becomes 'acid-proof' with a liner of polyethylene film. Ethyl's VisQueen division is a leading producer of this versatile plastic sheeting.



Black agricultural mulch film—also by VisQueen—contains moisture, controls temperature, and spurs initial crop growth.



almost eight times its present size. By comparison, the same forecast anticipates a growth of only 45 percent for the aircraft industry and 56 percent for iron and steel. According to the Society of the Plastics Industry, within two decades more items will be made of plastic than of any other material.

Long before the turn of the century plastics will influence, even more strongly, the life of every person in almost every endeavor ranging from space exploration to household chores . . . from life-preserving artificial human organs to dent-proof automobiles. In preparation for this demand the plastics industry is spending 11 cents of every sales dollar for research and development—this, compared to the national average of three cents.

Here is a preview of plastic's role in the world of tomorrow:

**T**RANSPORTATION: The automotive and plastics industries will be linked even more closely together. This year each new car contains an estimated average of 82 pounds of plastic. Even without any technical breakthrough the figure is expected to rise to 200 lb. per car by 1980 according to a leading plastics trade magazine. Chrysler Corporation predicts a total plastics market in the automotive field of 3 billion pounds by the mid-80's based on current technology. *If there is a design or material breakthrough affecting body or structural components, that figure will soar to 8.6 billion pounds or some 500 pounds per car.*

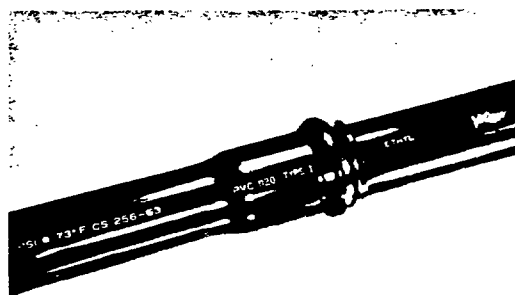
What of the all plastic-body car? It's coming, but because of assembly line needs, the changeover will be evolutionary rather than revolutionary. Production speed right now is the major

stumbling block. There is, however, progress in developing ways to feed plastic sheets into conventional metal stamping and metal working presses. This is leading us to the time when—according to Joel Frados, editor-in-chief of *Modern Plastics Magazine*—"the same basic car body shell will be stamped out of metal from year to year and then customized with reinforced plastic components. That body shell will grow smaller and smaller and smaller—until it disappears from the scene entirely." The plastic car will be much less expensive to maintain—body repairs can be made by hot air welding; it will resist impact and bending stresses better than current auto steel; and will require less insulation and noise reduction because of its damping effect on vibration. In short, it seems that the plastic car of the future will be better, less

Polyethylene film—by VisQueen—is used extensively in the construction industry to cure concrete.



Vis-Queen PVC "Bell: Ring" Pipe—for ease-of-installation potable water and irrigation services.



Polyvinyl chloride (PVC) bottles—by Vypak Company, an Ethyl subsidiary—for liquid, solids, from cosmetics to foods.

From the primary heat shield of the Apollo space craft to the Nose Radome of a C-5A, plastics fulfill a myriad of useful purposes—in the heat shield, as an example, the phenolic-filled honeycomb 'ablates' or disintegrates from temperatures as high as 20,000°F protecting the heat shield during re-entry.

expensive, and safer than its metal counterpart.

**C**ONSTRUCTION: Looking ahead to the next century, we may see entire cities built under a plastic dome—this, to assure optimum weather and atmospheric conditions even in the arctic or the tropics. Houses may still be built of bricks—*injection molded polyvinyl chloride (PVC) bricks*. These can be snapped together without the need of mortar or adhesives, ten times as fast as conventional bricks. The vacation house of the future may be all prefabricated plastic—floors, walls, and roof. Already, prefabricated panels are beginning to be an important factor in the construction of office buildings, schools, hospitals and high rise apartments. They are also being used residentially for low-cost vacation homes. At Expo 67—last year—a one-piece

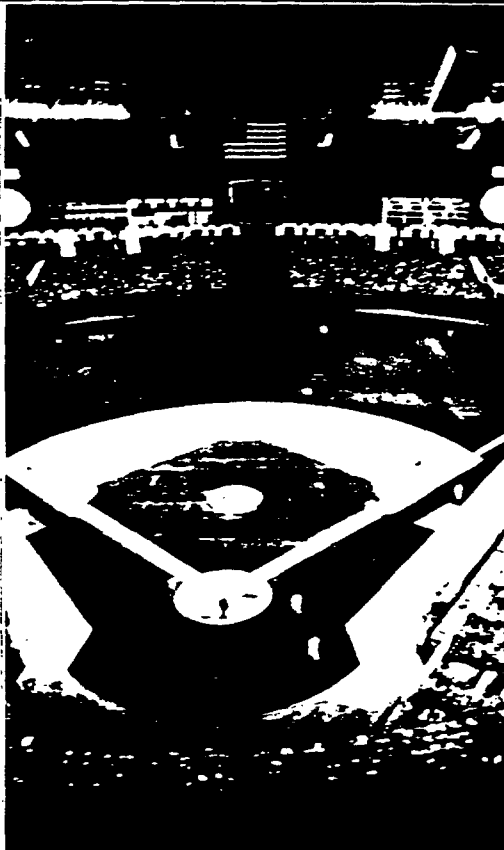
plastic bathroom was displayed as a foretaste of future living. Instead of replacing appliances and fixtures piece-meal, tomorrow's housewife will simply have a new one-piece kitchen or bathroom installed every decade and a half. This trend towards one-piece plastic units has already started on a small scale with kitchen and bathroom sinks and counters.

Plastic piping for all uses show prospects of its replacing all other materials in the future because of ease of installation, strength, flexibility and economy. Just as important, these pipes will eliminate or certainly reduce many of the maintenance headaches inherent with present metal materials. Much research is being conducted to speed the installation of plastic pipe, which will be critical when entire cities changeover to the new system. A portable extruder

is being investigated that will extrude pipe right at the spot of installation. All that's needed is the "raw material" plastic pellets. Another possibility is flexible plastic pipe that can be transported like fire hose and then inflated at the job with a portable air and steam supply unit.

**A**T HOME: One expert foresees a dishmaker—not a dishwasher, a dishmaker—for harried housewives. It's a vacuum forming unit for making disposable plastic dishware quickly and economically. A series of inexpensive dies could produce anything from fine ersatz chinaware to baby dishes. And, the entire unit would require less storage space than is needed for present-day dishware.

For the man of the house, even one with all thumbs, there's a furniture kit in his future. He will be able to buy a



An all-'plastic' playing surface—the grass is green but never needs mowing and is virtually maintenance free.

plastic-film chair in a tube, blow it up, and leave it in his backyard on his way to work in the morning. By evening it will have been transformed into a solid piece of furniture. The secret is a specially formulated polyester resin that self-cures under exposure to ultra-violet light.

Plastic will make the homeowner's life easier in so many other ways. Extensive use of plastic roofing and siding will eliminate the triannual painting chore and cut down on maintenance as well. Breakproof plastic lightbulbs will reduce a safety hazard. Even clothing will be more comfortable. A suit lined with a network of flexible vinyl tubing to circulate water as a heat transfer unit could be adapted into comfortable clothing for the "dog days" of August. The principle of a life preserver vest could be translated into very comfortable inflatable plastic seats built right into clothing. This for things like watching the Mets play in the World Series—we're talking about the distant future of course.

The latest cost of living index shows appliance prices decreasing while labor and other materials costs are on the rise. The shift to plastic components on

both major and minor appliances is part of the reason. Within two to four years, many experts predict that lightweight inner cabinet liners, will be standard on all refrigerators. Before long the outer shells will follow suit.

A top appliance manufacturer put it this way, "there is a potential for 80 pounds of plastic to replace 240 pounds of various metals in refrigerators, washers, dryers, dishwashers and air-conditioners." The housewife of the future will find appliances even more economical, stronger, maintenance free, and easier to move.

In the next few years plastics will take much of the grimy work out of cooking. The market for non-stick pans and appliances is expected to rise. The trend to frozen foods that can be reconstructed right in the bag will be extended to other uses. Meat will be roasted in unsupported plastic bags. All of this will not only save pan cleaning, but also reduce food shrinkage.

**FURNITURE:** One top furniture executive recently predicted that within 10 years plastics will supplant wood in furniture with the exception of antiques, or possibly only the highest priced units. Wood-grained plastics look, feel and even sound like wood—but are lighter and more economical.

**Atomic wood** is a new development which holds great promise for the future. It can be used not only for furniture but for every other application where wood is now employed. This is a newly developed plastic-impregnated irradiated wood which possesses the best properties of both plastics and wood—and then some. Atomic wood will eliminate finishing operations, as well as bring new color and strength dimensions to conventional wood. The material will resist cigarette burns, stains and scuffing—in case of unusual damage, sanding will restore the material to its original condition.

**AGRICULTURE:** Plastics will play a key role in fighting starvation in a world of ever increasing population. Plastics are being used to repel pests, to fumigate, to retain soil, to store silage, to bring water to the deserts and to change the very environment of crops. Plastic films can provide an individual, tiny greenhouse for each single plant or huge air-expanded plastic domes to cover entire farms. The present agriculture market of 30 million pounds of plastic annually is expected to increase by 10 percent annually for years to come.

**PACKAGING:** The demand for plastics for packaging will skyrocket during the '70's—but the market will

continue, for the most part, along present lines. Low cost polyvinyl chloride (PVC) bottles will move into full competition with glass bottles and metal cans—and plastic films will have even greater applications in the packaging of perishable goods. The lightweight packages, made possible by the use of plastic, will make quite an economic difference with the advent of supersonic air freight. In addition, their permeability characteristics will allow meat, fish and other perishables to be air-shipped to all corners of the globe, without extreme refrigeration in individual-optimum atmospheres controlled by the package characteristics itself.

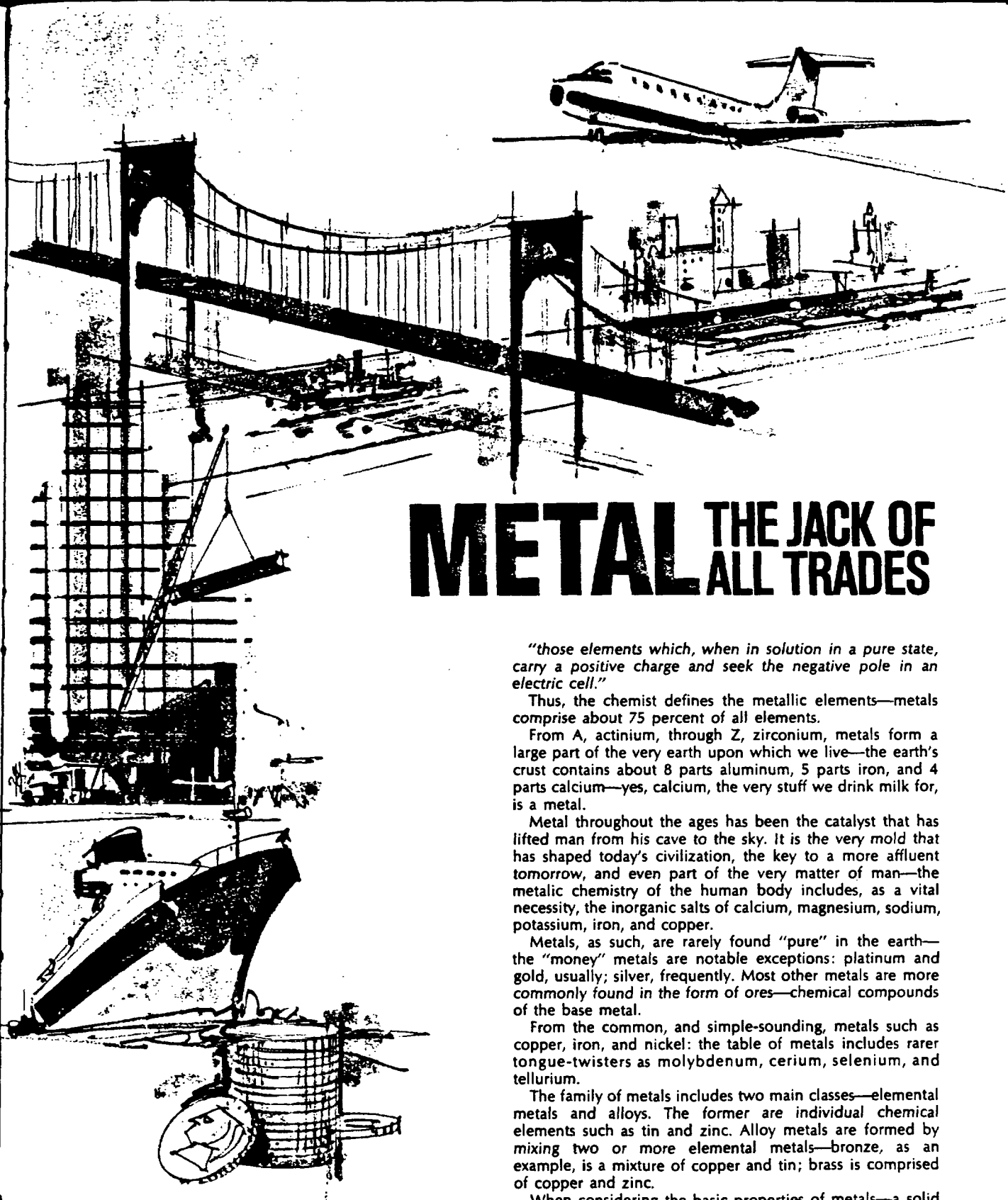
Plastic films will probably have the greatest growth rate, because of their tremendous versatility.

Ralph L. Harding, Jr., of the Society of the Plastics Industry, Inc., indicates, "The Reasons for the impressive growth of plastic films for packaging stem from the incredible and constantly increasing number of attributes which can be built into them. They can be clear; translucent or opaque; with any color, quality, design, or graphics; as light as a breath, or as stiff as steel; molded or formed to any shape or to fit any object; made to keep air or moisture in or out. They can be formulated to contain or resist all manner of corrosive gases or chemicals, or to remain intact at temperatures far below zero—or far above. Combinations of plastics materials can be tailored to create new film or sheeting which will possess virtually any compatible group of characteristics . . . In truth there is hardly any quality which can't be built into a plastic film."

**IN THE WORLD ABOUT US:** Plastic heart valves are prolonging life and there is great potential for other artificial human organs. Disposable hospital rooms will be commonplace before long—plastic sheets, pillow cases, wall coverings, dishes, bedside accessories. When the patient leaves, the nurse zips out the old room and installs a sanitary new one.

In space travel, phenolic filled honeycombs will protect the Apollo space ship from temperatures as high as 20,000°F. when it returns to earth after its history making voyage to the moon. Without the honeycombs, the heat shield would fail when temperatures exceed 600 degrees.

The plastics industry, which really came into its own during World War II, has only dented its potential so far. The versatile material—which is harder than steel or softer than silk—will be the building material for the world of tomorrow. ■



# METAL THE JACK OF ALL TRADES

*"those elements which, when in solution in a pure state, carry a positive charge and seek the negative pole in an electric cell."*

Thus, the chemist defines the metallic elements—metals comprise about 75 percent of all elements.

From A, actinium, through Z, zirconium, metals form a large part of the very earth upon which we live—the earth's crust contains about 8 parts aluminum, 5 parts iron, and 4 parts calcium—yes, calcium, the very stuff we drink milk for, is a metal.

Metal throughout the ages has been the catalyst that has lifted man from his cave to the sky. It is the very mold that has shaped today's civilization, the key to a more affluent tomorrow, and even part of the very matter of man—the metallic chemistry of the human body includes, as a vital necessity, the inorganic salts of calcium, magnesium, sodium, potassium, iron, and copper.

Metals, as such, are rarely found "pure" in the earth—the "money" metals are notable exceptions: platinum and gold, usually; silver, frequently. Most other metals are more commonly found in the form of ores—chemical compounds of the base metal.

From the common, and simple-sounding, metals such as copper, iron, and nickel: the table of metals includes rarer tongue-twisters as molybdenum, cerium, selenium, and tellurium.

The family of metals includes two main classes—elemental metals and alloys. The former are individual chemical elements such as tin and zinc. Alloy metals are formed by mixing two or more elemental metals—bronze, as an example, is a mixture of copper and tin; brass is comprised of copper and zinc.

When considering the basic properties of metals—a solid at ordinary temperatures; opaque; a good reflector of light

*continued*



The mighty Verazanno-Narrows Bridge—connecting Brooklyn to Staten Island in New York—is protected by a lead-based corrosion-resistant paint.

when polished; a conductor of heat and electricity—there are some interesting exceptions. Arsenic is a metal, and so is potassium. Mercury, a liquid at temperatures higher than  $38.87^{\circ}\text{C}$ . below zero is another metal.

The history of metals, for the most part has been evolutionary in nature, with each advance meeting a specific need of its age. One exception however, is the discovery of iron—the beginning of man's step out of the stone age onto the road to civilization.

Today, our space-age requirements have scientists searching for lighter metals that can withstand tremendous stresses at temperatures ranging from near-absolute zero to blazing heat. Half a century ago, similar scientific quests led to the conversion of aluminum from a \$500 a pound laboratory curiosity to an economically-practical tool of industry; discovery that lead could revolutionize motor transportation; and electrolytically turning sodium into a commercially useful product.

These metals, today, touch the lives of almost every living person in so many ways—they make space travel possible, pinpoint weather forecasting, and effect notable advances in medicine. National defense efforts rely on the continued development and use of virtually all metals.

**A**luminum, less than a century old as a commercial product, is second only to steel as the nation's most widely used metal—and the gap is closing fast. In the decade starting in 1956 production of aluminum grew nearly 80 per cent compared with a 10 per cent growth for steel. Interestingly enough, it was steel that gave aluminum one of its biggest boosts early in its history—steel producers discovered that aluminum would draw off oxygen to free steel ingots from furnace blow holes. Aluminum is still used for that purpose today.

Although aluminum was developed as a pure metal during the 19th century, its compounds date back to the dawn of civilization. About 5300 BC in Northern Iraq, the art of pottery was developed with a hydrated silicate of aluminum clay. Other aluminum compounds such as alum were used as dyes, chemical intermediates, and medicines by the ancient Egyptians and Babylonians. But there the history of aluminum rested for thousands of years until, in 1809, Sir Humphrey Davy, separated the metal aluminum from alumina clay by reacting it with iron. Nearly half a century later sodium was reacted with an aluminum compound and

the aluminum industry was born. In the beginning there were problems—aluminum, sold for jewelry, cost an astronomical \$545 a pound. It was until the 1880's when commercially feasible electrolytic processes were developed to free the metal from its ores. Then aluminum came into its own.

One of the first uses for this "new" metal was as the "cap" for the Washington Monument—this, in 1884. The original cap is still atop the obelisk, withstanding 84 years of weathering without need for replacement.

The key to the commercial growth of aluminum is its versatility. The metal can be made into flimsy tinsel for Christmas trees and into armor-plate for tanks. It is light enough to be used as food-wrapping foil and strong enough to withstand the pressure of the ocean depths as a submarine hull.

Aluminum weighs only one-third as much as steel, has twice the electrical conductance of copper, and carries a built-in defense mechanism—when aluminum is exposed to air, an extremely fine film of transparent oxide forms, instantly protecting the surface from further decay. Scratch the metal and another self-sealing surface forms. This is why aluminum can be so efficiently extruded. In fact, for many applications, the exterior of the extruded product is so highly polished in its passage through the die, that it needs no further finishing.

Starting with the Washington Monument, the construction field has now become the largest user of aluminum—exterior panels of aluminum can be erected so fast, that the facade of a 40-story New York skyscraper was covered in one day. The Vehicle Assembly Building at Merritt Island, Florida—said to be the largest building in the world in acreage—is sheathed in special aluminum-ribbed siding. The building—where the moon-bound Saturn V rocket will be assembled—is constructed of about four million pounds of aluminum. Dr. Walter Gropius, of the Harvard School of Design, notes the following reasons for the growth of aluminum from a "rivet in a bucket" to hundreds-of-million pounds of construction-industry material: "Its homogeneity, weather resistance, water repellency and rust-proofness, its susceptibility to precision fitting of parts and finally the beauty of surface that aluminum affords."

Aluminum is by far the most widely used metal for air frames of all private, commercial and military aircraft. Some 80 percent of the structural weight of a typical aircraft is aluminum. Lightness of weight is the reason—each pound saved in the air frame means nine pounds saved in the power unit and other components.

Aluminum's future in all phases of the transportation industry looks bright. Railroad people are investigating light-weight, high capacity aluminum freight cars. On the passenger side of the ledger the siding, doors, and interior of the new 100 MPH trains, will be made of aluminum.

The family automobile too is aluminum-complemented. Much of the bright metal trim—moldings, grills and other decorative and functional appointments—is made of aluminum. Of specific alloy and special finish these parts offer protection, and design appeal with a virtual maintenance-free advantage. Aluminum wheel covers in attractive designs are becoming increasingly popular as are air conditioning components made of the versatile metal.

The underwater sea vehicles that are powered by lead-acid batteries have aluminum hulls to withstand the tremendous pressures of the oceans. Aluminum has also made tremendous gains in electrical applications. Today more than 90 percent of the overhead-transmission power lines that carry electrical current throughout the nation, are made

of aluminum. This is because the light weight of aluminum wire and cable make possible a wider and more economical spacing of supporting towers. And, there is a growing use of aluminum for these towers as well. Aside from the virtually maintenance-free corrosion-resistance that aluminum offers, its light weight can allow entire towers or components to be lifted by helicopter and easily installed in formerly inaccessible areas.

In packaging, easy-open tops which have come into their own during the last few years are rapidly making can-openers obsolete. From canned soft-drinks to meats, the "in-can" opener is a forefinger and thumb.

The petroleum industry is also benefiting from aluminum. Lightweight drill-pipe permits longer strings to be laid with standard surface equipment—this reduces transportation costs and on-site handling problems. In chemical processing plants, aluminum containers are used as they resist many powerful bleaches and solvents. In tire factories, aluminum, which has a high rate of thermal conductivity, aids in the rapid transfer of heat in molding operations. Since certain aluminum alloys retain their strength even in temperatures approaching absolute zero, the metal is playing a part in the new cryogenic supercold industry—the storage of liquid nitrogen and other fuels for rocketry, as an example.

As early as 1892, when France ordered aluminum torpedo-boats, this remarkable metal played a large part in modern warfare. Ballistic armor-plate, made of new high strength aluminum alloys deflects shells, while permitting an increase in the speed and maneuverability of tanks and other military vehicles. The new all-aluminum fan-jet C-5A can carry more than 500 armed troops at 550 miles per hour—ten of these planes could have handled the whole job during the Berlin airlift. As far as the Navy is concerned, there is more than 3½ million pounds of aluminum on the nuclear-powered aircraft carrier "Enterprise."

Jules Verne, in his book *From Earth to The Moon*, in 1865, first foresaw the use of aluminum in space travel. One hundred years later it became a reality. The light weight of aluminum allows more thrust and less fuel required for space vehicles. In addition, aluminum can be easily extruded into the intricate shapes that go into the making of a space ship. The reflectance of the metal turns back the sun's heat and its superior buckling efficiency withstands the stresses encountered at 17,000 miles per hour.

Some 40 tons of aluminum are an integral part of the *Telstar* satellite that, for the first time, permits world-wide telecasting. However, aluminum is not only part of space hardware, but an important component of missile fuels as well. Aluminum powder contributes to blast-off as an ingredient in solid fuels.

When America's astronauts depart for the moon, they will be sharing their trip with half-a-billion pounds of aluminum used in their Saturn V space craft.

Versatile aluminum—the metal industry's "number two"—will continue to give "number one" a-run-for-its-money as space age exotica becomes commonplace.

**F**rom one of the lightest metals, we came to one of the heaviest—lead.

From lead-acid batteries that permit surgeons to perform life-saving surgery during power failures, to vibration pads that allow music lovers to enjoy concerts undisturbed by outside noise in perfect acoustical conditions, lead has been proven one of the most valuable, yet economical metals on earth.

Lead is a plentiful metal. Some three million tons of it were mined in 1965, and another million tons of scrap was melted down for reuse.

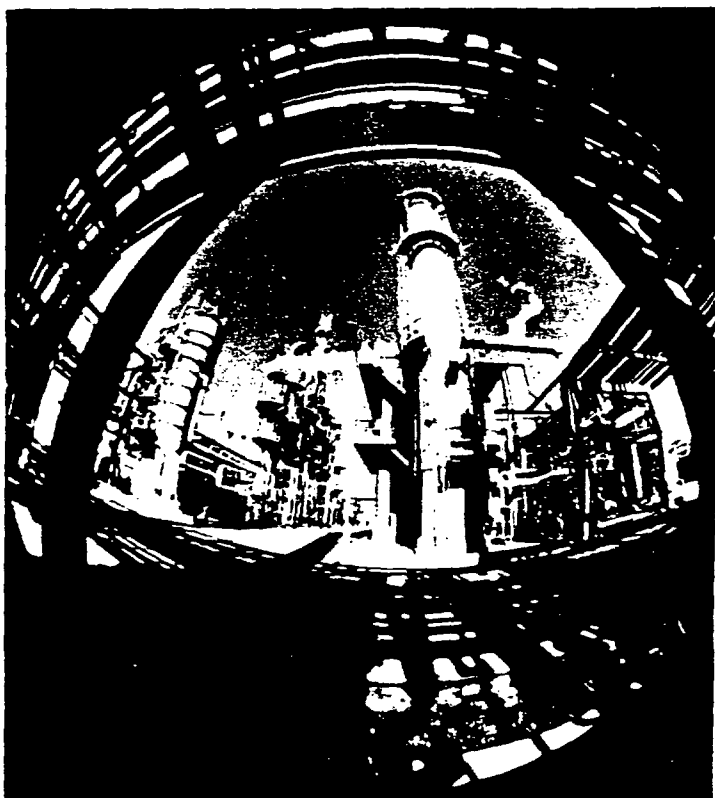
New discoveries of lead deposits, together with advanced mining techniques assure the continued availability of lead for the foreseeable future. Lead, in both solid and liquid form is benefiting the world of today while shaping the world of tomorrow.

Lead is the ideal barrier against noise pollution. Strange as it seems, lead, though a relatively heavy metal is one of the *lightest* materials that can be used for noise reduction. This seemingly paradoxical statement is true—a 1/3-inch sheet of lead fights noise as effectively as 8-inch-thick brick and solid masonry construction. Yet, lead has a density of only two or three times that of common building materials. This means that if two equally effective sound barriers are built, one of lead and the other of any ordinary construction material, the lead barrier will almost invariably be the lighter.

Lead's effectiveness in hushing noise stems from its ability to absorb or damp sound waves of low frequency. As a side benefit, the high mass of the metal dissipates vibrations that ordinary acoustical materials cannot handle. Lead-asbestos pads have made it possible for New York's *Lincoln Center for the Performing Arts* to be constructed directly over a subway-train station.

Lead shielding too is helping to accomplish a revolution in agriculture, medicine and commerce. Fresh food—vegetables, meats and fish—may be able to be shipped to all corners of the world, and even stored in tropic heat, without spoiling—this, by means of a radioactive isotope bombardment. Right now, a mobile irradiator, built and

Aluminum alkyls—multi-purpose organometallic compounds—are produced by Ethyl Corporation at its expanded facility at Pasadena, Texas.



operated by Atomic Energy of Canada, Ltd. protects potatoes and onions, harvested in rural Ontario, from spoilage on their long journey to market. The vegetables inside the lead-shielded irradiator are exposed on all sides to gamma radiation which effectively stops sprouting and greatly reduces spoilage during storage—even at temperatures as high as 70°F. This treatment presents no danger to the consumer, even when the food is eaten. The radiation passes through, the produce destroying harmful bacteria, and leaving no residual traces. Mass irradiation of foodstuffs holds great promise for the future and may be an important answer to the growing hunger problem in an overpopulated world.

Lead shielding too, has medical applications ranging from X-rays to check the conditions of teeth, to the use of radioactive isotopes that can control or may even be able to cure malignancies.

In commerce, lead shielding eliminates radiation danger to passengers and crews on nuclear-powered ships. The S. S. Savannah's nuclear power plant is shielded by more than 500 tons of lead.

Lead is an important source of power. Lead-acid batteries supply the power that starts the family automobile, similarly providing energy for deep sea diving craft that permits a crew of three to explore the ocean to depths exceeding two miles.

Lead antiknock compounds improve 97 out of every 100 gallons of gasoline sold in the free world. Tetraethyl lead, tetramethyl lead, or combinations of these two important compounds currently increase the octane rating of gasoline an average of nine octane numbers. (Octane numbers reflect a gasoline's ability to produce power without harmful knocking). Without antiknocks, the performance, efficiency and economy of gasoline would be drastically reduced. For one thing, it would take at least 11 gallons of gasoline to do the job of ten. Put another way, antiknock compounds save American motorists about \$2 billion a year in gasoline costs. It takes about a teaspoon of lead-antiknock compound in a gallon of gasoline—together with the customary refinery processing—to reach an optimum octane number. If the processing of the fuel alone was used to reach the optimum octane number, the severity required would substantially reduce the gasoline yield per barrel. Currently, the use of antiknocks is saving almost 200 million barrels of petroleum a year in the United States alone.

Most people do not realize that lead is part of everyday life. It helps bring food and water to our lips and is a part of every appliance we own. Expensive crystal, dinnerware and glasses receive their high index of refraction and clarity through the use of lead. Lead solder, of course, is used in so many ways—in "tin" cans, to joining plumbing fixtures, to fastening the wiring in space-age rockets. (It is interesting to note that the chemical symbol for lead is Pb—for the Latin *plumbum*—the derivation of the words plumber, plumb bob, and plumbing). Polyvinyl chloride (PVC) pipe the latest, most efficient, and economical means of transporting water, and used as non-metallic electrical conduit, is stabilized through the use of lead.

Despite some diehard belief, continuing studies have proved that lead, as it is used in today's civilization, constitutes no danger to either man or his environment. No study by any governmental, university or other scientific group has shown the lead levels in the atmosphere, anywhere in earth, to approach a dangerous level.

**T**he history of sodium—building block of industry—parallels that of aluminum. Metallic sodium was also first isolated by Sir Humphrey Davy, in 1808, by passing an elec-

tric current through potassium and sodium hydroxide. This would have been a most important discovery at the time, except, no practical use for the metal could be found. Nearly two decades passed before it was learned that sodium would reduce aluminum chloride to give pure aluminum. For the next 60 years improvements in sodium production became intimately associated with the early development of the aluminum industry. Ironically, however, about that time an electrolytic process for aluminum replaced the need for sodium. Fortunately, other uses for the metal were quickly discovered and sodium became an important factor in all facets of chemical economy.

The soft, silvery metal is used in the manufacture of a host of organometallic chemicals including antiknock compounds, insecticides, alcoholates, drugs and dyes. Sodium and its compounds can remove impurities from hydrocarbon-feed material and serve as a raw material for certain lubricating oil additives.

Sodium is also an important chemical intermediate in the production of certain important and unique non-ferrous metals such as titanium. Sodium is a good conductor of electricity and is being used in the underground feeding of high voltage current. Drawn into wire and cable—much the same as the more expensive copper—it is manufactured with a tight fitting polyethylene insulation. This insulation assures the exclusion of air and water from the sodium wire. As the world's use of electrical power grows so will the use of sodium.

The future of sodium continues to look even more promising. Experiments have shown that the metal, in liquid form, can be used to help power nuclear reactors. And, sodium's heat transfer qualities, may give it an important place in nuclear powered electricity generating plants.

Although discovered as a pure metal 160 years ago, it should be remembered that sodium has been with us since time immemorial—as every schoolboy knows, NaCl is common salt—sodium chloride.

Whatever direction civilization will take in the future, the fulcrum of change will be composed of metal. ■

The salt of the earth, sodium chloride, is a nutritional necessity. Ethyl Corporation is one of the world's leading producers of the semi-soft base metal—sodium.



## DEVELOPMENTS



### At Vypak

"Vypak" PVC bottles, produced by Vypak Company an Ethyl Corporation subsidiary in either 'custom' or stock shapes and sizes—have seen wide usage in the toiletries and detergents fields. Just recently, Vypak developed a clear food-grade PVC bottle which meets the requirements as established by the Food and Drug Administration. This opens the market wherein pharmaceutical and food-product manufacturers now have the opportunity to package their products in the clear, shatterproof, lightweight Vypak PVC bottles.

Ethyl's Polymer division manufactures 'raw material' compounds used in the Vypak bottle and is a supplier to other plastic-product manufacturers.

### Named to Key Posts

George F. Kirby, president of Ethyl Corporation, has been named to an eight man Fuel Additives Advisory Committee to the National Center for Air Pollution Control. This announcement, made by acting secretary of Health, Education and Welfare, Wilbur J. Cohen, also outlined the Committee's responsibility to "advise the Center on policies and procedures under which information on fuel additives will be registered with the Secretary prior to introduction of fuels containing the additives in interstate commerce."

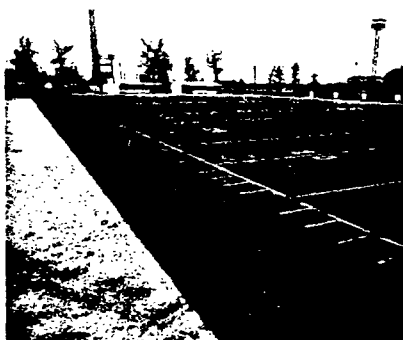
E. Claiborne Robins, and Andrew M. McBurney—members of the Board of Directors of Ethyl Corporation—were accorded special honor in recent weeks.

Robins, president of A. H. Robins Company, Inc., a leading Richmond-based pharmaceutical firm has been elected chairman of the Pharmaceutical Manufacturers Association. The Association is a professional and trade organization of drug manufacturers.

McBurney, executive vice president of our Oxford Paper Company division, has

been named a member of the Executive Reserve for the Office of Emergency Planning, by Price Daniel, director.

The National Defense Executive Reserve program was established by Congress in 1955. Its purpose is to provide for the training of persons selected to serve the United States Government in key civilian positions at local, regional, and national headquarters during national emergencies.



### VisQueen From Goal to Goal

Black, 6 mil, polyethylene film manufactured by Ethyl's VisQueen division was used to protect the first outdoor installation of plastic "grass" football field.

The playing field surface material—similar to that being used in Houston's famed Astrodome—was just recently installed at Indiana State University's Memorial Stadium in Terre Haute.

The 72,000 square foot installation was protected from the ravages of this past winter by the overlaying of "VisQueen" Polyethylene Film. The film, supplied in 20-foot wide rolls was produced at the division's Terre Haute plant.

Polyethylene film is produced in a variety of thicknesses, colors, and finishes

and used in countless packaging and industrial applications.

The inventory of "VisQueen" Polyethylene Film includes shrink film for 'skin-tight' packaging and other special films for unique applications.

### St. Augustine Goes PVC

In a recent article—prepared by Scott Stepp, former director of Utilities, St. Augustine, Florida.—VisQueen PVC "Bell: Ring Pipe" is pictured as "a major advancement in water distribution . . . inspired by several compelling factors:

- The unique PVC "Bell: Ring" joint markedly speeds installation and eliminates maintenance.

- Overall project costs can be reduced by as much as 30 percent because the lighter weight of PVC pipe makes it easier and less expensive to transport and install.

- In addition to possessing flexibility, research has shown plastic pipe to have a greater life expectancy and a generally higher level of resistance to corrosion than either cast iron or asbestos cement pipe. . . ."

Due to St. Augustine's unusually high salt content of the soil and its corrosive effect to many materials, Mr. Stepp continued: "we in St. Augustine were at first a bit reluctant to abandon the proved effectiveness of cast iron—especially in light of our rather peculiar situation. . . ."

"However, an extensive survey, underscoring PVC's extraordinary resistance to acids, alkali, water, alcohol, hydrocarbons, salt solutions and crude oil, revealed that plastic pipe was more than equal to the challenge. Based on that, and in anticipation of an attractive dollar savings (which was realized), I decided to break the tradition of seven decades and approved the installation of the six-inch "Bell: Ring" PVC pipe manufactured by the VisQueen division of Ethyl Corporation."

## PRODUCTION NOTES

**PRINTING/** This issue of Ethyl Magazine was printed by offset lithography on a #61 Miehle, four-color, 43x60, press at 5,500 impressions per hour. Color sequence was yellow, blue, black and red. **PAPER STOCK/** The Paper, 100# Star Sapphire® Enamel Dull was produced by Oxford Paper Company, an Ethyl Corporation Division. The ultimate in deluxe enamel papers, "Star Sapphire" adds snap and sparkle—it is made with the brightest, highest quality pigments available. Produced on Oxford's North Star® Trailing Blade Coater, "Star Sapphire" Enamel has superior surface levelness. "Star Sapphire" Enamel, Gloss on Dull with matching covers, offers press-proven dependability—it is the finest medium available for enhancing prestige printing. Consult your Oxford Merchant Representative for additional information concerning "Star Sapphire" as well as the entire line of Oxford Papers. **CREDITS/** Front Cover: Irving J. Olson, Akron, Ohio/ Pages 4-8: Albemarle Paper Company, North Carolina Forest Service, Maine Forestry Service/ Pages 9-13: Mexican National Tourist Council, InfoPlan/ Pages 14-17: National Geographic Society (cover design, page 14, reproduced by special permission—design and title protected by international trademark/ Page 19: Hattaras Yacht Company/ Pages 21-22: Texaco, Inc./ Pages 23-26: Ethyl Corporation, Society of the Plastics Industry/ Pages 28-29: Lead Industries Association/ Original art by H. Newman Graphic Arts, Inc., New York.

**Most people know us  
for gasoline. And we  
don't even make it.  
We do make:**

fine paper, kraft paper and board,  
plastic packaging film, diesel additives,  
vinyl polymers and monomers,  
plastic bottles and packages,  
fuel detergents, handle shopping bags,  
sewerage filter components, mulch film,  
dry cleaning fluids, PVC pipe,  
rubber additives, reinforced building film,  
degreasing solvents, aluminum alkyls,  
antioxidants, primary alcohols,  
caustic soda, aluminum extrusions,  
metallic sodium, chlorine,  
chemical intermediates, combustion improvers.

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**Stanley M. Siegel, coordinator-publications.**

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Another cover photo by Irving J. Olson—*Blight*. The blight which erodes the natural beauty of a leaf is like the listlessness of an unchanging company—both destroy productive change and growth. Ethyl Corporation's rise in *Fortune Magazine's* "500" listing is evidence of the company's change by design for continuing growth.

## ETHYL CORPORATION/1968

In the words of Mr. Floyd D. Gottwald, chief executive officer of Ethyl Corporation: "As much progress as we've made thus far, there are countless further opportunities for us to grow . . . to expand . . . to diversify . . . and to contribute to our company's and our country's continued progress." This was in 1964.

And what of that prophecy?

Ethyl Corporation today—a company with roots firmly established in petroleum chemicals and quality paper—has assiduously spread its interests and capabilities into industrial chemicals, plastics, aluminum extrusion, and packaging worldwide.

Again, Ethyl Corporation is a company of change by design for continuing growth.



ETC 17920

# ETHYL CORPORATION

CHANGING TO SERVE A CHANGING WORLD



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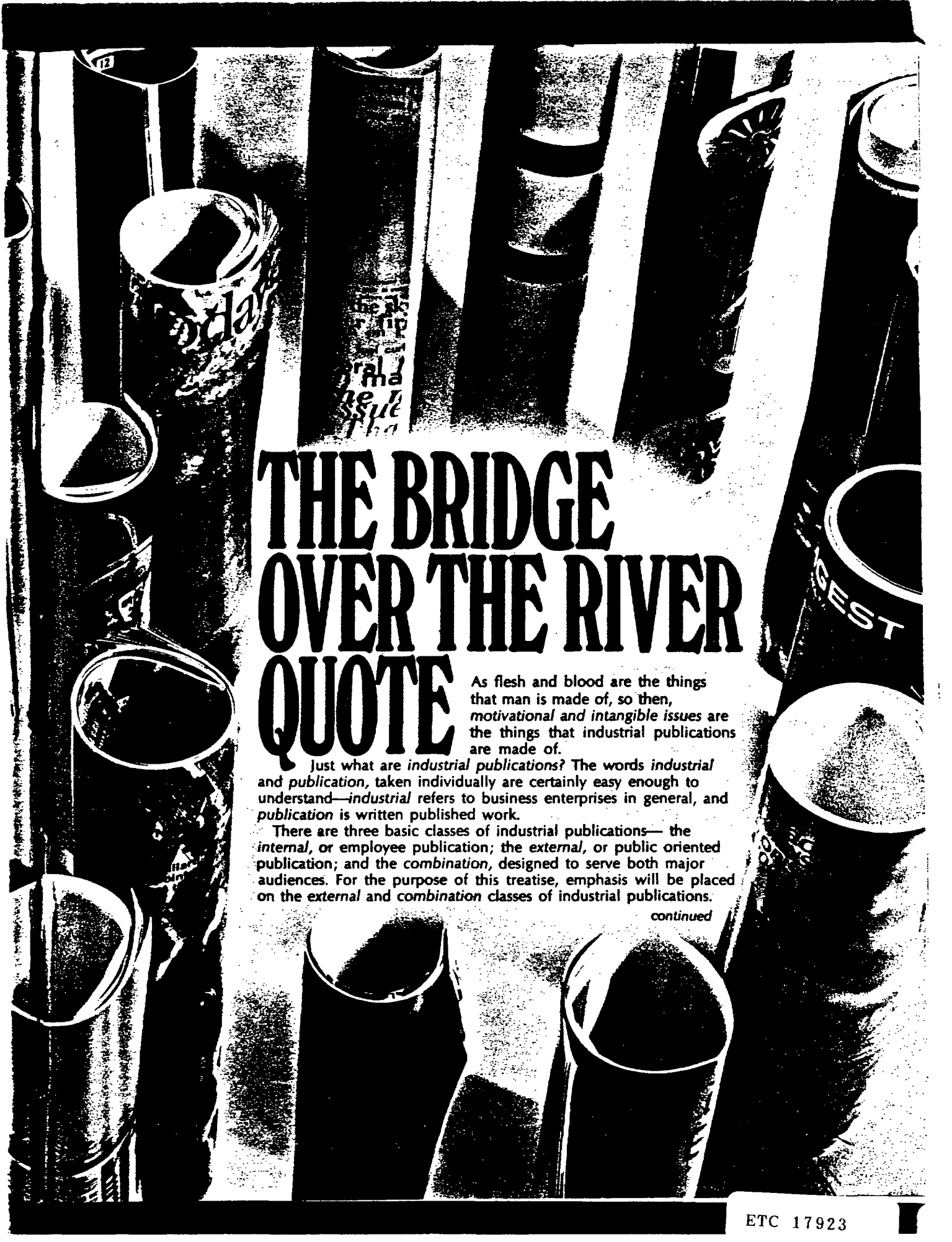
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# THE BRIDGE OVER THE RIVER QUOTE

As flesh and blood are the things that man is made of, so then, motivational and intangible issues are the things that industrial publications are made of.

Just what are *industrial publications*? The words *industrial* and *publication*, taken individually are certainly easy enough to understand—*industrial* refers to business enterprises in general, and *publication* is written published work.

There are three basic classes of industrial publications— the *internal*, or employee publication; the *external*, or public oriented publication; and the *combination*, designed to serve both major audiences. For the purpose of this treatise, emphasis will be placed on the *external* and *combination* classes of industrial publications.

*continued*



Do they fulfill this purpose? The natural question is: How effective have these publications been? There are surveys which show that the publications are looked at consistently, and that is the satisfaction.

Let's examine this point of view, for it may be puzzling. Since people's attitudes are the result of the assimilation—consciously and subconsciously—of a range of stories, pictures, headlines, movie scenes, radio flashes, etc., repeated exposure to fact and opinion, to explanation and persuasion, crystalizes into an attitude. But what experience, what thought, what argument was most influential, most persuasive, is difficult to identify.

The effort then must be to expose the readers continuously and repeatedly to the ideas, the points of view, the opinions that are thought important. The hope is that an impression will be made, a softening of a strongly held prejudice will be effected, and some questions will be raised in the reader's mind.

When selling ideas, abstractions, intangibles, their impact cannot be measured precisely. But if an attempt isn't made to sell them, those ideas which are injurious to business triumph by default. The job is to present these ideas credibly, arrestingly, persuasively, and in the faith that, if they are good ideas, they will in time prevail.

In sum a publications program must be tailored to fit the needs of a company. The critical factors in the program are a clear concept of purpose, talent, and careful planning. Results cannot be told exactly, but, as long as the publications reflect thoughtfully, interestingly, and convincingly the ideas which are thought important the purpose is achieved.

This thought then, answers two questions—are industrial publications useful? And, what of their content?

In analyzing a representative sampling of industrial publications being produced today, a subject-type classification can be made. Most obviously, the content deals with product-oriented features—new developments, applications, and affidavits. There is a category which may be called educational or entertaining. These are general interest subject of travel, parts of the world, in-depth studies of specific events, and so on—here too however, although not always obvious, are subtle tie-ins with the company's business interests. Then too there are stands on civic and public affairs—legislation, community problems and solutions, world situations, and treatises on other aspects of modern life.

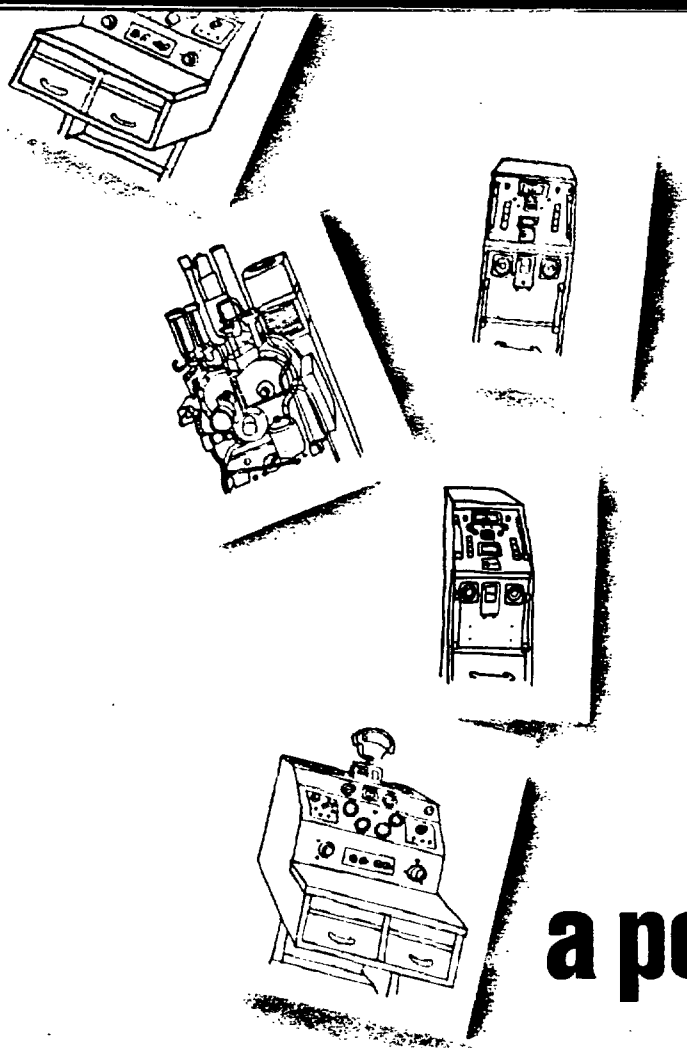
Although no industrial publication can satisfy every reader's particular interests, many of the more successful journals do come very close.

To answer the questions concerning management's thinking on the subject of the whys and wherefores of industrial publications, refer back to some earlier paragraphs—"It is reasonably estimated that there are close to 10,000 such periodicals published today . . . In reviewing the top 20 firms listed in the 1968 Fortune Magazine "500," virtually every firm had at least one publication—many even more . . ." Evidently, a good measure of businesses management believe in the value and usefulness of industrial publications.

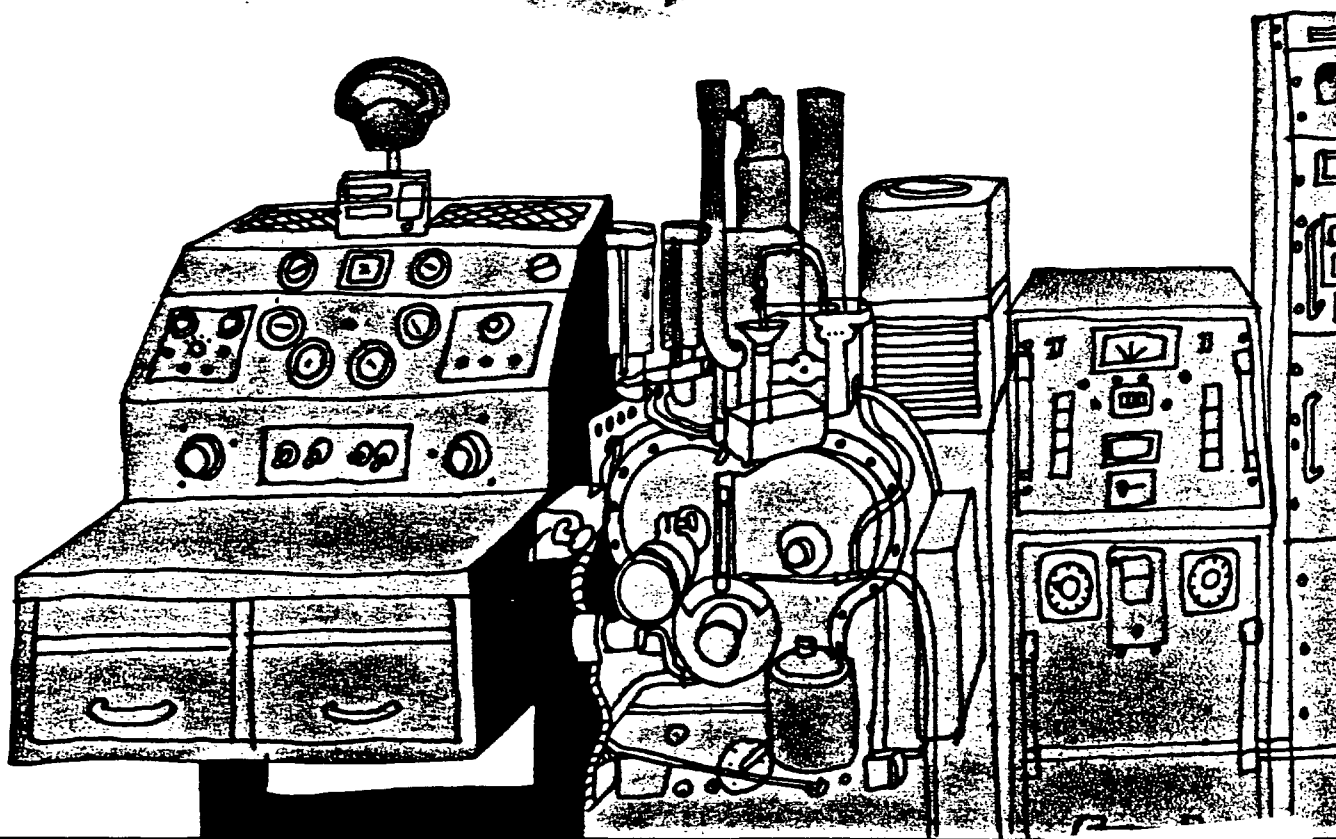
It is very obvious, of course, but perhaps a good way to close this article would be to note that it was read in Ethyl Magazine—Ethyl Corporation's external industrial publication.

You may not be able to tell a book by its cover but the type, feel and compatability of the paper stock and the magazine content go hand in hand. Many of today's prestige industrial publications are printed on Oxford paper—as are annual reports, booklets and brochures. Oxford Paper Company, a division of Ethyl Corporation, is a leading producer of printing and publication papers.





**a perfect blend**



ETC 17926

# automatically

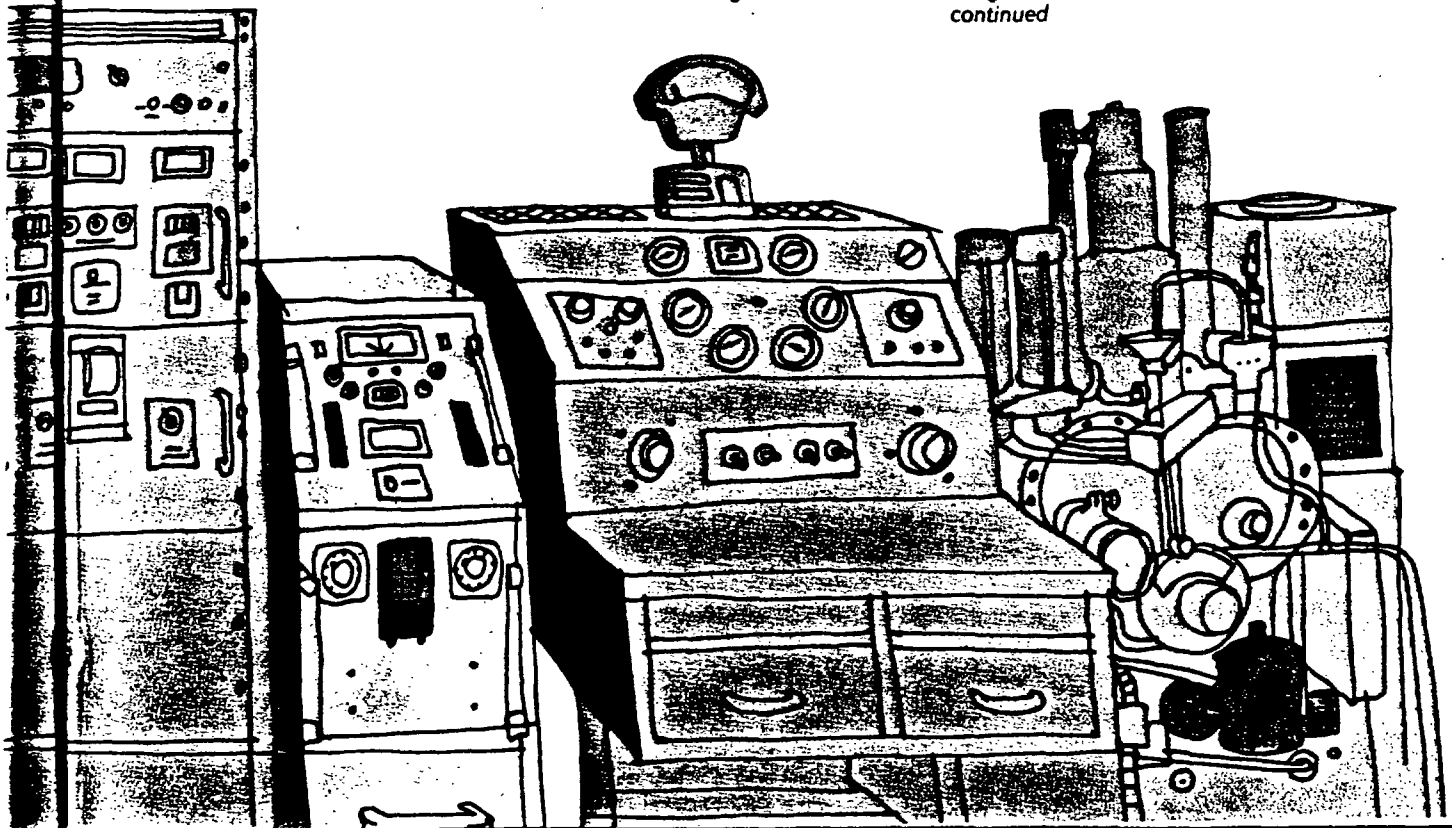
When Elwood Haynes made the initial run in what is believed to be the first successful automobile on July 4, 1894, the gasoline used to power his motor was a bothersome by-product which oil refiners spent more effort in dumping than in developing.

Within 30 years of that summer day, the situation in the oil industry changed from an effort to dispose of a troublesome and apparently almost useless liquid to one of making every effort to produce enough of it to supply the demands of a growing motoring public.

A highly sophisticated refining technique resulting from this challenge was the development of in-line blending—the continuous and automatic mixing of numerous gasoline components and additives to produce today's high quality finished gasoline. But this streamlined method of blending took more than 50 years of development to bring it to its current level of technical efficiency.

In the early days of gasoline manufacturing blending was a simple job. Initially, there were only two gasoline components—straightrun gasoline from crude oil and casinghead gasoline from natural gas wells. To obtain straightrun

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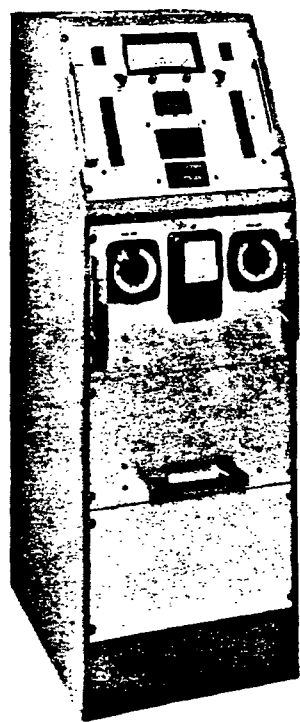
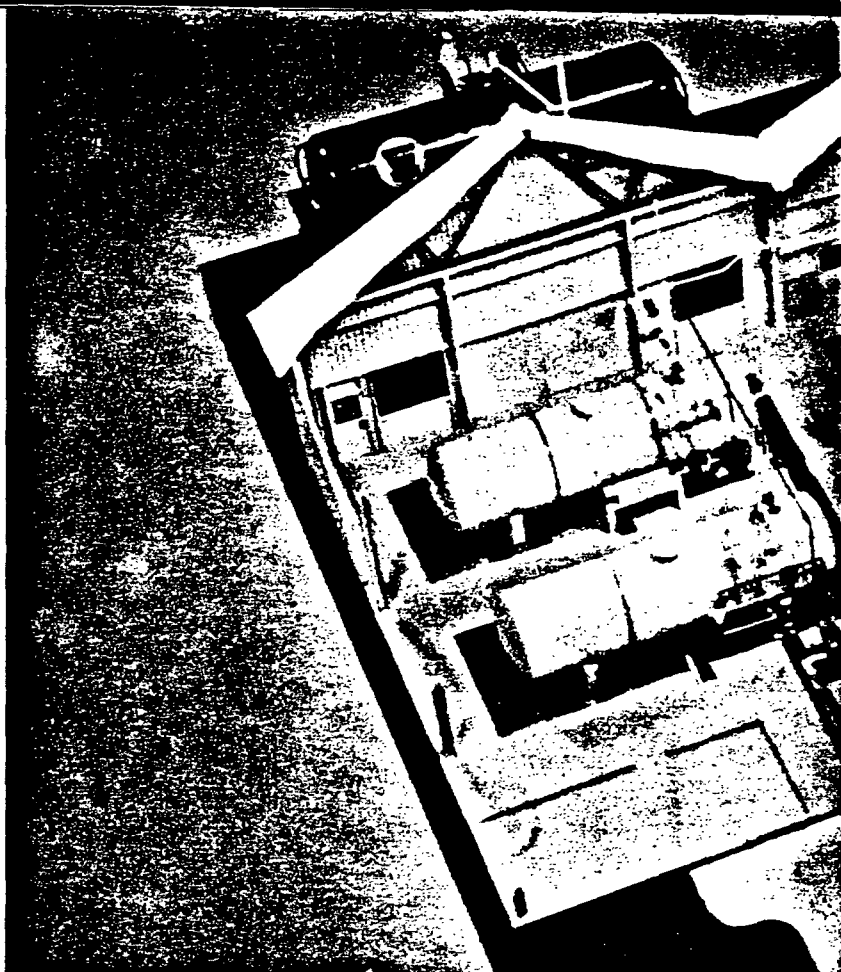


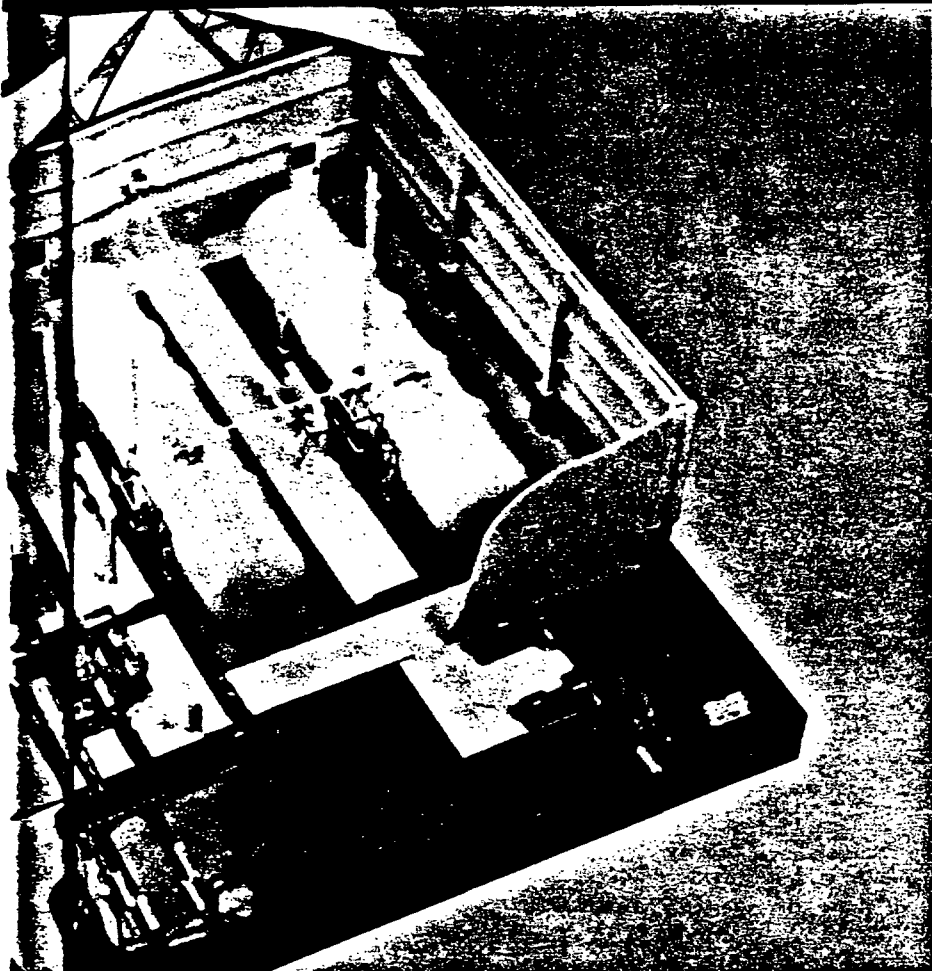
gasoline, crude oil was heated directly in a still. The light or lower boiling fractions of the crude oil were condensed by cooling and treated chemically to remove impurities and improve color and odor. These light fractions or distillates contained both gasoline and some heavier products such as kerosene for lamps and stoves.

One operation in this process used a rather distant cousin of today's metering devices for in-line blending. This operation was the cutting of the distillate stream into gasoline and heavier product in the "receiving house." The receiving house in a refinery contained numerous pipes and valves controlling the flow of the distillate gasoline to receiving tanks. (In this early process, pumps were not used to move the distillate product. The still was elevated and the products ran down by gravity to the run down tanks). In the receiving house the condensed stream of distillate from the still ran through a "look box," a metal enclosure provided with a glass window. Through the window, the size of the stream and something of its color could be observed. The man in charge of the receiving house could withdraw and examine frequent samples of the distillate stream. He could then decide when a cut between gasoline and heavier products should be made, and the stream would be directed to a different receiver tank. It was a simple matter of opening one valve and closing another—a far cry from today's multifaceted blending operation.

The other basic gasoline stock in the early days of oil refining was casinghead or natural gasoline. Oil drillers learned quickly that gas vapors formed above a petroleum bed and around the tube which is run down into the casing to pump out oil—thus the name casinghead gasoline. As early as 1904 A. Fasnemeyer of Titusville, Pennsylvania was extracting gasoline from the gas obtained from oil wells near Titusville. He first compressed the gas and then collected it by passing it through a pipe placed on a tank of water. The light gasoline squeezed out of the gas in this way was allowed to drip into an open barrel. A more refined version of this same process was one of the three used by oil refiners to produce casinghead gasoline. The second method was the absorption process which brought natural gas into contact with a heavy petroleum oil which "scrubbed" the gas or removed from it the gasoline hydrocarbons it contained. The third process for obtaining casinghead gasoline used an absorber filled with a specially prepared charcoal, which absorbed about 15 per cent of its weight in hydrocarbons. The gasoline contained in the

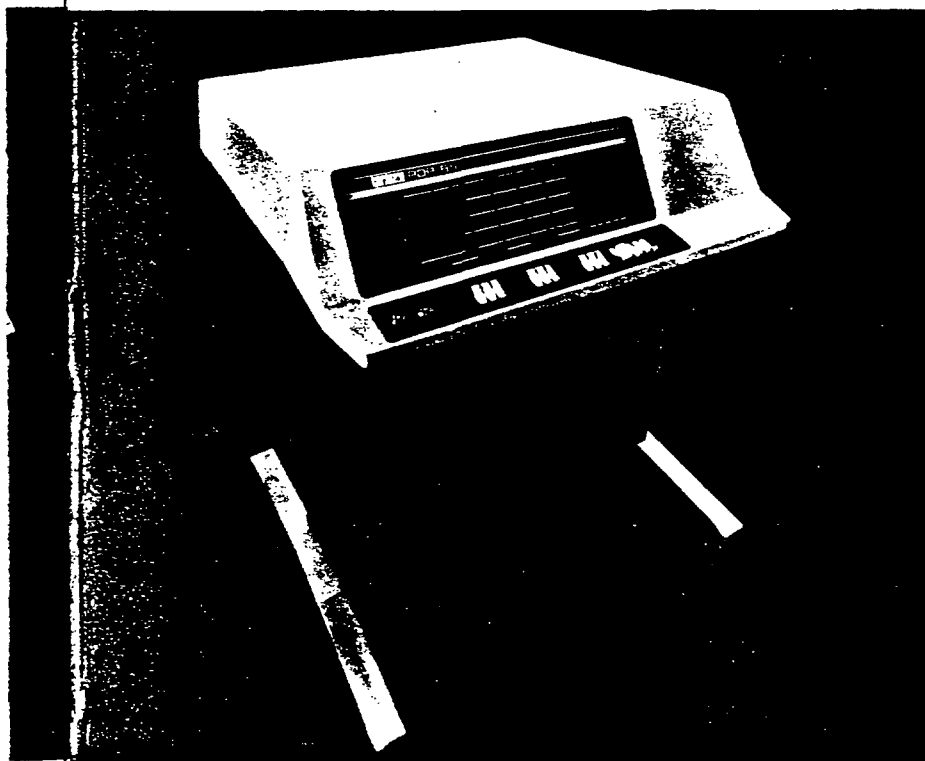
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Ethyl's years of experience in instrumentation to improve octane quality evaluation has produced the most complete line of octane analyzers available to the petroleum industry. For use in Laboratories, on-line monitoring or control, and process stream evaluation, Ethyl equipment provides quick results for closer control, greater blending flexibility and substantial savings, while accelerating production.

The Ethyl mixing plant as depicted is a vital part of the total in-line blending system in the refinery. The mixing plant receives, stores and adds antiknock compound to gasoline. Essentially, all refiners use the Ethyl-developed concept on lead handling plants. Ethyl's contribution, made in the development of this design in 1960, helped accelerate the use of in-line blending.



The Push Button Octane Number Unit (PBON) is an instrument for use with an ASTM engine to obtain octane numbers automatically in gasoline testing laboratories.

Computer octane analysis offers computerized on-line gasoline octane quality analysis and/or control. It automates operation of several ASTM engines for gasoline quality evaluations and provides any octane number data desired, including a calculated Road Index, printed on demand or at present time intervals.

## a perfect blend...automatically *continued*

charcoal was distilled out with steam and condensed into a liquid.

Simple distillation and the processing of natural gasoline quickly proved inadequate to meet the burgeoning needs of a growing motoring public and the demands of the more sophisticated automotive engines. The next process to be developed commercially was thermal cracking—the basic idea for which dates back to the early 19th century. In thermal cracking, heavy oils were heated to such high temperatures that they “cracked” or broke up into smaller molecules, producing considerable gasoline. The mixture was then distilled to obtain these gasoline fractions. Thermal cracking was the forerunner of today’s catalytic processes for cracking heavy oils.

With the advent of higher compression engines, these early gasoline components proved ineffective against the severe problem of engine knock. When in 1921 at the General Motors Research Laboratory—the forerunner to today’s Ethyl Corporation—it was discovered that tetraethyl lead (TEL) eliminated the problem of knock, a new step in gasoline manufacture was inaugurated. Now TEL had to be added to gasolines to give them the ability to combat engine knock in the bigger and more powerful automobiles being developed by Detroit.

The first example of the now essential in-line blending in the petroleum industry took place right at the pumps of local filling stations. TEL was metered from a small container into the gasoline stream—the blending was inline and directly into a car. The primitive blending process to produce this “Ethyl” Gasoline, as it was called, was known as “Ethylizing.”

By the end of 1923, the same year that TEL became commercially available to the consumer, there were several thousand “Ethylizing” units in existence.

Following the refinement of handling techniques for TEL, the blending of gasoline additives took place in the refinery, where TEL was mixed with the various components, along with dye to identify the leaded gasoline, to yield the finished gasoline.

This time-consuming and repetitious process actually became more complicated as the quality of gasoline improved. In the 1930’s, catalytic cracking and polymerization were developed to provide larger volumes of gasoline. This also provided gasoline with improved resistance to knock.

Another factor leading to quality improvement in the later years was the fuel requirements of the military during World War II. The need for high-octane aviation gasoline hastened the early de-

velopment of alkylation—and the later development of catalytic reforming. These gasoline stocks and high concentrations of TEL were needed to meet the octane requirements of high-performance aircraft engines. These new processes, combined with the development of antioxidants and other additives, meant more mixing, sampling and testing for oil refiners. These gasoline components were pumped into a single tank and mixed along with additives. Samples were taken and tested to determine if the finished gasoline met exact specifications. This was often followed by a sequence of remixing, resampling and retesting before final approval for shipping was obtained. This method, which is still used today by some refiners, is known as batch blending.

Various production, manpower and economic problems associated with batch blending were among the reasons for the evolution of direct in-line blending as a superior blending process. For one thing, experience had shown that a system like batch blending, which required almost continuous operation to meet normal gasoline budgets, was seriously undersized. This had economic consequences since normal operating problems such as equipment failures, shortage of components, off-test components, special blends, peak shipments and rebinding forced refiners to use more expensive blends to meet shipment schedules. In addition, batch blending called for a greater amount of manpower and supervision—a factor which, at times, failed to assure the technical accuracy of improved instrumentation and automatic controls inherent in a direct in-line blending system.

In terms of tankage volume and space, batch blending put refiners at a disadvantage since the finished gasoline product had to be stored after blending while it was tested and awaited shipping. In-line blending—using separate and isolated tankage for each blending component—provided for improved use of expensive components and more reliable component data, while utilizing less tank storage space.

The evaluation of these aspects of batch blending by petroleum manufacturers revealed that the cost of expanding these batch blending facilities to meet new gasoline demands was prohibitive. Furthermore, the batch system would not lend itself to automation necessary to achieve the desired improvement in quality control, manpower and safety.

As a result, three basic in-line blending systems were developed by the 1960’s—a mechanical reference system, an electronic analog-to-digital system and an

electronic Direct Digital Control System. One of the first refineries to install an in-line blending operation was the Oleum, California plant of Union Oil Co. of California in 1955. It used mechanical transmission throughout.

These systems vary according to the measuring mechanism they employ, but they are basic in their metering and mixing operations. The blending sequence in each starts with the gasoline components which are contained in isolated lines which run directly into the component unit. The refiner selects the gasoline components and additives he needs for a certain specification gasoline. These components are then metered into a blend manifold. Simultaneously, the lead antiknock compound, dyes, and other specified additives such as antioxidants, detergents, and anti-icing agents, are added to finish the blend.

In the control room this tailored blend is continually monitored for Reid vapor pressure, volatility, and rate of flow among other things.

This blending system of rapidly moving liquids necessitates on-the-spot and repetitious evaluation throughout a blend run. This requirement has resulted in extensive development work to produce a myriad of on-line analyzers to monitor or control the various critical fuel properties. Ethyl Corporation, which pioneered the use of the turbine meter for in-line addition of antiknock compound, recognized some years ago the need to develop an on-line octane analyzer. Since octane number remains one of the major specification properties of gasoline, an on-line octane analyzer has become basic to the in-line blending operation.

The octane analyzer provides an almost continuous indication of octane quality by measuring the knock intensity of the blend, which is inversely proportional to octane number. Because octane quality can be so accurately and continuously measured, the octane specification can be met or corrected more quickly and more economically by simply adjusting the addition of the antiknock compound to the blend. The analyzer thus helps preclude complicated and expensive rebinding.

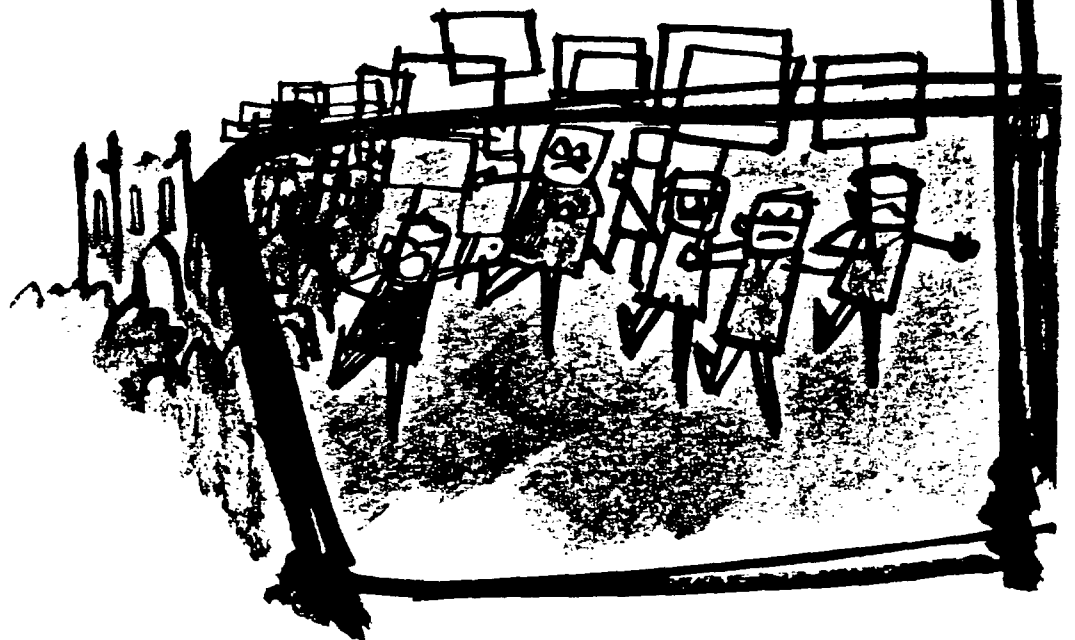
The octane analyzer pioneered by Ethyl Corporation is just one of the many sophisticated systems or techniques developed by and for the petroleum industry which has made the in-line blending of gasoline the answer to a challenge facing oil refiners for more than 40 years—how to provide the automotive industry and the motoring public with the best fuel at the lowest price with the greatest satisfaction and performance. ■

# ANARCHY ON THE CAMPUS



*Lewis F. Powell, Jr., is a member of the Board of Directors of Ethyl Corporation and a leading Richmond attorney. As past president of the American Bar Association and as an appointee to President Johnson's Commission on Law Enforcement and Administration of Justice, Mr. Powell has a varied and most useful experience in the profession of law and its application. In addition, Mr. Powell is a member of the Virginia State Board of Education, and a trustee of Washington & Lee University. This article, "Anarchy on the Campus," is presented here from a speech given by Mr. Powell on May 20, 1968, before the Virginia Retail Merchants Association.*

## ANARCHY ON THE CAMPUS



You may have seen the story in Life Magazine.

The first sentence read:

"With the brashness of a victorious banana-republic revolutionary, the mustachioed undergraduate sat in the chair of the President of Columbia University and puffed on an expropriated cigar."<sup>1</sup>

The accompanying picture showed a student, looking like a junior Castro, seated at President Kirk's desk—smoking one of Dr. Kirk's cigars. This was one of the leaders of some 600 radical students who seized—and held for a week—five buildings on the Columbia campus, including the President's office. They also held the Dean as a hostage for 26 hours.

Stories in the press disclosed the filth and wreckage left in the University buildings when the rebels were finally evicted by the police. The damage—estimated at several hundred thousand dollars—was deliberate vandalism of furniture and furnishings. President Kirk's personal files were rifled.

Yet, despite this vicious hoodlumism, many faculty members defended the students, and criticized Dr. Kirk when—quite belatedly—he called the police.

The full consequences of this ravishing of a great university cannot yet be assessed. In the short term, thousands of decent students were deprived of an education, and the acrimony and bitterness—among students and faculty—destroyed the atmosphere of scholarship and detachment which should be the hallmark of a university campus.

Serious as these consequences are, they might not cause national concern if the Columbia experience were an isolated episode. But it is by no means isolated. For several years there has been a growing movement, vaguely described as the New Left on the Campus, which preaches

hatred of and revolt against authority. It is not too much to say—the leaders themselves boast of it—that they are fermenting revolution against our educational system, and, indeed, against our country.

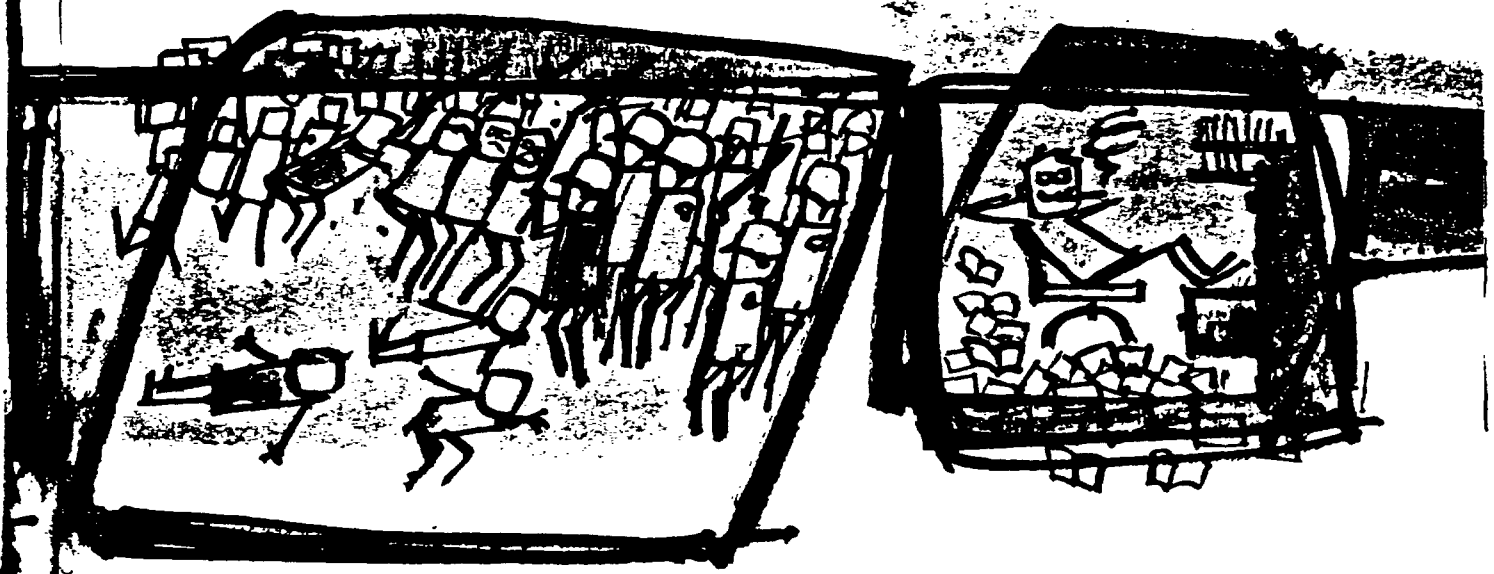
We are witnessing, with no inconsequential participation by faculty members as well as students, an organized attempt to destroy the free institutions of higher learning which have required centuries to develop and refine. As the New York Times, in commenting on the Columbia revolt, put it:

Student leftists are employing "intolerably undemocratic" methods designed to "undermine academic freedom and free society itself".

The roots of the movement in America go back at least to the formation in 1962 of the leftist organization which has taken the lead—named ironically, Students for Democratic Society (SDS). Little attention was paid the young radicals until the 1965 rebellion at Berkeley, California. As the Berkeley revolt has been the inspiration and the model for much that has followed, it may be useful to recall what happened.

Employing the familiar techniques of civil disobedience—sit-ins and coercive demonstrations—students created at Berkeley the same sort of havoc we have seen recently at Columbia. The original student demand was for greater free speech. But when a timid and vacillating administration capitulated, new demands were immediately made. The call for unfettered free speech deteriorated into the "filthy speech movement".

The irony is that few, if any, campuses afforded greater freedom of discussion. In subsequent Congressional testimony, Prof. Peterson stated that the University of California already tolerated free discussion of "every variety of radical politics"; that student meetings—openly held—advocated everything from "imbibing of marijuana" to "selling contraceptives in the student union".<sup>2</sup>



The Berkeley experience was the first frightening example of what massive civil disobedience techniques can do to an institution of learning.

In the three years since Berkeley, we have seen scores of campus disorders across the country, with the militancy of leftist student groups increasing in geometric proportion to the irresolution of college administrators who have lacked the courage, as well as faculty backing, to deal firmly with lawlessness.

Not only has there been an absence of firmness, but often—far too often—appeasement oriented presidents and faculties have given in to student coercion by granting their demands. Indeed, it cannot be doubted that this escalating lawlessness has been encouraged—not deterred—by the excessive tolerance so widely practiced by those in authority. After initial capitulation to demands, the typical university goes through the charade of imposing a few transitory penalties, and then—again buckling to pressure—grants amnesty to all concerned.

The predictable and inevitable result of this policy of appeasement and retreat is increased militancy, accompanied by scorn and utter contempt for the appeasers.

The average citizen and parent, dismayed by the expanding discord, is bewildered by the motivation of the student radicals. There is nothing new about a certain restlessness on the part of students. Johnny has always developed a lot of ideas at college which make his old man nervous. But Johnny matures in due time, as he faces the realities of making a living, and as his student liberalism is tempered by experience and responsibility. This has been a natural and wholesome evolution, contributing to a desirable process of ordered social change.

But the New Left on the campus is not within this honored American tradition. It does not want ordered and evolutionary change. It demands revolutionary change—now! As restrained an observer as President Pusey of Harvard has described some of this radicalism as the "crudest display of force . . . clearly intended to be no less than a revolutionary struggle for power".

If the New Left is engaged in a struggle for power, the questions of "what kind of power" and "power for what purpose" become of vital importance. The professed tactical objectives are usually associated with emotional causes—such as civil rights, poverty, and American foreign policy—especially in Vietnam.

But the underlying strategic goals of the New Left are no less than destruction of our most cherished democratic institutions—our system of higher education and our form of government.

As a New York Times interview reported, the rebels "oppose the very structure of the American type university". They demand that control of our higher institutions of learning, whether state or privately endowed, be turned over exclusively to the faculty and students.

Their ultimate goal is destruction of representative democracy.<sup>3</sup> The enemy, as the New Leftists view it, is our present system of constitutional government, with legislative power vested in elected representatives and executive power in an elected president. They assert that American "society and all of its institutions" are "rotten". There is a virulent hatred of the system, and "the power structure".

They propose to substitute, by revolutionary means, what they call a "participatory democracy". This would be a so-called "communitarian" system, modeled after the theory (though not in fact the practice) of Castro's Cuba and Mao's China. The people's will would be expressed directly through mass demonstrations, rather than by elected representatives. In short, democracy is to be exercised primarily by one's feet—through mobs in the streets.

Prof. Staughton Lynd, formerly a co-faculty member with Dr. Coffin at Yale, is a leading advocate of democracy. Prof. Lynd admits that revolution is necessary to accomplish this radical change in our system. He speaks of "students chaining themselves to the Capitol in wave after wave of massive disobedience." He says it could mean people setting up their own "continental congresses" all over the country, defying elected officials, and sending their



own emissaries "to make direct contact with the peoples of other countries."<sup>4</sup>

Prof. Lynd, practicing what he preached, made an illegal visit to Hanoi—giving aid and comfort to the Communist enemy.

What is the organizational structure of the New Left? It is difficult to identify, as it is essentially a conglomeration of organizations, groups and individuals. The principal components are, however, well known. They include Students for Democratic Society, W.E.B. DuBois Clubs, Student Non-Violent Coordinating Committee (SNCC), Progressive Labor Party, and a host of so-called peace organizations.

Perhaps the most effective of these is the misnamed Students for a Democratic Society, with chapters on most of the major college campuses. Appropriately, its daily newsletter is named "Fire Bomb". J. Edgar Hoover says that SDS is supported by the Communist Party, and in turn SDS "supports Communist objectives and tactics".<sup>5</sup>

Some of the leadership in other New Left organizations is also Communist and much of it is Communist oriented—some toward Havana and Peiping rather than Moscow.

It is important to remember, however, that many of the participating and sympathizing students are neither Communist nor revolutionaries. For the most part, these are the dupes. Many are motivated by a perverted sense of idealism, and are taken in by the professed causes of the New Left. Others are genuinely disenchanted by the unsolved problems of this perplexing age, and alienated from those in authority—on the campus and in government.

But the hard core New Leftists are revolutionaries. Their foreign policy posture, and their domestic goals, are straight Communist Party line.

In reflecting upon the New Left movement in this country, one is struck by the parallelism in other democratic countries. We have seen leftist students in Germany try, by mass coercive demonstrations, to close down newspapers which were anti-Communist. At the very time rioters seized Columbia University, pro-Peiping students

were demonstrating in Rome, and students were burning American flags in Tokyo.

The most chilling example of student discord, and where it can lead, was the recent experience in France. Starting with leftist students seizing the Sorbonne, and hoisting Viet Cong flags, the Communist dominated trade unions then moved in and paralyzed France with a general strike.

The Premier of France, whose normal posture had been one of genuflecting to the Communists, concluded that the rebellious French students were led by "agitators . . . belonging to an international organization." In emphasizing the gravity of the situation, Mr. Pompidou said:

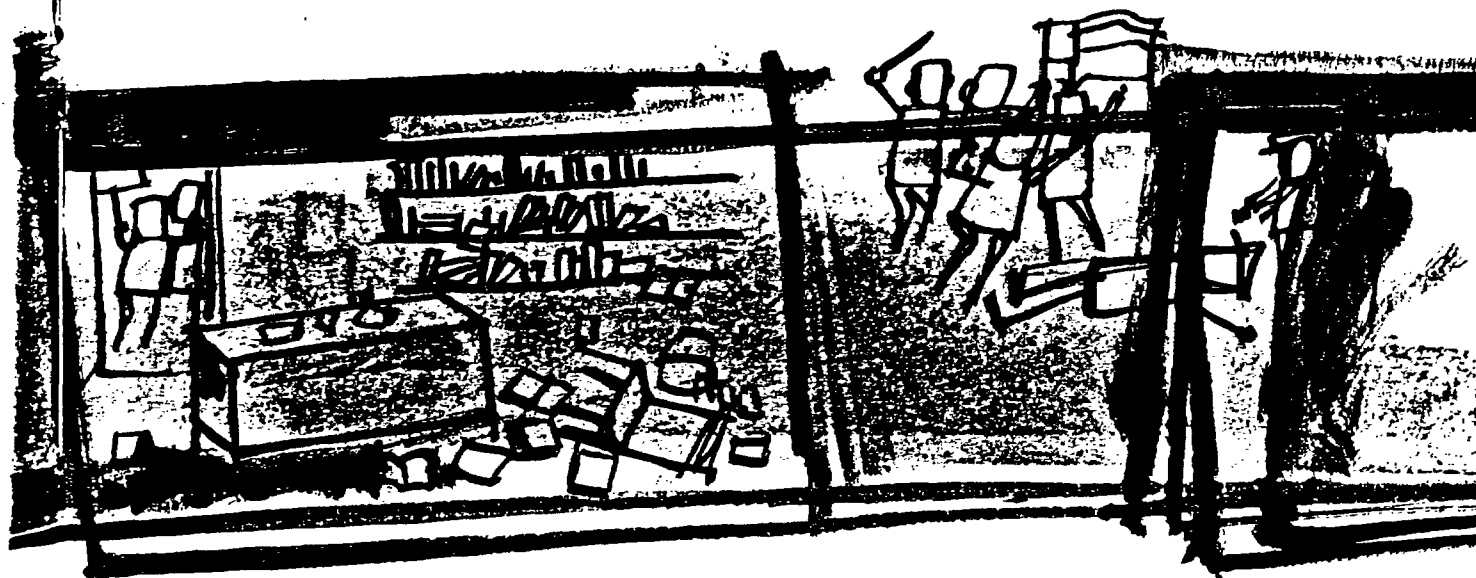
"Not just the French government, but civilization itself, is on trial. I see no precedent in our history since the hopeless days of the 15th Century when the structures of the Middle Ages were collapsing."

The situation in America differs from that in France. We are fortunate to have a vast middle class of stable citizens, and our major labor unions are not Communist controlled. But the extremist black power movement, committed to revolution, is closely aligned with the New Left. The universities are the first target. In a lead editorial, the Washington Post—rarely intolerant of deviant conduct—commented:

"The (New Leftists) . . . regard the universities as the soft spot in a society they are trying to bring down . . . . The rebels are out of touch with and do not understand the principles of democracy. . . . The language they talk is that of anarchy . . . . They are totally at war with everything this country has ever stood for."

The Post has not overstated the threat to our universities. Even the most liberally complacent university president must by now be concerned. But what can be done?

First, a word of caution. Care must be exercised to distinguish between the revolutionaries and the vast majority of students and faculty members who—like society in general—are really the victims of the New Leftists. Moreover, the universities must always foster and encourage



—and never suppress—the freedom of students to express their views, to protest injustice, and to promote social changes in which they believe. Our universities must be preserved as citadels of free inquiry, devoted to the concept that rational discussion is the surest way to truth and to a resolution of honest differences.

It must also be recognized that some of our universities—especially the larger ones—have been conspicuously unresponsive to legitimate concerns.

There is resulting student ferment and dissatisfaction. Channels of communication—announced in advance—must be established between responsible students and the administration. Greater student participation, in matters of their legitimate concern, must be arranged and scrupulously nurtured. These students who constitute the great majority, even of the activists, must be treated with consideration. It would be folly to push them into the camp of the New Leftist radicals.

But the line must be drawn—sharply and resolutely—between those willing to observe traditional methods of rational discussion and orderly procedures, and those who resort to lawless coercion.<sup>8</sup> The latter are the New Leftist revolutionaries. Like their Communist heroes, the only language they understand is force. Such students, and the faculty members who support them in their lawlessness, have forfeited any right to “negotiate” or to remain as members of a university community.<sup>9</sup>

University administrators would do well to remember that history demonstrates the capacity for evil of fanatical minorities. Such minorities have gained control of many of the universities in Latin American countries, with disastrous consequences well known to all who are interested in education. These universities are the models of the New Leftists. Their heroes—admittedly—are Che Guevara, Fidel Castro and Mao Tse-tung.

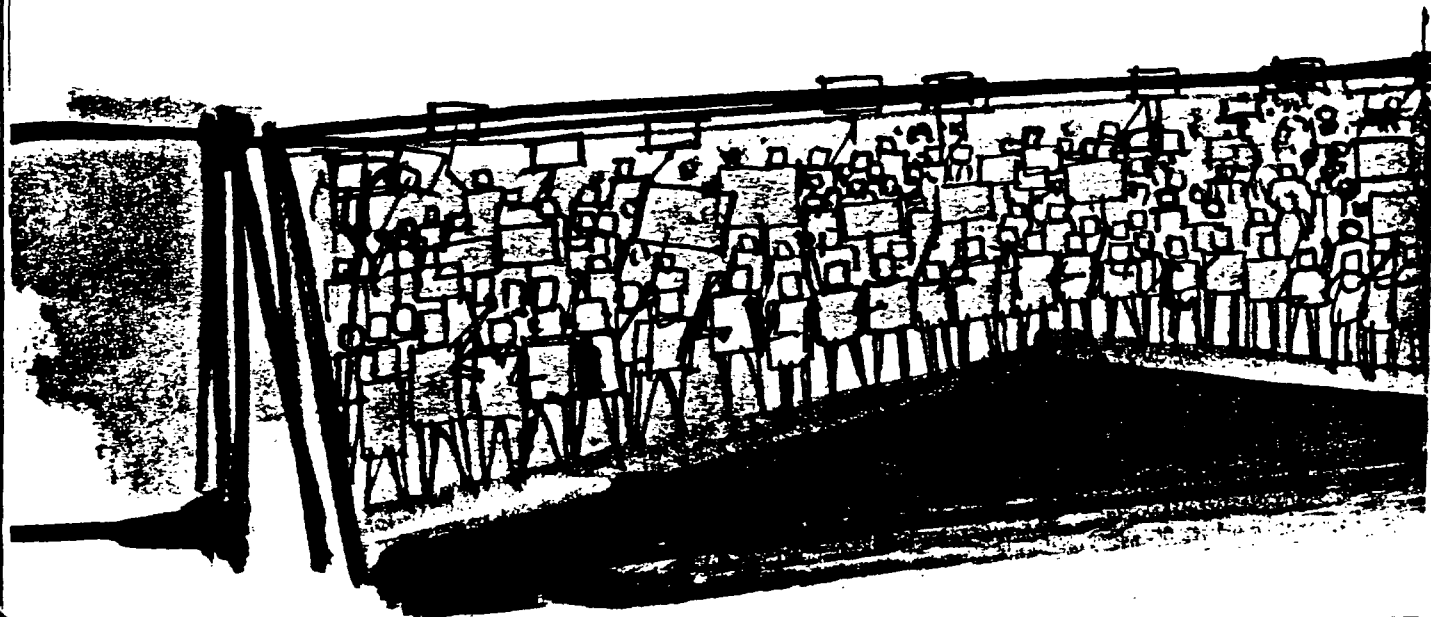
In a broader context, it is important to understand that there is a close relationship between the lawlessness on the campus and that in the streets. The underlying philosophy of the disorders which now rack America is the alien doctrine of civil disobedience. Unfortunately, this doctrine

has been accorded respectability by many influential Americans—including politicians, clergymen and campus intellectuals. These persons appear so enchanted by emotional slogans and causes that they give no thought either to the lawless means employed or to where the disobedience road will lead. With rioting, looting and burning becoming commonplace, this road is leading perilously close to disaster.

As we meet here tonight the headlines and the television screens are full of the so-called poor people’s demonstration in Washington. With the elaborate precautions taken by the government, including the massing of thousands of troops, this may not disintegrate into a riot.

One of the techniques of civil disobedience is the massive street demonstration. Many of these lead to riots and disorder, and even the so-called peaceful demonstration is often a form of coercion which sets a dismaying example. It professes to be an exercise of the right to assemble and petition one’s government. The founding fathers never imagined that these rights would be corrupted and distorted into their present chaotic dimensions. This, indeed, is the type of participatory democracy which the New Leftists want. If carried to its logical conclusion, pressure groups will compete with each other to muster the largest mobs. Representative government will first be bypassed and eventually disintegrate in the inevitable chaos. The ultimate end result will be an authoritarian dictatorship either of the left or the right—with all of the repression that this implies.

I have been talking about the national scene. Here in Virginia, with a state government and with university administrations responsive to the honored traditions of this state, we have experienced few intrusions from the New Left. The presidents and faculties of our universities and colleges, and particularly the student bodies, deserve the commendation and support of our people. President Shannon at the University of Virginia has recently set a splendid example for all to follow in his policy statement with respect to preserving channels of communication while tolerating no lawless conduct.



Now, some concluding comments:

The question most frequently asked is what can responsible citizens do to reverse the trend towards anarchy. There is, of course, no dramatic or easy answer. Yet, it is distinctly possible, unless the apathetic majority soon asserts itself, that the New Leftist minority—with its fierce hatred and utter ruthlessness—will destroy the most cherished values of western civilization.

There are many pressing needs in this country and worldwide—which we cannot discuss at this time. I do not minimize any of them. I do say that none can be met—indeed there will be no opportunity for enduring social progress—unless we preserve an ordered society, governed by the rule of law.

Thus, the first and overriding priority is revitalizing the rule of law. This means the meeting of lawlessness with appropriate force to put it down—whether it be conventional crime, sit-ins on the campus or riots in the streets; it means taking a stand against civil disobedience in all of its forms; and it also means insistence upon the orderly processes of our democratic system, rather than supine toleration of marching mobs of mindless demonstrators.<sup>10</sup>

The law abiding, responsible citizens of this country—and these are an overwhelming majority of our people of all races—have been sitting mutely on the sidelines while varying shades of revolutionaries are tearing apart the fabric of our free society.

The time has come for the majority to assert itself, to demand that elected officials, ministers, educators and opinion makers in the media respect and preserve the honored codes of civilized man, and abandon their excessive tolerance of the demands and conduct of the radical extremists.

The great American majority have seemed to be too intimidated or too apathetic to speak out against the New Leftist tyranny, and against those who justify and encourage it. If this silence and inaction continue much longer what has happened to other civilizations in history can and will happen to ours.

<sup>1</sup> Life, May 10, 1968.

<sup>2</sup> Hearings, Subcommittee of Senate Judiciary Committee, 89th Congress. Part 1, p. 17, et seq.

<sup>3</sup> Washington Post editorial, May 14, 1968, quoting article in New Republic: "Everywhere, the purpose (is) to destroy institutions of the American Establishment, in the hope that out of the chaos a better America would emerge".

<sup>4</sup> See Walsh, What the Students Want, Commonweal Magazine, Nov. 19, 1965, pp. 206, 207.

<sup>5</sup> U.S. News & World Report, May 20, 1968, p. 40.

<sup>6</sup> Premier Pompidou, quoted in Washington Post, May 15, 1968.

<sup>7</sup> Washington Post, May 14, 1968. A student publication at the University of California "The Berkeley Barb", states the New Leftist view as follows: "The universities cannot be reformed; they must be abandoned or closed down. They should be used as bases for action against society, but never taken seriously". N.Y. Times Magazine Section, May 18, 1968, p. 104.

<sup>8</sup> A majority of the law school faculty at Columbia, in supporting the calling of police, said: "Using muscles instead of minds to express dissent has no place in the academic setting". See text of statement, N.Y. Times, May 17, 1968; editorial comment, N.Y. Times, May 18, 1968. Cf. the mishandling at Columbia with the firmness at the University of Chicago, where sit-in students were ordered to leave or be expelled by a designated hour. See editorial, N.Y. Times, May 18, 1968.

<sup>9</sup> See Interview with Dr. Logan Wilson, President of American Council of Education, U.S. News & World Report, May 20, 1968, pp. 41-44.

<sup>10</sup> As a lawyer, I am mindful of preserving cherished First Amendment rights. But the right to assemble and petition is not unlimited. Massed mobs in the street become unlawfully coercive when they interfere seriously with the rights of other citizens and tend to provoke violence.



# ANAP ON CAMP



ETC 17938



**Deep  
are  
the roots**

by Maurice R. Castagne

Maurice R. Castagne is a writer, editor and photographer specializing in the paper industry. It was while he was the editor of a paper industry magazine that he became disturbed by what the forest industry companies were blamed for regarding the redwoods in Northern California. Full-page ads in the New York Times concerned him. These ads spoke of the destruction of the last redwoods. To see for himself, Mr. Castagne made a personal visit at his own expense to the redwood forests to learn the facts. This is his story.

To see the redwoods is to fall in love with them.

No matter how many pictures you have seen or stories you have read, you will still be caught up in wonder at their majesty. It is truly an emotional experience.

Why do we feel this way? Perhaps, it is because deep within each of us there is a reverence for, an awe of nature. Whatever the reason, this reverence has deep roots in man's love of trees. It is a common denominator among men. At the drop of a leaf we will fight, demonstrate, protest the cutting of a single tree.

*continued*

It was the cutting of not one, but of many old-growth virgin redwood stands too near a public highway that touched off the battle of the redwoods. Before we proceed, let's define the redwoods.

### Two Species of Redwoods

1. *Sequoia gigantea*. These are the big trees through which you can drive your car. These trees grow inland, are not used commercially and most of the stands are in national and state parks. You can see some beautiful stands, for example, in Yosemite National Park.

2. *Sequoia sempervirens*. *Semper* means always and *virens* means living. These trees grow for centuries and some have been estimated to date back before the time of Christ. These tall trees grow along the Northern California coast. These are the coastal redwoods. These are the trees over which the battle has raged.

There are two kinds of coastal redwoods. The virgin growth, grove-type magnificent monarchs grow on the flatlands. These are largely in small areas of high density, old, pure redwood stands preserved in the publicly owned forest of the state parks and other public lands. It is these old-growth virgin redwood forests which are of particular scenic and heritage quality. *These scenic forests are preserved and maintained in the public interests for sightseeing, inspiration and recreation.*

The second type of the coastal redwoods is the commercial forest, the source of the redwood lumber, which is the principal economy in the North Coast counties of California. The commercial forest comprises, by far, the greatest area of the redwood lands. It contains some old growth areas, which include some of the old, large trees such as are preserved in the park forests, but it also has far greater areas of forests where smaller and younger trees grow on rugged terrain, mixed with stands of Douglas fir, spruce and hemlock.

### Redwood Growth

Man has been cutting the coastal redwoods for more than 100 years. As he has matured in his relation with nature,

man has learned that all trees, not only redwoods, can be planted, grown and harvested as a crop; much as he harvests corn. In fact, because of modern scientific forestry management practices, the forest industry today grows more trees than it harvests; 60 per cent more!

The centuries-old monarchs that tower more than 200 feet into the skies are the redwoods with which we are concerned here. And, it is here that our emotions enter the battle.

To understand what we are talking about, play this emotion-word-association game. There's only one word to this game: Redwoods. Just say this one word and see what the reaction is. Chances are that many will associate the word "Shame," with redwoods. They will say what a terrible shame it is what man is doing to the redwoods. The reaction will probably proceed in this vein, "*How can man be so destructive? These grand old trees have been growing since time immemorial and now, here we are supposedly an enlightened nation, and what are we doing? We're destroying these magnificent giants. If someone doesn't put a stop to this destruction, there won't be a single redwood left.*"

Would you believe that someone who could make a statement like that had been brainwashed? Would you believe that the redwoods are not being destroyed? Would you find it hard to believe that these tall trees do not need saving—that they were saved before the battle had begun?

You find all of these statements hard to believe. The reason you are so skeptical is because some so-called conservationists groups have waged an unabashedly distorted campaign to convince you that the redwoods need saving. I say, "*so-called conservationists,*" because their idea of conservation is to lock everything up forever. On the other hand, the forest products industry, the people who grow, harvest and plant trees as a crop, have been just as bashfully giving a timid, defensive answer that they are not destroying the trees.

### What are the Facts?

The redwood controversy centers around the establishment of a National Redwoods Park. All parties engaged in this dispute agree on one point: There should be a National Redwoods Park. The snag is how much and how to go about it.

The Federal Government has proposed a National Redwoods Park of 45,000 acres. Originally, the Sierra Club (a preservationist group) had proposed

one of 90,000 acres. What is strange about both proposals is that there are now 28 California Redwoods State Parks encompassing almost 117,000 acres in 185 square miles! The Sierra Club has stated in an advertisement in *The New York Times* that man can spend billions of dollars to put a man on the moon, but cannot spare the money to save enough redwood forests a man could walk through in a day. How about trying to walk through 117,000 acres in a day?

In a handsome book with excellent photographs, the Sierra Club has stated that less than 2 per cent of the redwoods that once existed are left. The title of this book: *The Last Redwoods*. The fact is that almost 33 per cent of the truly outstanding redwood groves that ever existed are now preserved in these 28 state parks. This was possible through the cooperation of the Save-The-Redwoods League, the State of California and the redwood industry.

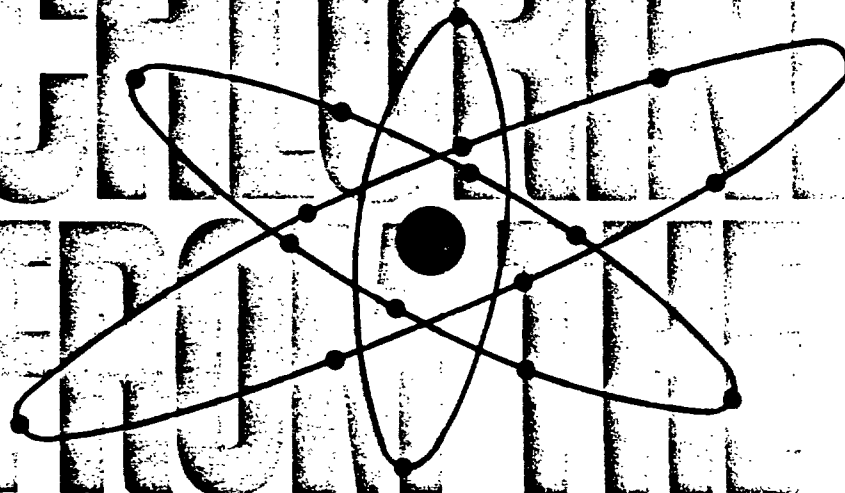
It is an interesting fact that many of the redwood companies make it their practice to set aside some of these old growth stands voluntarily until the Save-The-Redwoods League can purchase them. And, more interesting is that they continue to pay taxes on these lands which they do not use. In addition, many forest product companies permit the public to enjoy the great outdoors on its forest lands either free or at little cost. The American forest products industry and the American paper industry have matured immeasurably from the days of the old lumber barons of the cut-and-get-out policy.

Trees are a crop to the forest company of today. And, today's investment in a new pulp and paper mill approximates upwards of \$100 million. No company is going to make that kind of investment and then harvest all the trees. Each year the forest products industry plants billions of seedlings to literally make its investment grow.

As intelligent man does not "cut off his nose to spite his face," so too, the forest industry companies of the United States will not cut down the redwoods without providing for regrowth for the betterment of the nation's future. ■



# CHLORINE FROM THE EARTH.



Some months ago a leading financial journal stated "... By the end of 1968, U.S. daily capacity for chlorine will hit 23,125 tons, up 2,500 tons or nearly 11 percent above current level. Canadian daily capacity, now 2,280 tons, will increase by more than 2 percent during the year."

Just what is this stuff 'chlorine'?

To many, its the 'stuff they put in pools to make the water clean'. This is but one the myriad uses of the countless chlorine compounds serving mankind today.

Perhaps the earliest known and most familiar chlorine compound—known long before its in-

dividual components were even considered—is sodium chloride, common but oh-so-very important salt.

Virtually every form of life has been eating, living in, and requiring—as a staff of life itself—common salt.

There is a Latin proverb: "Nothing more useful than the sun and salt."

And, a Sanskrit proverb: "There are six flavors, and of them all, salt is the chief."

But, this story is not about salt. It is of chlorine —"a gaseous chemical element of the halogen

*continued*



A view of Ethyl's perchlorethylene and vinyl chloride manufacturing facility at Baton Rouge, Louisiana

group, taking its name from the color, greenish-yellow."

Chlorine was discovered nearly 200 years ago—in 1774, by a Swedish pharmacist, Carl Wilhelm Scheele, who called it *dephlogisticated muriatic acid*. Eleven years later, it was regarded as being a compound of hydrochloric acid and oxygen and renamed *oxygenized muriatic acid* by C. L. Berthollet. It wasn't until Sir H. Davy, in 1810, proved it to be a chemical element unto itself and named it chlorine.

Years before Humphrey's pronouncement, chlorine was given its first commercial application. Potassium hypochlorite was produced by an obscure worker in a textile mill located in a suburb near Paris—Javelle. This chemical, formed by bubbling chlorine into a potash solution was found to be a most efficient bleach. *Javelle water* is still known by that name and in widespread use today—the only refinement is its change from potassium to sodium hypochlorite. As word of its use spread from the continent, through England and on to the United States, this remarkable bleach soon found its way into papermaking processes where it proved as efficient on pulp and paper as it was on textiles.

Virtually all of the chlorine produced until nearly 1900 was by chemical process—much the same way as it was discovered by Scheele—from manganese dioxide and sulfuric acid and salt (the latter two ingredients being substituted for the original hydrochloric acid).

Again original experiment was left unnoticed until revived—years later—by another adventuresome spirit. So it was with the electrolytic process presently used for the commercial production of chlorine. An English researcher, William Cruickshank, reported, in 1800, that chlorine evolved as a product of electrolyzed common salt. However, it took the reknowned Michael Faraday—a man of many important discoveries—to bring the process of chlorine by electrolysis to the fore. This was during the 1830's when Faraday included common salt and potassium chloride among countless other chemical compounds he attempted to compose.

Work continued during the middle 1800's on ways to commercially produce chlorine by electrolysis. One problem to be overcome had to do with the separation of the components of the basic salt solution and the soluble product—caustic soda—formed in the process. It was necessary to keep this component from interacting with the chlorine gas formed. An English chemist—Charles Watt—found such a way. He devised an electrolytic cell with a porous diaphragm—it kept the chemical products separated but allowed the flow of electricity.

This basic method is still used today.

As electricity came into more widespread use and availability, so did the electrolytic process for the manufacture of chlorine.

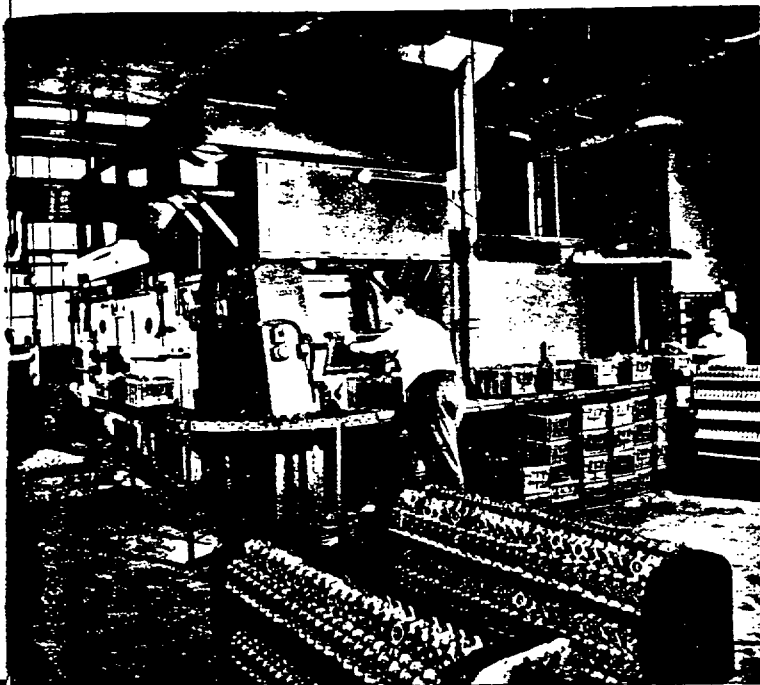
In 1893 the first plant in the United States for the manufacture of chlorine and caustic soda was built in Rumford, Maine—coincidentally, Rumford was the scene of the first mill, built in 1900, by Ethyl's Oxford Paper Company.

#### MANUFACTURE CHLORINE? WHAT FOR?

For years after its discovery and commercial production, chlorine was used almost exclusively in the manufacture of bleaching compounds.

Liquified chlorine was a next step. Here too problems had

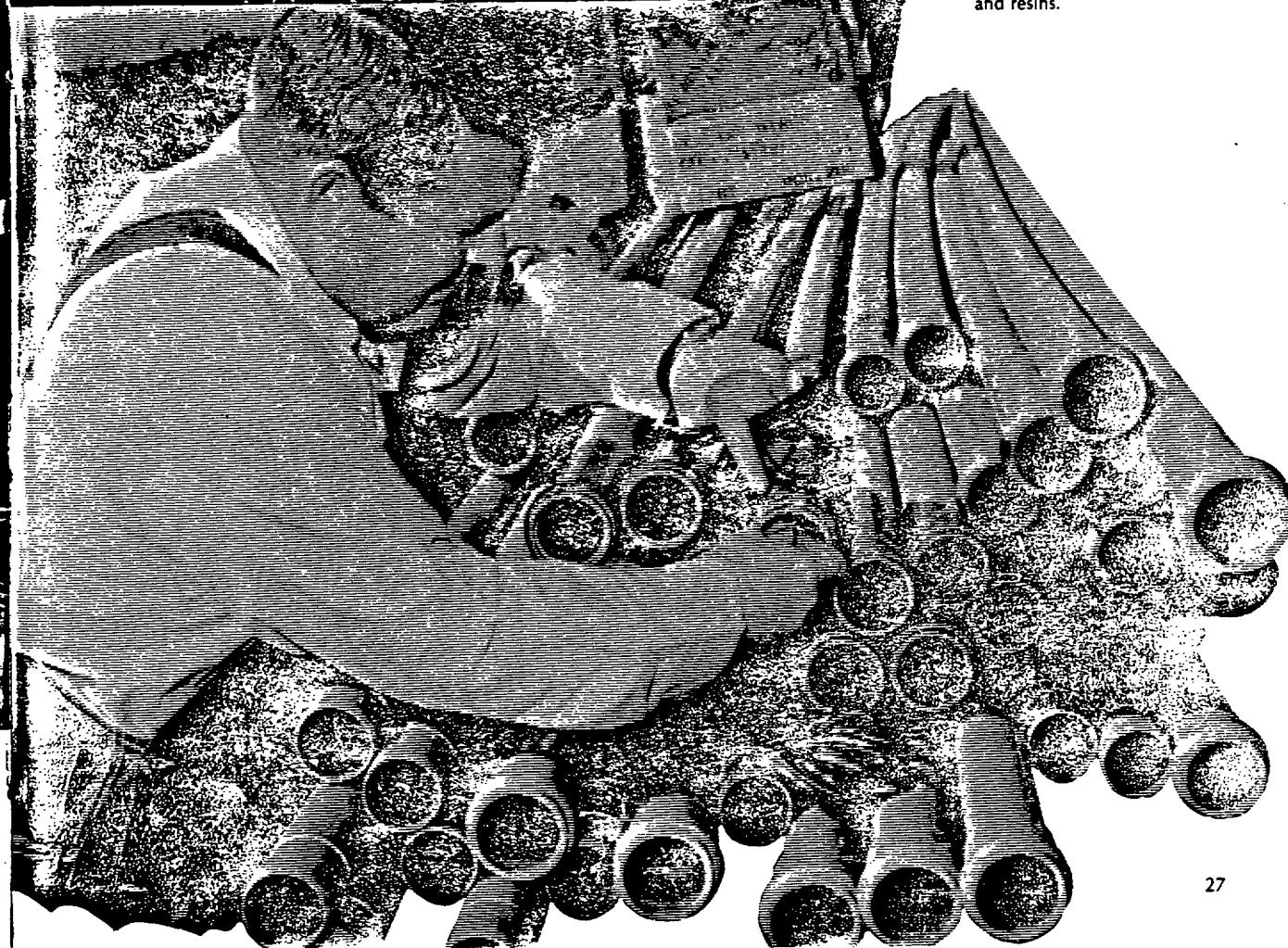




Degreasing—A vital step in metal cleansing utilizes the advantage of the chlorinated solvent, trichlorethylene, one of Ethyl's industrial chemicals.



Bottles, bags, film, pipe—All of polyvinyl chloride. All products of Ethyl Corporation—including the base compounds and resins.



to be overcome. While it was relatively easy to liquify the gas, the early results, a combination of chlorine and water made it nearly impossible to pump, compress and transport the product due to its highly-corrosive properties. It was a German chemist—Rudolf Knietsch—who discovered that chlorine liquid, with all the moisture removed, could be shipped and stored in common iron or steel containers without any corrosive effect. Liquid chlorine was now practical. In this form many new industrial uses were developed.

### TO YOUR HEALTH

Interestingly, chlorine is used in military training—its pungency is such that it provided the stimulus for recruits to quickly learn how to use their gas mask. This use had greater ramifications. A resident physician noticed that men who were working closely with the gas at the army chlorine plant in Maryland had a great tolerance against the effect of the common cold. This led to a technical paper being published in a leading medical journal—which in turn led to the treatment of colds by the inhalation of dilute chlorine. A newspaper headline of the day declared "President's Cold Cured by Chlorine."—the president was Calvin Coolidge.

This then was the early use of chlorine in the war against disease.

Chlorine's usefulness in this area actually had an early beginning. As far back as 1787 two Frenchmen discovered that chlorine solution would deodorize cancerous ulcers. Deodorization of putrefying meat was managed in England two years later. In 1797, chlorine was being used in English hospital wards to reduce infection during a fever epidemic. During the ensuing years after much trial—and some error—chlorine compounds used as disinfectants became quite routine.

Chlorination of water was a next important discovery. It was a Philadelphia physician who, in 1835, proposed to purify marsh water by the addition of chlorine or one of the chlorides. It was Maidstone, England, that was the first city to chlorinate its entire water supply—it used hypochlorite bleach powder to do so in 1897. Other townships followed—perhaps the most significant of that period was Boonton, New Jersey, where, in 1908, the reservoir was treated—it provided 40 million gallons of water each day to Jersey City. Within three years other great cities followed and there were more than 800 million gallons of water being treated each day. It was in 1913 that the first use of liquid chlorine as a water purifier came into use—this was in Philadelphia.

As the uses for chlorine increased over the years, major facilities were installed in the United States. During the 1920's, chlorine production almost tripled.

It was in 1924 that the chlorine industry—an industry of growing size and importance within the chemical manufacturing community—developed a cooperative effort to develop new markets for their product. Here then, The Chlorine Institute, Inc., was formed.

By 1926, the Institute adopted an attitude of prime concern regarding chlorine—promulgation of rules and procedures for the safe manufacture, shipment and use of chlorine.

The effect of industry's concern and the Institute's

efforts toward maximum safety culminated in the publication, in 1947, of the first *Chlorine Manual*. Since, more than a quarter of a million copies have been printed and widely distributed. Safety in manufacture and safety in transportation became key projects of all involved in the use and production of this versatile element and its many compounds. In-plant training is an important part of daily routine at every chlorine-manufacturing facility. Rules, methods, and experiences are standardized and shared and updated as required.

This concern and implementation of safe practices within the chlorine industry stands as a guideline throughout the industrial community.



"ETHYL" Chlorinated Solvents used in many industries, such as dry-cleaning, and in industrial degreasing operations.



## AND OF TOMORROW

The growth of 'the touch of chlorine' in developmental and manufacturing processes has been remarkable. After more than eighty years since its production by electrolysis, its production continues to double each decade—primarily in two areas, chlorinated plastics and solvents.

Vinyl chloride—the base material for chlorinated plastics—was first produced in 1835 by the French chemist, Henri-Victor Regnault. As a point of reference, it should be noted that the increasingly popular polyvinyl chloride is but one of the chlorinated plastics.

Chlorinated solvents? Well, carbon tetrachloride (or carbon tet) is well known as a cleaning agent and as a fire extinguisher. But, chloroform too—a non-flammable, faster affecting substitute for ether—is one of several early chlorinated solvents. The dry-cleaning industry today relies, almost exclusively, on perchloethylene—another of the use-

ful family of chlorinated solvents. Its related trichlorethylene is also used in cleaning as a metal degreaser. Ethyl chloride—another relative—finds its major use in the manufacture of tetraethyl lead antiknock compounds—in this case as an intermediate.

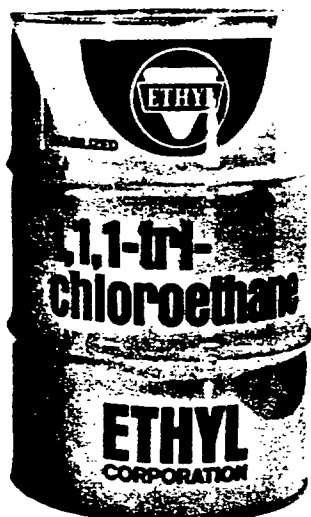
And on the list goes: 1,1,1-trichloroethane—another chlorinated solvent—originally it was used as a moth-proofing agent. Today it's perhaps best known due to its use in DDT.

And of tomorrow? From The Chlorine Institute's *History of Chlorine* we read:

"What will prompt chlorine's next spurt in growth? It may be a new rocket fuel component. Or perhaps a major new use for a vinyl plastic . . .

"Truly, if there is one thing that can be expected from chlorine, it is that the utility of this material will continue to exceed expectations." ■

From cosmetics to dishwashing detergents to foods and drugs, "clear like glass" polyvinyl chloride bottles are manufactured by Vypak Company—an Ethyl Corporation subsidiary.



# DEVELOPMENTS

## The American Chemical Industry —A Salute.

The American Chemical Industry is celebrating an anniversary this year—its 50th. Born out of the pressing needs of a nation at war to feed, clothe and move an overseas army, it pervades the whole spectrum of American life today from the shirt or dress we wear to the gasoline we use in our cars, from the food we eat to the paper we read.

It is an industry in which more than 50% of the products now sold were not known in 1939.

It is an industry which has helped to steadily reduce the acreage needed to grow the food supply for the nation, while consistently increasing the yield.

It is an industry which virtually every manufacturing enterprise relies on in its production operations from metals to rubber, from petroleum to plastics.

It is an industry which has spawned new jobs and new industries through its research, technology and productivity.

Ethyl Corporation's pride in the contributions the chemical industry has made to the consumer, to other industries and to the American economy as a whole stems from the company's own parallel history of chemical research, development and manufacturing.

Ethyl Corporation salutes the American Chemical Industry.



Smoke plume rises from gas turbine unit operating on distillate fuel.



"Ethyl" CI 2 improves stack plume appearance by eliminating excessive smoke.

## New CI 2 Markets Developed Overseas

Recently, Long Island Lighting Company and Consolidated Edison Company, two major electricity producers in the Metropolitan New York area, have found use for Ethyl Corporation's Combustion Improver 2 to combat problems in their steam generating plants and stationary gas turbine units operating on distillate fuel.

These companies have found that CI 2 acts to modify fireside deposits and "cold-side" corrosion, improves stack appearance and stack plume and in distillate fueled turbine units virtually eliminates objectionable smoke.

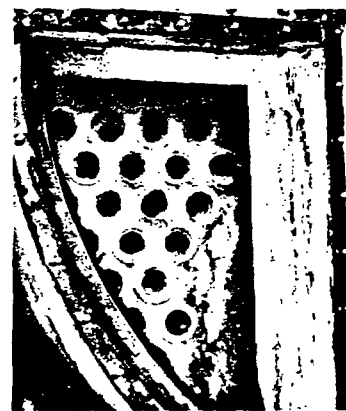
The needs of other industries around the world have caused them to turn to CI 2 to emulate the success of power plant users. As a result, CI 2 has emerged

as the main ingredient in many multi-component packages used to improve fuel oil combustion operations in such diverse industries as cosmetics, glass, lime, cement and petroleum products processing.

These additives, known by various brand names and neat CI 2, are being used by such companies as Avon Cosmetics in the United Kingdom, Kodak of Australia, Refinery of Panama in the Caribbean and SwissAir in Switzerland. In addition, CI 2 in a multi-component additive is being distributed to every port-of-call around the world through The Perolin Company, Inc., Ethyl's distributor of the compound to the marine trade worldwide and to the industrial power plant trade in the United States.



Fireside deposits clog heating tubes in a boiler.



"Ethyl" CI 2 reduces these deposits and makes them easier to remove.

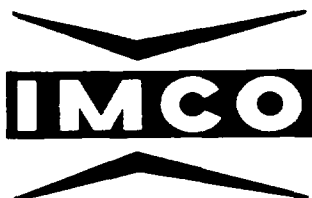
## Ethyl Acquires IMCO — Major PE Bottle Producer

Ethyl Corporation is now participating in a new field of plastic bottle manufacture as a result of its purchase of the Imco Container Company from Rexall Drug and Chemical Company and El Paso Products Company.

Imco is one of the nation's leading producers of polyethylene bottles and containers for use in packaging a wide range of detergents and household chemical products, toiletries and cosmetics, pharmaceuticals, food and beverages.

The Imco operations have become part of Ethyl's Plastics division—and known as the Imco Container Company, division of Ethyl Corporation.

Ethyl has exclusive rights to the "Imco" trademark in the United States and Canada.

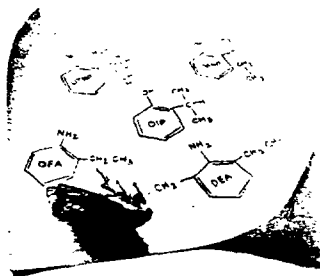


The terms of the purchase include the acquisition of Imco's polyethylene bottle making operations in the United States and Canada—with plants in Goleta and Los Angeles, California; Jeffersonville, Indiana; Kansas City, Missouri; Belvedere and Plainfield, New Jersey; Harrisonburg, Virginia; and Cooksville, Ontario, Canada. Also included is a closure manufacturing plant for Imco bottles in South Grafton, Massachusetts; and a bottle machinery manufacturing plant in Kansas City, Missouri.

Imco has developed a good reputation as a "quality" bottle producer and as the leading manufacturer of the more highly decorated plastic bottles. In addition to bottle manufacture, Imco designs and manufactures its own molds and bottle manufacturing and decorating equipment.

Imco maintains sales office in the following cities: New York; Chicago; Cincinnati; Los Angeles; Toronto; and Montreal. The Company also markets a portion of its products through distributors located throughout the United States and Canada. Operation headquarters are located in Kansas City, Missouri.

## Ethyl Technology Fights World Food Problems



Although Ethyl Corporation does not manufacture a finished pesticide, the Company's products are finding use in some of the most effective weed and bug killers around the world. For example, Ethyl has recently licensed the Mitsubishi Chemical Company of Japan to manufacture ortho-isopropylphenol, a chemical intermediate used to make a potent new pesticide. OIP is produced by Ethyl's patented ortho-alkylation process, and is used by Mitsubishi to manufacture the new carbamate pesticide.

An interesting point is that the OIP carbamate is selectively effective against the small brown plant hopper and green rice leaf hopper, without killing spiders and wasps which are natural enemies of the above rice pests.

Through this and other cooperative efforts with pesticide manufacturers around the world, Ethyl technology is helping to solve critical food problems that trouble many nations.

## Bromet — New Ethyl Venture

Ethyl Corporation has recently formed the Bromet Company in partnership with Great Lakes Chemical Corporation of West Lafayette, Ind., and has already started construction on a plant to manufacture bromine and ethylene dibromide, integral ingredients in Ethyl's anti-knock compounds.

The Bromet plant, scheduled for construction in mid-1969, will be located south of the city of Magnolia in Columbia County, Arkansas. A bromine-bearing brine field will also be set up by Ethyl to supply the Magnolia plant.

The new company will utilize Great Lakes' experience in the construction and operation of bromine and ethylene dibromide plants and Ethyl's brine property in Columbia County.

As a major producer of bromine and its derivatives, Great Lakes presently serves the agricultural, automotive, pharmaceutical, chemical, textile and mining industries.

## Ethyl Executive To NICB

William H. Chisholm, executive vice president of Ethyl Corporation and president of its Oxford Paper Company division, last month was elected a member of the National Industrial Conference Board for a two year term. The Board is an independent, non-profit institution for business and industrial fact finding through scientific research. It is a source of facts and figures bearing on all aspects of economic life and business operation.

## PRODUCTION NOTES

**PRINTING** / This issue of Ethyl Magazine was printed by offset lithography on a #61 Miehle, four-color, 43x60, press at 5,500 impressions per hour. Color sequence was yellow, blue black and red. **TYPOGRAPHY** / Body copy set 9/10 Optima with semibold and italic. Pages 30, 31 set 9/10 Melior.

**PAPER STOCK** / The paper 80# 'Solitaire' Embossed Dull was produced by Oxford Paper Company, an Ethyl Corporation division, at the Lawrence, Massachusetts, mill. A new standard of quality in the medium grade price range, 'Solitaire' is available in gloss, dull and embossed finish—in matching text and cover weights. Consult your Oxford Merchant Representative for additional information concerning 'Solitaire' as well as the entire line of Oxford Papers.

**CREDITS** / Front Cover: Irving J. Olson, Akron, Ohio/ Page 3: American Museum of Natural History/ Page 23: Maurice R. Castagne/ Original art by H. Newman Graphic Arts, Inc., New York. Printed by DeTroy Bergen division, Einson Freeman and DeTroy Corporation, at Fair Lawn, New Jersey.

# What do you think of when you think of Ethyl?

"I am sure others, as I was, were surprised to learn of the diversified areas in which Ethyl Corporation is involved. I must admit, that on hearing the name Ethyl I thought only of gasoline. Not so anymore."

"Even as an industrial chemist I was never aware of the really varied products and fields of endeavor in which Ethyl Corporation is associated."

"I did not know that Ethyl Corporation made anything more than anti-knock additives."

"Gasoline—that's all I knew about Ethyl Corporation. It is so very interesting and useful to know that Ethyl is so closely associated with industrial chemicals, paper, forestry, plastics and aluminum."

"I was ignorant of the fact that Ethyl does not make gasoline—I thought that was your prime product. It is interesting to learn, however, that Ethyl Corporation is really a well-diversified firm producing many things from paper, plastics and chemicals."

"I certainly had heard of Ethyl Corporation but I did not know anything about your business. Now I know that your company manufactures paper, plastics for industry, aluminum extrusions, and is a leading producer of specific chemicals such as sodium."

"Until I heard of Ethyl Corporation's activities in forestry, metals, chemicals, plastics and paper, the only thing that came to mind upon hearing the name was gasoline."

"I had heard of VisQueen, and certainly was familiar with the paper and plastic bottles business as well as other packaging industries. It was surprising to learn (and indeed refreshing) that Ethyl Corporation is all of these things."

These comments are typical of the reactions to the back cover of the previous Ethyl Magazine which showed the company's changing nature through its broad product line.

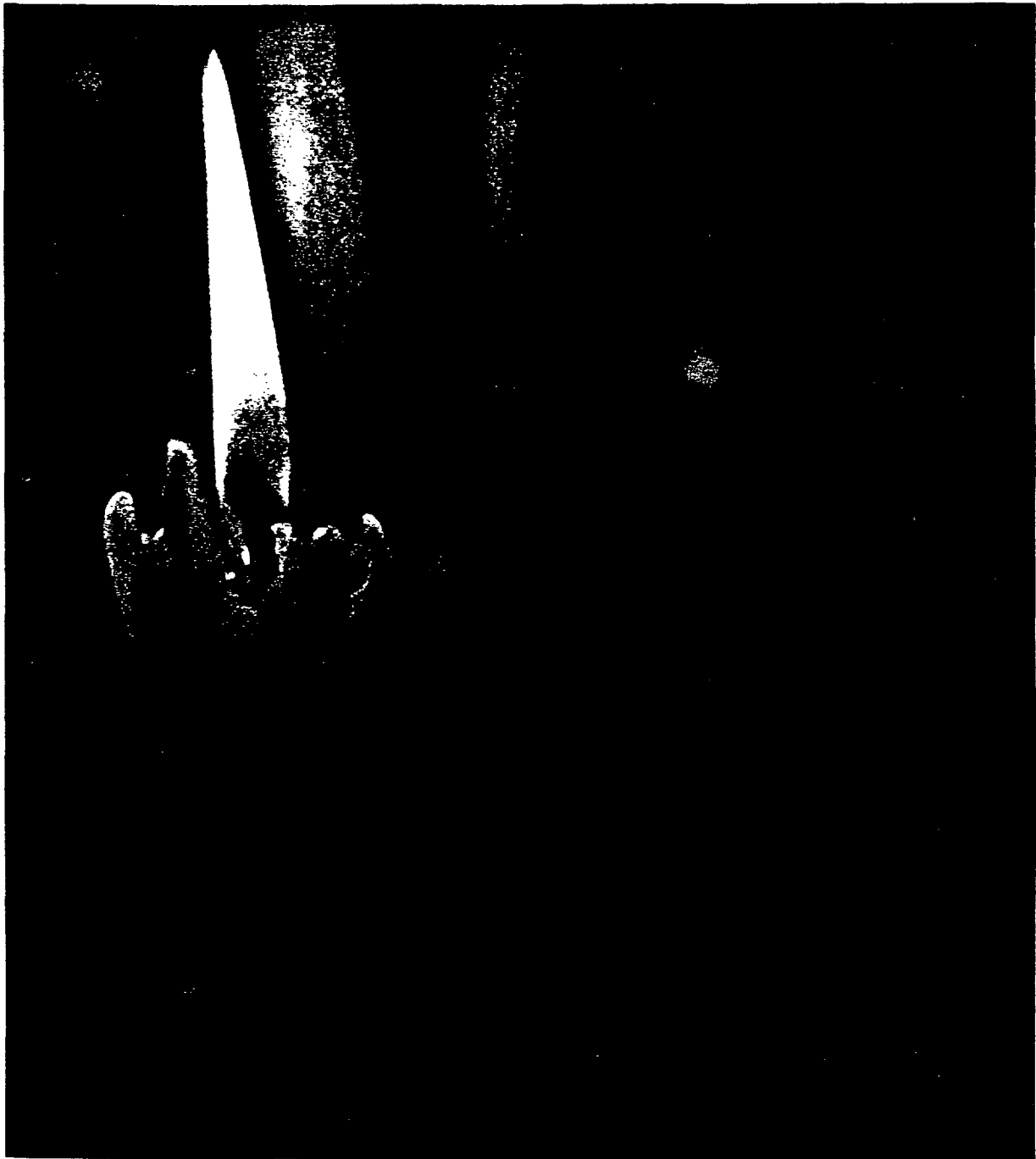
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Alton W. Becker }  
George J. Brogan } Contributing Editors  
Stanley M. Siegel }

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Another cover photo by Irving J. Olson—Candlelight. The blending of colors from a candle's glow produces a beauty only nature could create. The spectrum of ideas from the light of men's minds—imagination—is like the creation of these colors. From the flame of thought, ideas emanate, expand and change into a pattern of freshness and appeal. Ethyl Corporation strives to generate and sustain its light of ideas to satisfy the myriad needs of a changing world—always ready to absorb and reflect a new idea, a better way.

## ETHYL CORPORATION/1969

The trail-blazing moon voyage of Apollo 8 firmly established American preeminence in space. At the same time, it underscored the vast changes that have taken place in the U.S. space effort since John Glenn became the first American to orbit the earth in 1962.

As a departure point for far-reaching change, 1962 is as significant to Ethyl Corporation as it is to the men of NASA. Consummating a merger late that year which strengthened its capacity for growth and expansion, Ethyl embarked almost immediately on a program to broaden its interests.

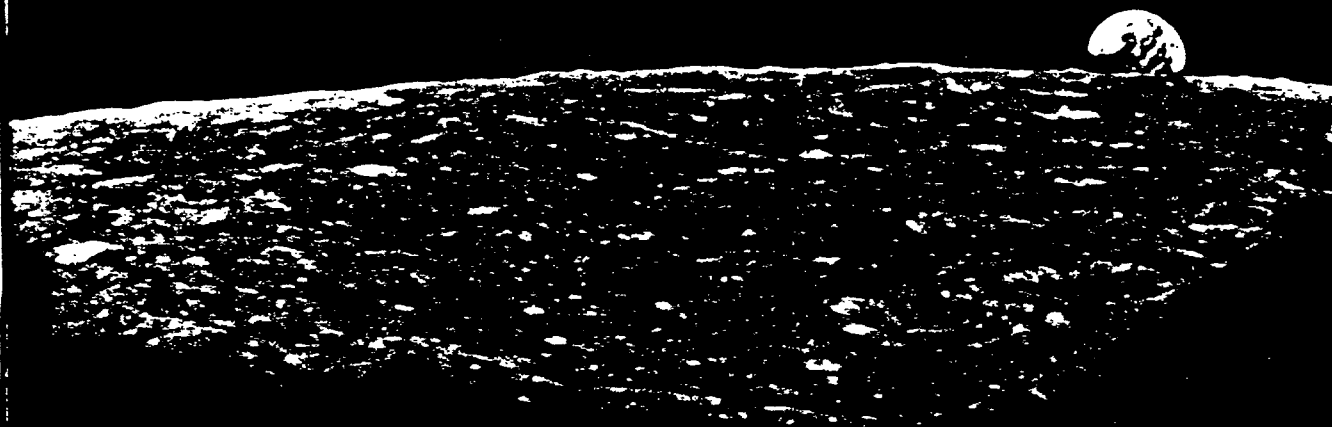
In just seven years that effort has seen Ethyl widen its role in petrochemicals and move into such new fields as industrial chemicals, fine printing papers, aluminum shapes and plastic products.

Through the spirit of purposeful change, Ethyl, like America's space program, has made important strides in the last few years. And the story really has just begun.

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*Observe always that everything is the result of a  
change, and get used to thinking that there is  
nothing Nature loves so well as to change  
existing forms and to make new ones like them.*

*MARCUS AURELIUS*



**ETHYL CORPORATION**

***Changing... to Serve a Changing World***

ETC 17953



**New Link i**

# nk in a Straight-Chain

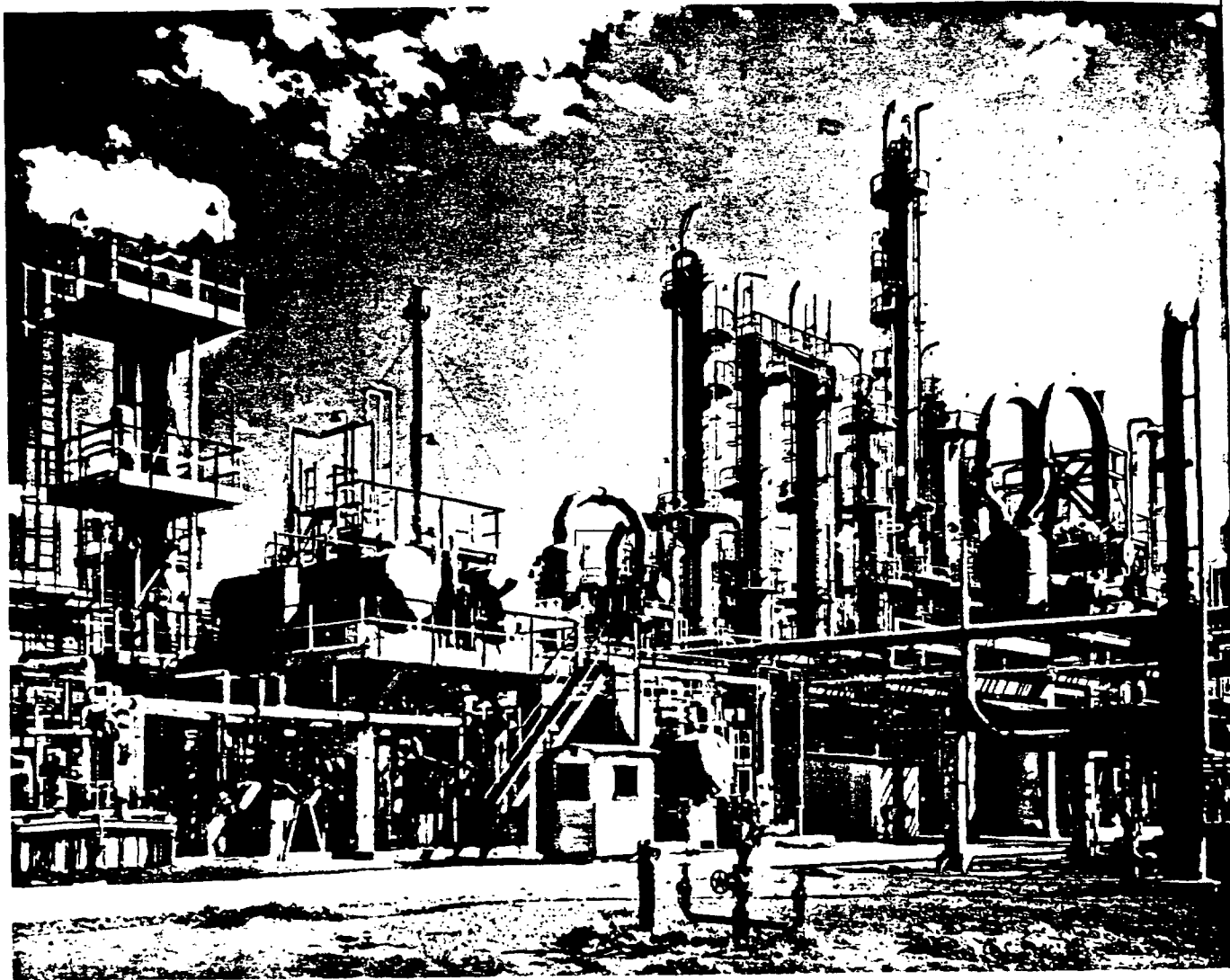
To most people the word alcohol connotes many different things—in almost every case different than the alcohol under consideration here. According to the dictionary: *alcohol is a colorless volatile flammable liquid,  $C_2H_5OH$  that is the intoxicating agent in fermented liquors.* Alcohol is also an antiseptic, a solvent, a fuel, and so on.

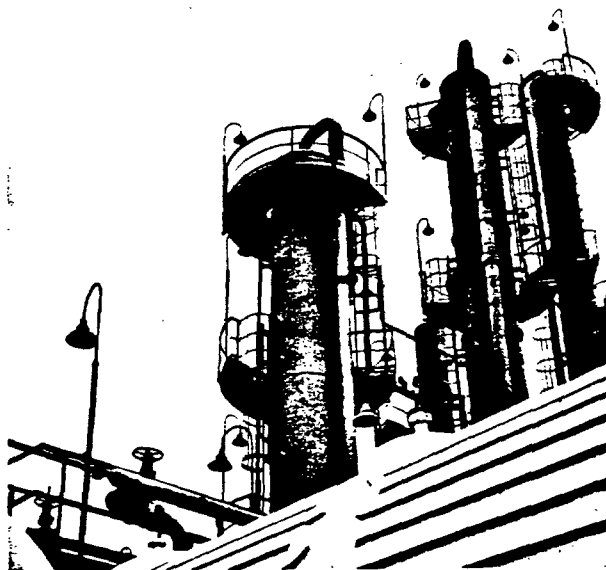
This story, however, deals with an alcohol of other characteristics—*synthetic straight-chain alcohols*. In addition, this story is also that of specific and unique research toward the development of a new method-product to satisfy the needs of a growing industry.

But, first things first—*synthetic straight-chain alcohols*. The need and use for straight-chain alcohol? Two main markets exist—in the manufacture of household detergents and in the manufacture of plasticizers for polyvinyl chloride (PVC).

The alcohols under consideration contain from 6 to 16 carbon atoms in a row. *They are very large volume chemicals, with the near-term market potential being several hundred million pounds per year.* The alcohols with 6 to 10 carbon atoms are used primarily in plasticizers for PVC and because of their straight chain give special high quality properties not obtained with the more common plasticizer alcohols. The alcohols with 12 to 16 carbon atoms are used primarily in detergents, not only making the highest quality detergents but resulting in biodegradable detergents as well—those which beneficial bacteria will feed on so as to eliminate any pollution of the nation's waters due to such effluent wastes.







For the most part, the straight-chain alcohols under consideration have been manufactured using coconut oil as a raw material. Coconut oil is an imported item (more than 800 million pounds used in the United States annually) and is subject to supply problems affected by weather, war and transportation. This has led to rather varied price swings in the coconut oil market, with variances from 12-22 cents per pound not being uncommon. This has made coconut oil a problematic raw material. Therefore, the economical production of synthetic straight chain alcohols became clearly an attractive target.

Here, then, is where the application of specific and unique research toward the development of a new method-product to satisfy the needs of a growing industry comes in.

It was in the late 1950's that Ethyl Corporation viewed the changing needs in the detergent industry—with specific regard to biodegradable products. The technology of that time had to work with chain-growth of ethylene based upon the discoveries of Dr. Karl Ziegler, of Germany. As far as Ethyl's interest in commercial production was concerned,

however, existing chain growth would not give the product mix which fit the market needs. Ethyl decided to place its initial research efforts—not at producing a manufacturing facility, but—at developing a process for chain-growth to make narrow ranges of alcohols. Ethyl's research was concentrated on discovering methods to control the specific end-product result—to tailor the chemistry to produce a specific carbon-number range of straight-chain alcohols.

Ethyl Corporation's competence and technical knowledge in synthetic straight-chain alcohol production is based on many years of research and development in the area of organometallic compounds, particularly in the field of organo-aluminum chemistry, which is fundamental to the ethylene chain-growth alcohol process.

The road to present success was not simple and short—however, the development process can perhaps best be described this way:

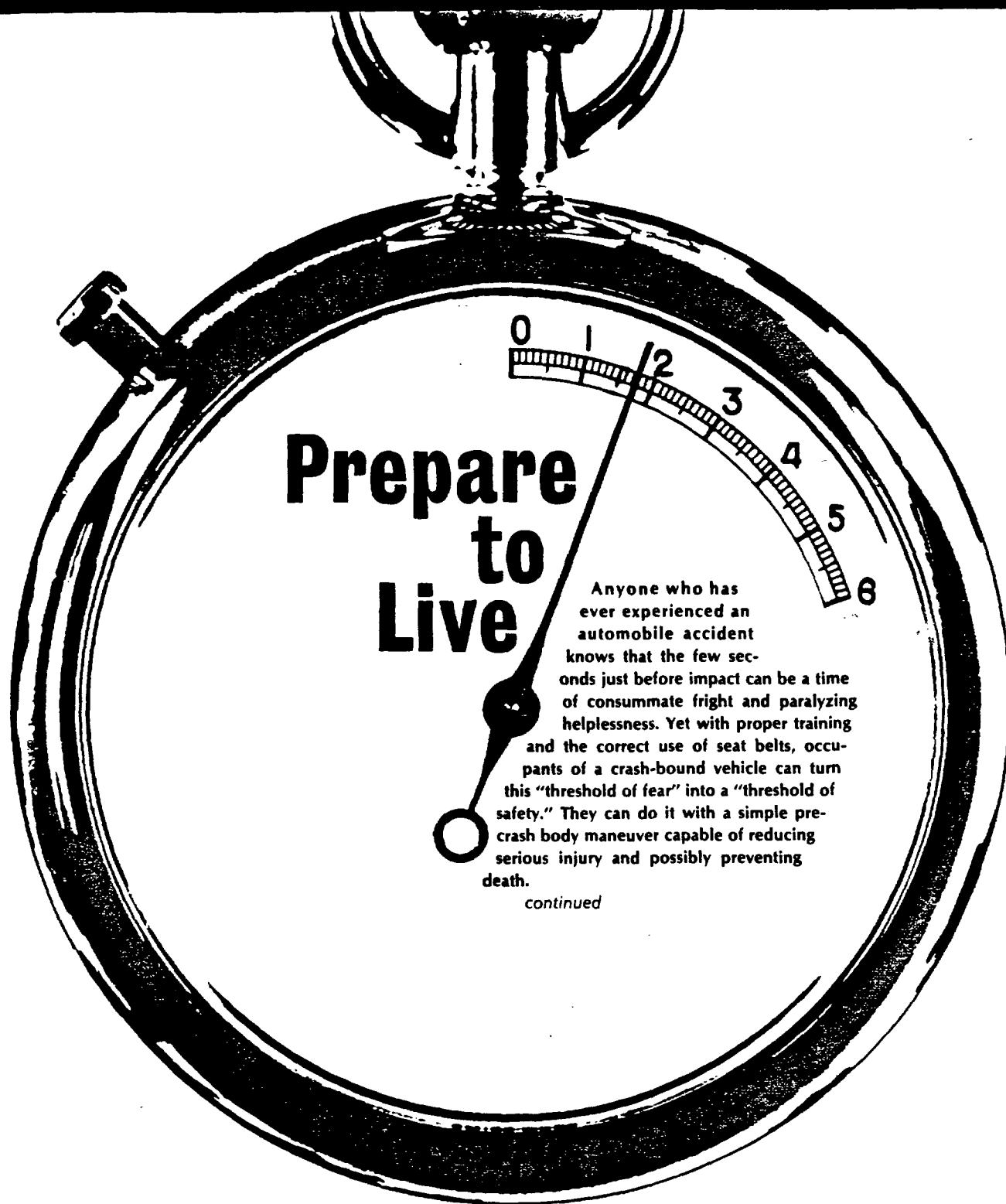
*"It has been known for some time that long-chain alcohols can be produced by oxidizing and hydrolyzing long-chain aluminum alkyls that result when ethylene is added to triethylaluminum. This addition of ethylene inherently produces a great variety of chain lengths in almost random portion (i.e., following a Poisson distribution). Yet it is a selected alcohol fraction in the C-12 to C-16 range that the detergent industry desires. Ethyl's process permits the production of selective alcohols in this narrow preferred range while making only very limited amounts of unwanted fractions."*

Extensive work in research and development led to the discovery of several methods of achieving the desired results. The most promising was chosen, and furnished the basis for design of a large scale integrated pilot plant, constructed and operated by 1963. Based on successful operation of this unit, the decision was made to proceed with a commercial plant. This plant, costing about \$20 million, with a capacity well in excess of 100 million pounds per year is complete and in full scale operation.

The development of this chain-growth technology, for which Ethyl Corporation already holds United States and foreign patents, also encourages Ethyl to consider alternate products which can be produced by related technology—straight-chain fatty acids and alpha olefins.

As a nurse applies alcohol to a scratched surface, so too have we only scratched the alcohol story surface. ■





# Prepare to Live

Anyone who has ever experienced an automobile accident knows that the few seconds just before impact can be a time of consummate fright and paralyzing helplessness. Yet with proper training and the correct use of seat belts, occupants of a crash-bound vehicle can turn this "threshold of fear" into a "threshold of safety." They can do it with a simple pre-crash body maneuver capable of reducing serious injury and possibly preventing death.

*continued*

This new technique in driving safety is called "pre-collision positioning," and it is described by two General Motors engineers in an article published recently by the Society of Automotive Engineers. Underscoring the crucial significance of seat belts as a precaution against injury, William G. Cichowski and Jeffrey N. Silver of GM's proving ground section note that "positioning," employed in combination with seat belts, can cut injury severity in auto crashes by as much as 80 percent. Not only this, but "positioning" is so simple that even a three-year-old can learn it.

The underlying principle of the technique is to substantially reduce, or eliminate, the space between occupants (the driver as well as passengers) and the interior of the automobile. This greatly diminishes the chances of being violently thrust forward during a collision. As a consequence, there is a big reduction in the possibility of severe injury—especially to the head, which, according to the GM engineers, is the part of the body most frequently injured in traffic accidents.

Pointing out that most accident situations provide occupants with a brief warning period, the authors stress the futility (and hazard) of trying to brace yourself against an impending crash.

"The usual reaction of the occupants is to brace themselves for the impact," the engineers remark. "This increases the distance between their bodies and the interior of the vehicle. If they are of sufficient strength and the impact is of a minor nature, they can benefit in the 'ride-down' (or abrupt slow-down) of the vehicle. Some recent tests indicate that male adults in good health can support 800 lbs with their legs and 350 lbs with their arms for short time durations. Usually, the forces present in an impact exceed these limits and the occupants velocity of contact with the interior of the vehicle is unchanged."

A much better—and safer—reaction is to use the seconds prior to impact to place your body as close as possible to the car interior. But the roadblock to this, the writers point out, is the mental "freeze" that grips most people as an accident is about to occur. They also make clear, however, that this impulse to fright can be overcome through a determined, assiduous program of training based on the "pre-collision positioning" technique.

"It is believed that pre-positioning can become a reflex if a training program is instituted to forestall the men-



*Lap-belted, prepositioned driver.*

tal paralysis and confusion which occurs just prior to impact."

Here is the technique of "pre-collision positioning" as set forth by the GM engineers for drivers and passengers, including children old enough to sit up:

- Drivers should place both hands, thumbs up, on the upper rim of the steering wheel with elbows out and forehead resting upon the backs of



Lap-belted prepositioned passenger.

hands. The driver can maintain control of the vehicle until the very last moment, when he lowers his head. If the driver is using his shoulder belt restraint in addition to his lap belt, he leans forward into the restraint system with head bent forward, his hand positions remaining the same.

- Passengers in the right front seat who have lap belts should lean forward and place their forearms on top

of the instrument panel pad and cradle their head. It is emphasized that an effort should be made to lean as far forward as possible and cradle the head above the level of the instrument panel. If the right front passenger is wearing a shoulder harness in addition to the lap belt, he again should place his hands on top of the instrument panel, elbows out to the side, and lean forward into his restraint system while bending his head as far forward as possible.

- Lap-belted rear seat occupants can "preposition" themselves by folding their arms around their head and leaning as far forward as possible. If they are of sufficient height to come into contact with the front seat back, they should place their hands and head upon its top rear surface.

- Lap-belted children, who have head-swing clearance either in the front or rear seat, should fold their arms around their upper legs.

The General Motors engineers write that full-scale and simulated impact tests at GM's proving grounds demonstrated the dramatic effectiveness of "positioning" in reducing injury severity. To illustrate this for head injuries, the engineers used a numerical scale, with 100 designating the injury severity level for a person not wearing seat belts. Using only the lap belt, the GM tests showed the severity level dropped to 80, and fell all the way to 35 with the combination of lap and shoulder belts.

The introduction of "pre-positioning" into the experiments brought the severity figures down even more markedly. The severity level dropped to 15 in tests using "positioning" with lap belts, and to 20 with "positioning" and the lap-shoulder belt combination. In cars equipped with energy-absorbing steering columns, the use of lap belts and the pre-crash body maneuver reduced the severity level to just 10!

"Our experiments indicate that a lap-belted driver can reduce the severity of his impact more than 80 percent by assuming (pre-collision positioning)," the authors declared.

The value and effectiveness of "positioning" is predicated not simply on the use of seat belts but on the proper use of them, and the two GM engineers have set down some valuable pointers on how to get the maximum benefit and safety value from the restraints.

Lap belts, they advise, should be worn snugly around the pelvic region so that in an impact, they pull the body down

and back. Care should be taken to prevent the belt from slipping up into the abdominal area. According to the engineers, the tendency with shoulder harnesses is to wear them as tightly as lap belts. But this is wrong, and detracts from the effectiveness of the strap. When properly used the shoulder strap has enough slack to allow a person to place his fist between the strap and his body.

Infants not yet able to sit up should be firmly restrained in a padded bassinet or car bed. There should be a strong webbing or cover to prevent the child from falling out in the event of a roll-over collision. Since forward impact is the most common and potentially the most serious, the child should be positioned against the forward wall of the enclosure, or as close to it as possible.

Children able to sit up should be placed in an auxiliary car seat with a lap-belt attachment. This system is usually sufficient until the child reaches 30 lbs (about three years old), at which time use of the adult restraints is desirable. Children not able to see over the dash board may be seated on a pillow. Finally, the engineers warn that shoulder straps should not be used on children until they reach a height of approximately 55".

Carefully followed, and used in conjunction with the new "pre-positioning" technique, these rules on seat-belt safety can head off injury—and make that Sunday drive much more fun. ■

#### RELATIVE INJURY SEVERITY FOR DIFFERING RESTRAINT SYSTEMS (DRIVER'S POSITION)

##### Without pre-collision positioning

|                         |     |
|-------------------------|-----|
| Unrestrained driver     | 100 |
| Lap belted              | 80  |
| Lap and shoulder belted | 35  |

##### With pre-collision positioning

|                                                                        |    |
|------------------------------------------------------------------------|----|
| Lap belted and prepositioned                                           | 15 |
| Lap and shoulder belted and prepositioned                              | 20 |
| Lap belted, prepositioned in car with energy-absorbing steering column | 10 |

Applied with "collision positioning," the following guidelines can give you increased protection against serious injury or worse:

- Lap belts should be worn snugly around pelvic region; take care to see that they don't slip upward into the abdomen;
- Shoulder harnesses should NOT be fastened as tightly as lap belts; leave enough slack to fit your fist between strap and your body;
- Secure infants firmly in a padded bassinet or car bed, with webbing or cover to prevent the child from falling out in roll-over crash;
- Put children up to 30 lbs (three years) in auxiliary car seat with lap belt attachment;
- Use adult seat-belt systems for children over 30 lbs;
- NEVER use shoulder harnesses on children under 55" in height.



*"Percentage Depletion—  
a consumer advantage"*

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Graphite, Il  
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Marble, Metal Mines, Mollusk  
Phosphate Rock, Potash, Quartzit  
Silver, Slate, Soapstone, Stone, Talc, Th



The Honorable A. Sydney Herlong, Jr. is a retiring member of the House of Representatives from the Fourth District in Florida. On August 31, 1967 he delivered a speech on the floor of Congress which still has ramifications today with regard to the perennial question of federal provisions for mineral depletion.

Representative Herlong's remarks are pertinent to the issue because he provides a short, yet terse history of mineral depletion provisions, shows the scope of their application today and traces the economic impact the provisions have had on the mineral industry, government revenue, the American consumer and the national economy as a whole.

The depletion provisions Representative Herlong discusses are a simplified version of an earlier arrangement based on the discovery value of minerals.

As he points out in these excerpts from his speech, mineral depletion is a question of concern to us all. With this in mind, may we suggest you read Representative Herlong's statement carefully.

The American public is being grossly and unfairly misled on a matter of vital concern to them. They are being misled by a small number of columnists and high public officials who display either an amazing lack of information, an unawareness to the facts, a desire for sensationalism, or a combination of these things. My purpose in requesting permission to address this House is to tell the practical, true story, once and for all, about a matter of vital concern to every consumer and to our Nation as a whole.

Before proceeding further, Mr. Speaker, I should like to point out that I have absolutely nothing to gain by my remarks—either politically or personally. I have already announced that I will retire from the Congress at the end of this term. To my knowledge no member of my family, including myself, owns a single share of stock in any companies in the industry which I will discuss, nor is that industry predominant in any way in my home State of Florida. The only personal interest I have in this matter is my desire to see justice done on a vital provision of Federal tax law. My qualifications for taking a stand on this issue derive from 19 years service in the Congress and, particularly, from my service on the Committee on Ways and Means, that committee which is primarily responsible for considering our tax policy. As I progress in my remarks I will present

further thoughts about these few columnists and others who apparently feel they can get personal or political gain from this whipping-boy issue but who possess little or no qualifications for intelligently informing the public about them.

I refer to what is erroneously called the oil depletion provision. Let us get this straight first. The correct, practical name is "mineral depletion" provision. For this provision in the Internal Revenue Code applies to practically all minerals—over 100 in number—except those considered to come from inexhaustible sources. I realize that the attention-seekers much prefer to use the term "oil depletion" because they feel it conjures up the image of some ultrarich fat cat in the minds of the average audience and that, therefore, they will get a better reception to their misleading statements.

They also often leave the impression that this tax provision is a boon only to the oil-producing States. That just is not true. Every State has some mineral production that is covered by percentage depletion. To mention just a few examples: Minnesota has its iron ore with a 15-percent rate; Virginia has kyanite—with a 23-percent depletion rate; New York leads the Nation in titanium production—which also comes in the 23-percent category; Missouri's lead production gets the same rate; Oregon is the source of our nickel production—and also gets 23-percent depletion on the

output of this mineral; Tennessee leads in zinc production—also in the 23-percent depletion category; West Virginia, Pennsylvania, Kentucky, and Illinois are the big four coal producers—and there is a 10-percent depletion rate on that. In my own State, our chief mineral is phosphate rock—which has a 15-percent rate.

For a thorough understanding of the mineral depletion provision we should take a quick look at its history. And, since the critics use oil as their symbol, I will use it as my primary example where possible. The principles, however, apply to all minerals under this provision.

There was no need to take depletion into account in the tax laws until ratification of the 16th—or income tax—Amendment in 1913. Then, with this dramatic change in the Nation's revenue structure, Congress was suddenly confronted with a swarm of new problems in writing equitable legislation to put the income tax into effect. One of these problems was how to draw up tax provisions that would effectively tax income without taxing capital.

In the case of ordinary capital assets, like machinery and equipment, this problem could be solved by authorizing regular deductions for depreciation until the cost of the income-earning piece of property was restored. The idea, of course, was to return the cost of the asset—tax free—over its life so that it could be replaced when worn out.

But this principle, though sound for machinery and plants and other depreciating things, did not work out at all with respect to depleting assets—such as oil and other minerals in the ground.

A simple illustration explains why this is so. If a man in some manufacturing business buys a piece of equipment for \$100,000 he can take depreciation deductions over its useful life, and by the time the machine is worn out—he will have recovered its original cost. He will have the money he needs to buy a replacement.

It is not that simple for the mineral producer. Now suppose an oilman has a producing property that cost him \$100,000, and suppose the tax laws permitted him to recover only that investment cost. The laws would be, in effect, putting him out of business. For he could not take \$100,000 recovered from a successful discovery and expect to go out and drill a replacement. Of every 100 wells drilled in search of new fields, only three—on the average—will find enough oil or gas to recover the costs of drilling and producing. Ninety-seven such tries in 100 will find no oil or gas at all—dry holes—or will find oil or gas fields so small that they are unlikely to be profitable.

And the average cost of drilling a well—whether it is a success or a failure—is around \$56,000.

Tax laws have to be based on realities—if we are to have a workable system of taxation. And the odds against success in exploring for oil and in all other mineral exploration had to be recognized by Congress in applying the income tax law to these industries. Congress could not pretend that these problems did not exist and—at the same

time—maintain that it was striving for equity in taxation.

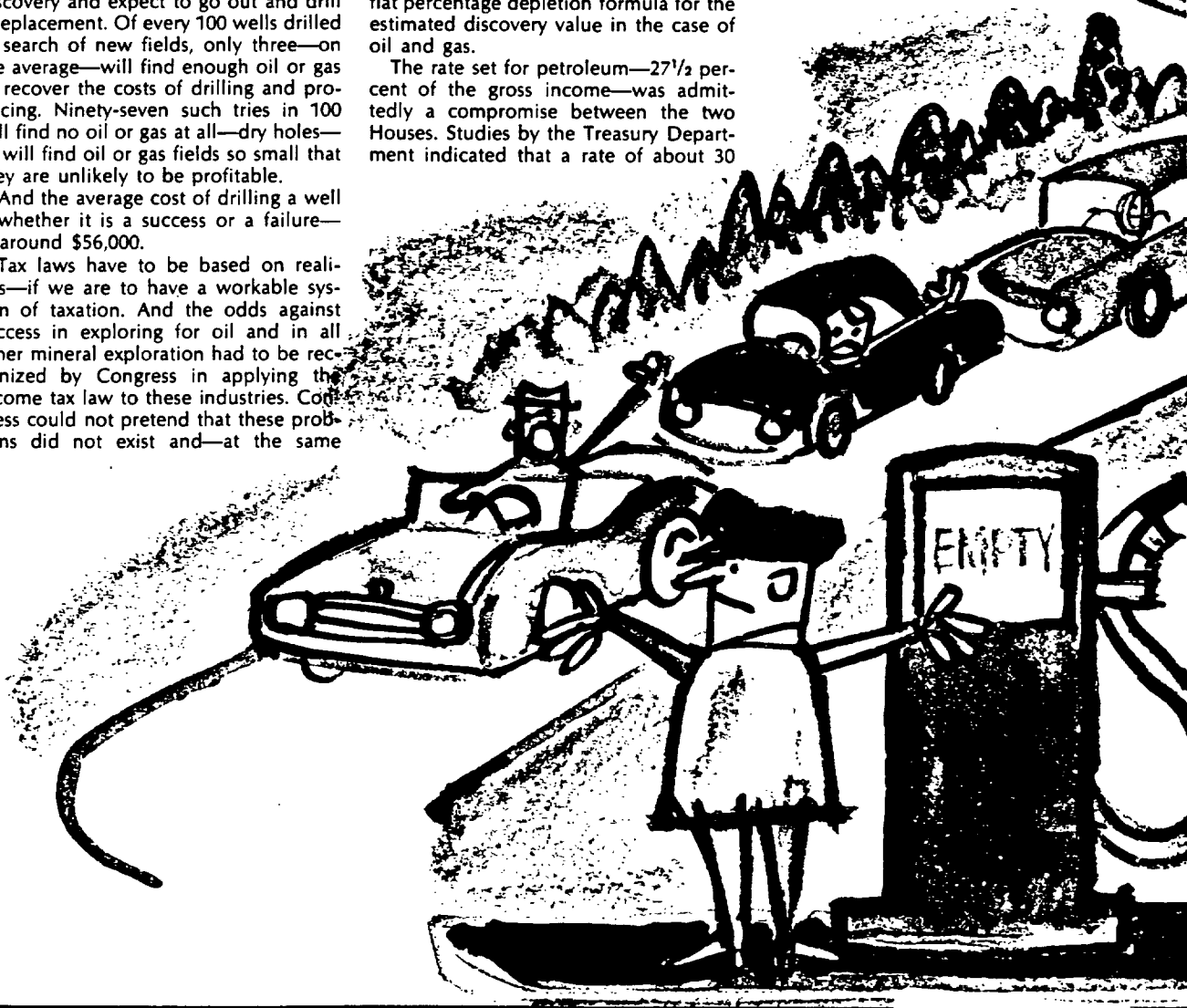
After study and experimentation, Congress finally developed what is known as the discovery value depletion provision as part of the Revenue Act of 1918. This provision, which applied to all minerals, allowed for the depletion deduction to be based on the fair market value of the mineral- or oil-producing property, if that value was significantly different from the cost.

Although sound in principle, because it recognized the capital value of the mineral in the ground, this discovery value provision bogged down in administrative complexities. Too much was left to human judgment in estimating the size and value of a mineral discovery. So, in 1926, Congress tried again. At the suggestion of the Treasury, Congress tested a new approach by substituting a flat percentage depletion formula for the estimated discovery value in the case of oil and gas.

The rate set for petroleum—27½ percent of the gross income—was admittedly a compromise between the two Houses. Studies by the Treasury Department indicated that a rate of about 30

percent would be more in line with deductions available under the discovery value law. Subsequent analysis by the Joint Committee on Internal Revenue Taxation also brought out that the shift from discovery value to percentage depletion materially increased the petroleum industry's tax burden.

However, percentage depletion—by its simplicity and ease of administration—worked out so well when applied to petroleum that Congress extended it to other minerals that had been entitled to deductions on the "discovery value" basis. As I have previously noted, today more than 100 minerals are covered by percentage depletion. The rates vary, as discovery values vary, but in each case the deduction for statutory depletion cannot exceed 50 percent of the producer's net income from the individual



property or, as the law applies to hard minerals—operating unit.

The farmer does not pay an income tax on the "seed corn" that he sets aside from his harvest to grow another crop in the succeeding year. Percentage depletion is, in a sense, a way of letting the mineral-producer retain—free of tax—funds that represent his "seed corn." He can use these to undertake a search for new mineral reserves to replace those being harvested—or depleted—by production. Yet, as I have indicated, the oil producer and, to varying degrees every other mineral producer, must plant many, many seeds in the ground before he can find another productive crop of mineral reserves.

Mr. Speaker, clearly this is no tax loophole. This is a deliberate legislative decision of Congress, a principle that has been on the statute books for almost half a century, and has been repeatedly reviewed at public hearings held by both the Ways and Means Committee and the Senate Finance Committee.

If percentage depletion goes down for oil and gas, it will go down for all the others—zinc, titanium, iron ore, coal—the whole list. And then we would all hear from our hard-hit constituents, and those of us who may now have doubts would find out most emphatically that this is no special boon for the oil-producing States. This is an essential provision for all America. It is essential because our mineral producing industries—all of them—from sand and gravel to oil and gas, are essential to America.

If the argument of those who would

abolish depletion is carried to its logical conclusion, and if they would be consistent and fair, they would also necessarily have to advocate a Federal tax on all forms of capital including savings accounts, investments, land and appurtenances, including homes and the like.

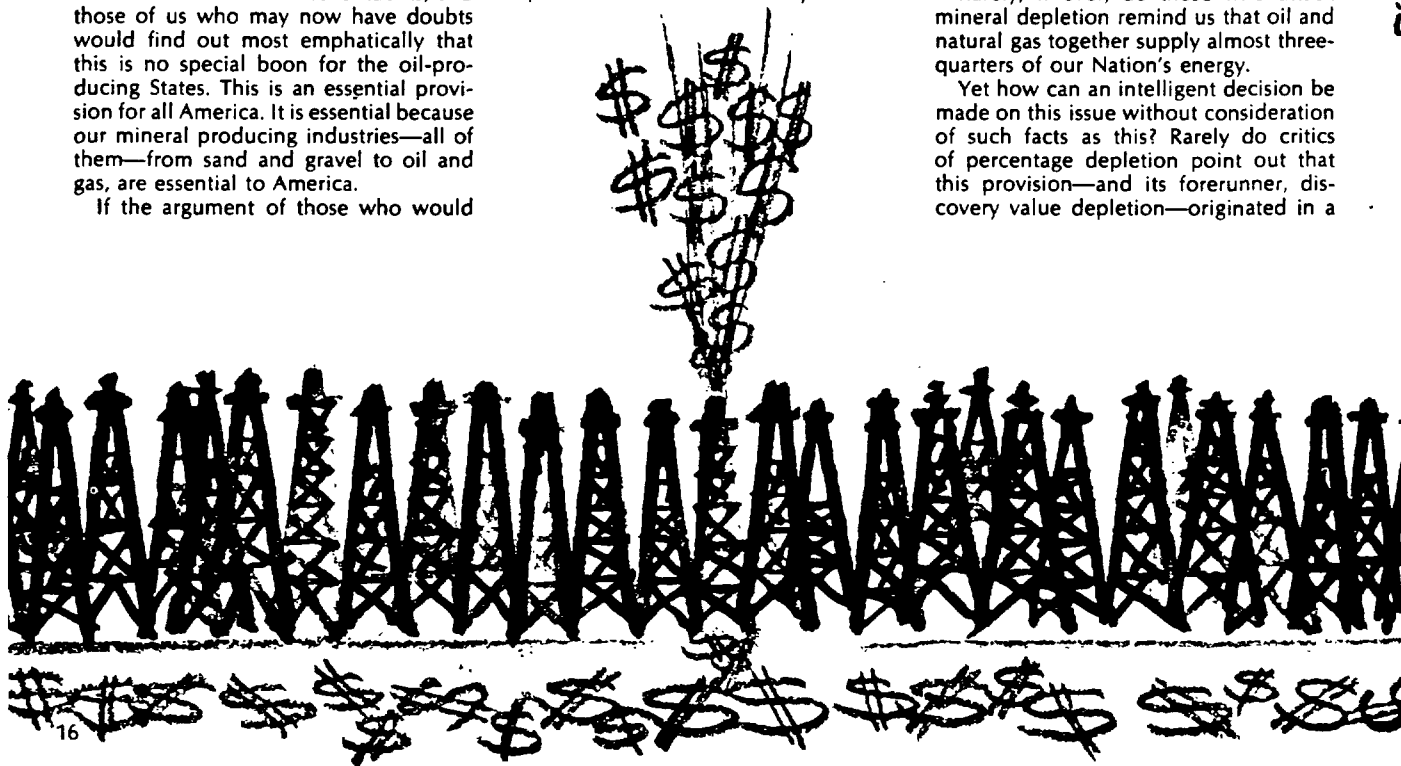
Let us stop listening to columnists and get down to the facts. We cannot base tax legislation on slogans and word games—like the insistent harping on the term "loophole." This is a phrase the critics of mineral depletion love to bandy about. It is also a prime example of the use—or misuse—of language to convey a false impression. The unabridged dictionary defines "loophole"—when used in this sense—as "a method of evading the intent of a statute, contract, or obligation." As history clearly shows, in no way does the percentage depletion provision resemble this definition. We have from time to time in the Committee on Ways and Means amended the tax laws to correct unintended benefits which arose during the practical application of the law. This, in my judgment, is the true definition of what really is a loophole. Nowhere has anyone ever contended that the benefits to be derived from the mineral industry's depletion was not intended by the Con-

gress—in fact, a study of the history of this legislation shows exactly the opposite.

I am convinced that our mineral depletion policy will be a decisive factor in determining whether the United States continues as the foremost power in the world with the highest standard of living, or whether it falls back into the ranks of the "have not" nations—the countries that must depend on other lands for their energy and fuels and other basic resources.

Rarely, if ever, do those who attack mineral depletion remind us that oil and natural gas together supply almost three-quarters of our Nation's energy.

Yet how can an intelligent decision be made on this issue without consideration of such facts as this? Rarely do critics of percentage depletion point out that this provision—and its forerunner, discovery value depletion—originated in a





time of widespread fear that we were getting close to the bottom of our oil reserves.

It is hard for us to realize now that back in 1916 legislation was actually introduced in this House to prohibit the exportation of petroleum products from the United States. Four years later, in 1920 the U.S. Geological Survey predicted that—if the then current rate of domestic consumption were to continue—the United States would run out of oil by 1938. Three years later, in 1923, a subcommittee of the Senate made sensational headlines with a report warning consumers that they had better start preparing themselves to pay at least \$1 a gallon for gasoline.

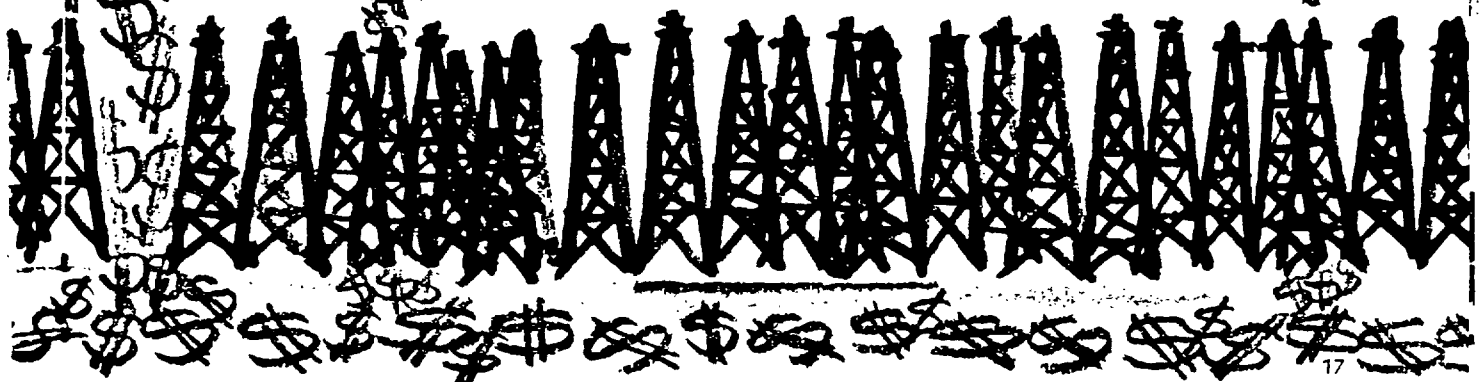
Because Congress wisely recognized the need to encourage the risky search for oil deposits, the American petroleum industry was able to confound all the experts. It found enough oil to keep America going in the automobile age. It found enough additional oil to fuel a global conflict in World War II, and to meet the tremendous and unexpected demands of postwar prosperity. It is producing enough oil today to tide us over the current Middle East crisis. And I would like to remind you, without laboring the point, that we would be facing one of the most desperate emergencies in our Nation's history at this very moment if the U.S. oil industry had not been ready and able to replace those cut-off Middle Eastern supplies.

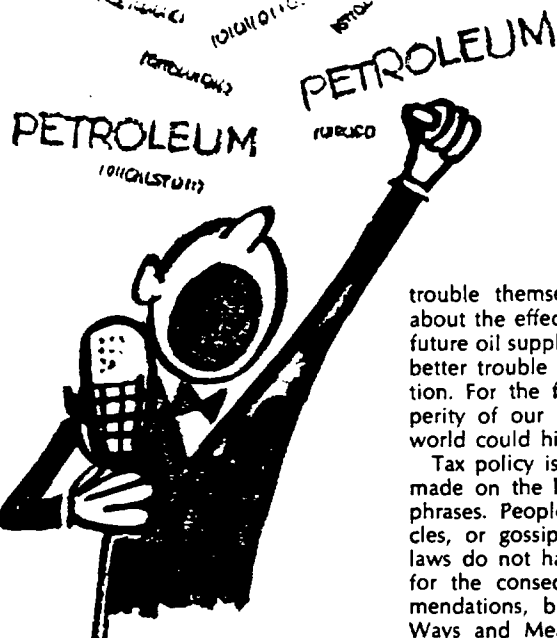
Were we dependent upon the Middle East for oil and natural gas—because we could not produce enough at home—we

would today be at the mercy of those nations, helpless and immobilized until we met their terms for a resumption of our vital oil supplies.

It is a nightmare that could have happened but did not. If it had happened, the dollar-a-gallon price that was feared in 1923 would by today's standards be a bargain basement item to the American user of these products. It did not happen because the American petroleum industry continued its record of meeting one crisis after another. This has been done so often that the industry's achievements are taken for granted. But could this latest achievement—and the others—have been possible without percentage depletion? In my judgment, that is doubtful, indeed.

Remember that it is not enough for the petroleum industry to replace each depleted barrel of oil with another barrel of newly discovered reserves. If that is all the industry were able to do, we would have due cause for feeling once again the oil shortage alarms that shook this country in the first quarter of the 20th century. The petroleum industry must do more than replace one depleted barrel with another newly discovered





barrel of reserves. This industry must continually step up its oil and gas finding to keep pace with steadily rising demand.

Last spring Interior Secretary Udall predicted that the United States will consume 78 billion barrels of oil and 283 trillion cubic feet of gas over the next 14 years—more oil and gas than was consumed in the previous 107 years of the petroleum industry's existence. I repeat—this supply will be needed to take care of just the next 14 years, and if that sounds like a long time just reflect that the year 1953 was only 14 years ago. Time passes more rapidly than we realize. It is passing very rapidly indeed for an industry that has to meet this enormous future demand.

Can the oil be found? The experts believe it can—though this is an exceedingly difficult assignment. But what if percentage depletion of oil and gas were abolished or sharply curtailed? The critics of this provision never seem to

trouble themselves with any question about the effect of such a move on our future oil supplies. But the rest of us had better trouble ourselves with this question. For the future security and prosperity of our country and of the free world could hinge on the answer.

Tax policy is far too important to be made on the basis of slogans or catch phrases. People who write books, articles, or gossip columns about the tax laws do not have to take responsibility for the consequences of their recommendations, but the members of the Ways and Means Committee do have this responsibility. And in my observation it is a responsibility that they exercise with integrity, diligence, fairness, and dedication second to no group of human beings on earth. I consider my association with them a privilege and a most inspiring experience.

It is quite a striking contrast to compare the laborious study and research of the Ways and Means Committee and its staff with the effusions of those who do their research in . . . sensation-seeking publications.

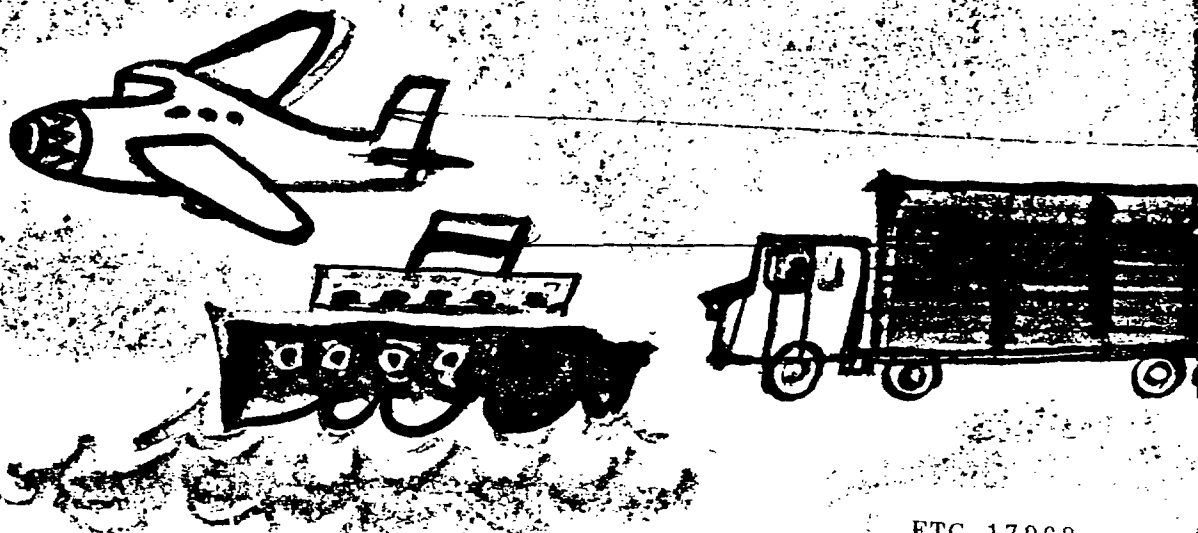
We on the Ways and Means Committee must concern ourselves with facts, whereas the sole concern of these responsibility-free commentators is the size of the headlines they can make. Therefore, they feel no qualms about giving the impression that oilmen have achieved what amounts to tax exemption. They have even gone so far as to claim that the producing branch of the oil industry escapes \$10 billion a year in taxation.

What are the facts behind this claim? Well, according to preliminary figures from the U.S. Bureau of Mines . . . the total value of all the crude oil, natural gas, and natural gas liquids produced in the United States last year was \$12.4 billion. Now how can an industry with output valued at \$12.4 billion pay an additional income tax of \$10 billion—on top of what it is already paying the Federal, State, and local governments, and have any money left to pay its employees, its royalty owners, its stockholders and investors, its creditors, and its operating expenses—not to mention the more than \$4 billion the industry spends annually on exploration for and development of new reserves, including almost \$1 billion each year in dry hole losses.

Let us turn from this myth about the industry's tax status to a serious study made to bring out the facts. The Petroleum Industry Research Foundation has made what is—to my knowledge—the only thorough study ever undertaken of the domestic petroleum industry's tax burden in comparison with that of other enterprises. The findings for the latest year covered—1963—are right in line with those for prior years.

In 1963, this study found, the petroleum industry paid at least \$2 billion in direct taxes to Federal, State, and local governments. This figure does not include any of the gasoline and other petroleum product taxes of \$6.5 billion paid in that year.

The study found that the petroleum



industry's direct 1963 domestic tax burden amounted to 5 cents in tax for every dollar of revenue. The ratio for other businesses was almost exactly the same. The biggest part of the petroleum industry's tax bill was paid to State governments, with a heavy portion of the total represented by severance and other production taxes that nonextractive industries do not pay.

But a tax dollar is a tax dollar, whatever level of government it is paid to, and with the tax-sharing ideas now being discussed in Congress, the petroleum industry's contribution to State revenue should be most welcome.

The charge of fabulous oil industry profits likewise falls apart when held up to the light of fact. According to figures compiled by the First National City Bank of New York, from 1925—the first year's income to come under the percentage depletion law—through 1966, oil industry after-tax earnings have averaged less than 10 percent of invested capital. The figure for all manufacturing companies in this same period was a shade higher—10.7 percent. Last year the relationship was: petroleum industry—12.6 percent, compared with 14.1 percent for all manufacturing companies. Clearly, then, the petroleum industry is not making any profit bonanza out of percentage depletion.

These figures make it clear that percentage depletion—instead of giving the petroleum industry an undue advantage

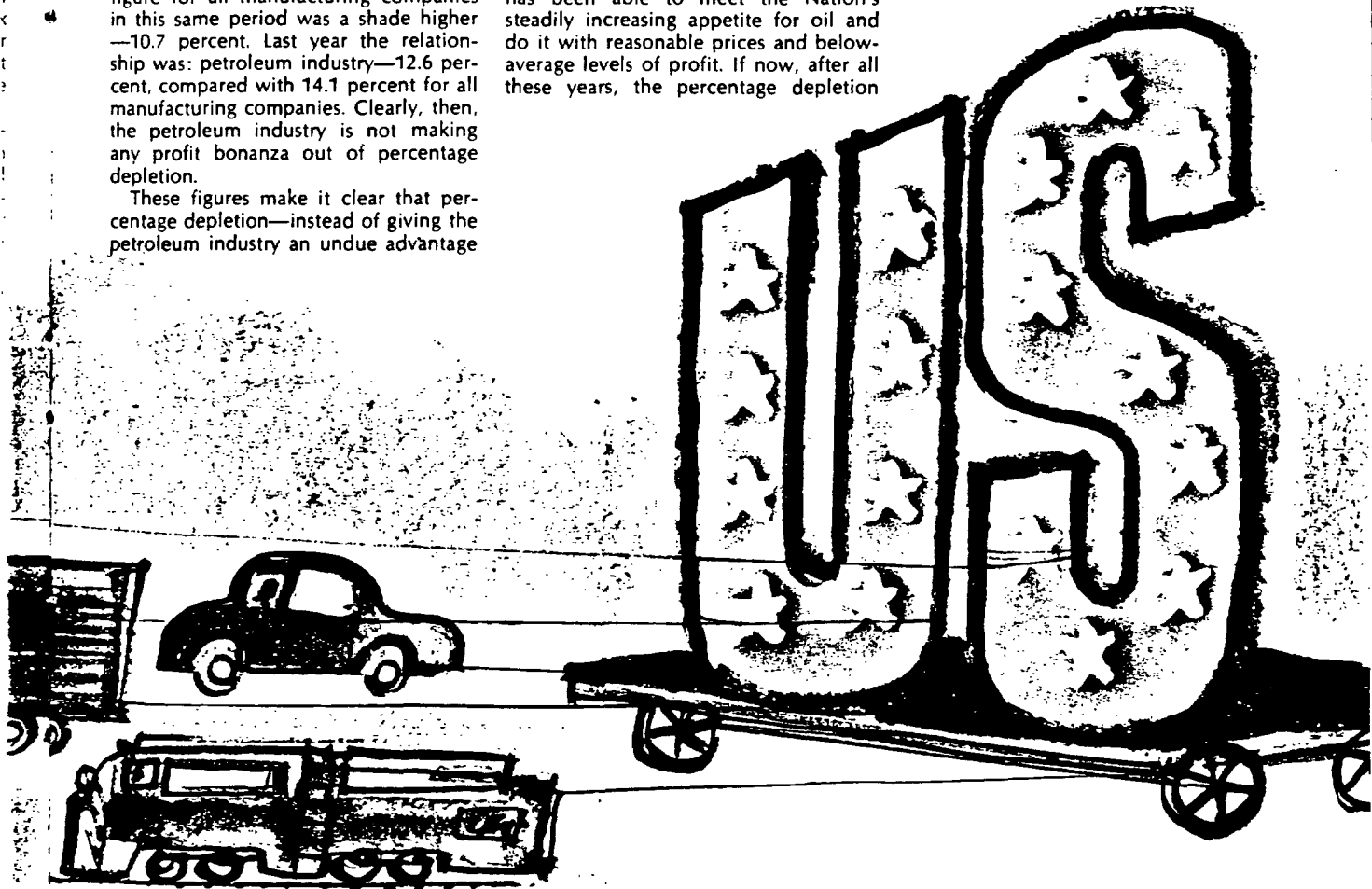
—simply counteracts, to some extent, the tremendous disadvantage entailed in the high-risk, high-cost search for new oil and gas reserves.

Actually, the big beneficiary of the percentage depletion provision is the consumer. I mentioned earlier that a Senate subcommittee predicted back in 1923 that the price of gasoline would soon rise to \$1 a gallon. The average price of gasoline in that year was 21 cents—excluding tax. And in August of this year the national average price of regular-grade gasoline—an incomparably better product than that sold in 1923—was 22.65 cents per gallon. This is, again, excluding tax. So the consumer is paying only 8 percent more for gasoline today than he paid in 1923. How many other products today could meet such a test?

After more than 40 years, percentage depletion has become part of the economic structure of the petroleum industry. Under this provision, the industry has been able to meet the Nation's steadily increasing appetite for oil and do it with reasonable prices and below-average levels of profit. If now, after all these years, the percentage depletion

provision were repealed—or the rate for oil reduced—it is inevitable that the price of crude oil and of petroleum products would have to rise. There would be no other way to close the gap—not with the industry's profits as moderate as they are and not with the future investment requirements what they are certain to be. It might not happen overnight, it probably would not happen that way, but in time—if percentage depletion was curtailed—something would have to give.

From time to time we see figures that are supposed to show the sums involved in percentage depletion for the mineral industries. I wish there were some way to calculate in monetary terms how much this provision means—and has meant over the years—to Americans. But you cannot put a price tag on security or on national independence in raw material. You cannot calculate in dollars and cents how much it meant to have the oil and iron and copper and coal to carry



us to victory in World War II.

This we do know: Every product in the marketplace represents the result of combining two basic ingredients under the guidance of human intelligence and skill. One of these basic ingredients is the raw material of which the product was made; the other basic ingredient is the fuel energy that was used in the manufacturing process.

Reducing or eliminating percentage depletion can only have the effect of increasing the cost of both ingredients. And the consumer will pay. In fact, I can think of no step that could do more to increase the cost of living—to make all our constituents pay more for everything they buy—than a cut in the rate of the mineral depletion provision. ■



**Let me briefly review the main points I have covered.**

**FIRST.** Percentage depletion is not a tax loophole. It was deliberately devised by Congress more than 40 years ago and is consistent with the policy of not taxing capital value as income.

**SECOND.** The phrase "oil depletion allowance" is a misnomer. This provision applies to more than 100 different minerals important to our national welfare and to the economies of every State.

**THIRD.** Ours is an energy-based economy—with oil and gas supplying nearly three-fourths of that energy. Percentage depletion is essential if the industry is to meet the anticipated tremendous future demand for petroleum.

**FOURTH.** The petroleum industry pays its fair share of domestic taxes—exactly the same percentage of its revenue as other industries, according to authoritative studies.

**FIFTH.** Percentage depletion has not produced excessive profits for oil companies; in fact, their profits have averaged slightly less than those of manufacturing industries as a whole.

**SIXTH.** The real beneficiary of percentage depletion is the American consumer. If the mineral depletion provision were deleted from our tax laws, the consumer would have to pay more for his every purchase since the cost of both the raw material in the product and the energy required to produce it would be more expensive.

**SEVENTH.** Percentage depletion has worked. It has enabled the petroleum industry and other mineral producing enterprises to meet the rapidly rising demands of an industrial civilization in peacetime, wartime, and the cold war era. It has helped keep our standard of living the highest in the history of the world.

**EIGHTH.** We have just seen the nationalization of oil properties of several American companies in the Middle East. How much more of a warning do we need that we cannot afford to let ourselves become dependent on foreign oil any time or anywhere in the world? We need percentage depletion because we need to maintain our national independence and our vital fuel supply.



## DISCOVER AMERICA

Have you ever been aboard "Old Slanskysides?" Or seen Swartz's Falls? When was the last time you crossed the Swenson Gate Bridge? Or viewed the harbor from the Statute of Chen?

If you are puzzled by these seemingly esoteric landmarks, you should be. They are meant to arouse your curiosity and interest in America—from the Golden Gate Bridge to the Statute of Liberty.

Each of the above questions headlined an individual advertisement which collectively are part of a continuing national and international campaign of *Discover America, Inc.* "to encourage Americans and citizens of other lands to discover and enjoy the scenic, historical, cultural, educational, recreational and industrial attractions of the United States, its territories and possessions and the commonwealth of Puerto Rico."

That quote is a capsule definition of *Discover America's* purpose, but the milieu out of which the organization emerged and its present composition and work are the real elements of the *Discover America* story.

The formulation of this purpose and the inception of *Discover America* itself grew out of a baffling and frustrating paradox haunting the travel industry in two areas. First, the United States was being out-promoted in the international travel market. Second, Americans, as affluent and as mobile as they were, were incredibly negative and provincial in their travel habits.

*continued*



There were statistics to confirm these conclusions. The number of visitors to America

from all of the countries of the world (approximately one million annually) was far less than the number of Americans traveling to foreign destinations. On the domestic scene, 60 million Americans—52 percent of the adult population—had never been more than 200 miles from home and three out of five citizens had never spent a night in a hotel or motel.

Concerned about the flow of American dollars out of the country and recognizing the need to foster greater understanding between Americans and foreigners, the United States Congress called upon the President to create an organization that would mobilize the forces of private enterprise, and in cooperation with government, examine these problems and effect a favorable change.

In response to a Congressional resolution and a Presidential proclamation, *Discover America, Inc.* was subsequently organized in August 1965 as a non-profit corporation, financed entirely by private enterprise, to serve as a catalyst in bringing the fragmented travel industry together in a cumulative effort to increase travel to and within the United States.

When it adopted its by-laws at its meeting in Washington, D.C., *Discover America* decided that its massive program would concentrate on four major areas—public information and promotion, research, liaison with industry groups and government relations. Its general objectives within the framework of increasing travel to and within the United States included:

*Obtaining cooperation from the government and all travel-related industries to create programs designed to help eliminate the major deterrents to travel;*

*Encouraging studies to determine ways for motivating citizens to use gains in leisure time and discretionary income in travel; and*

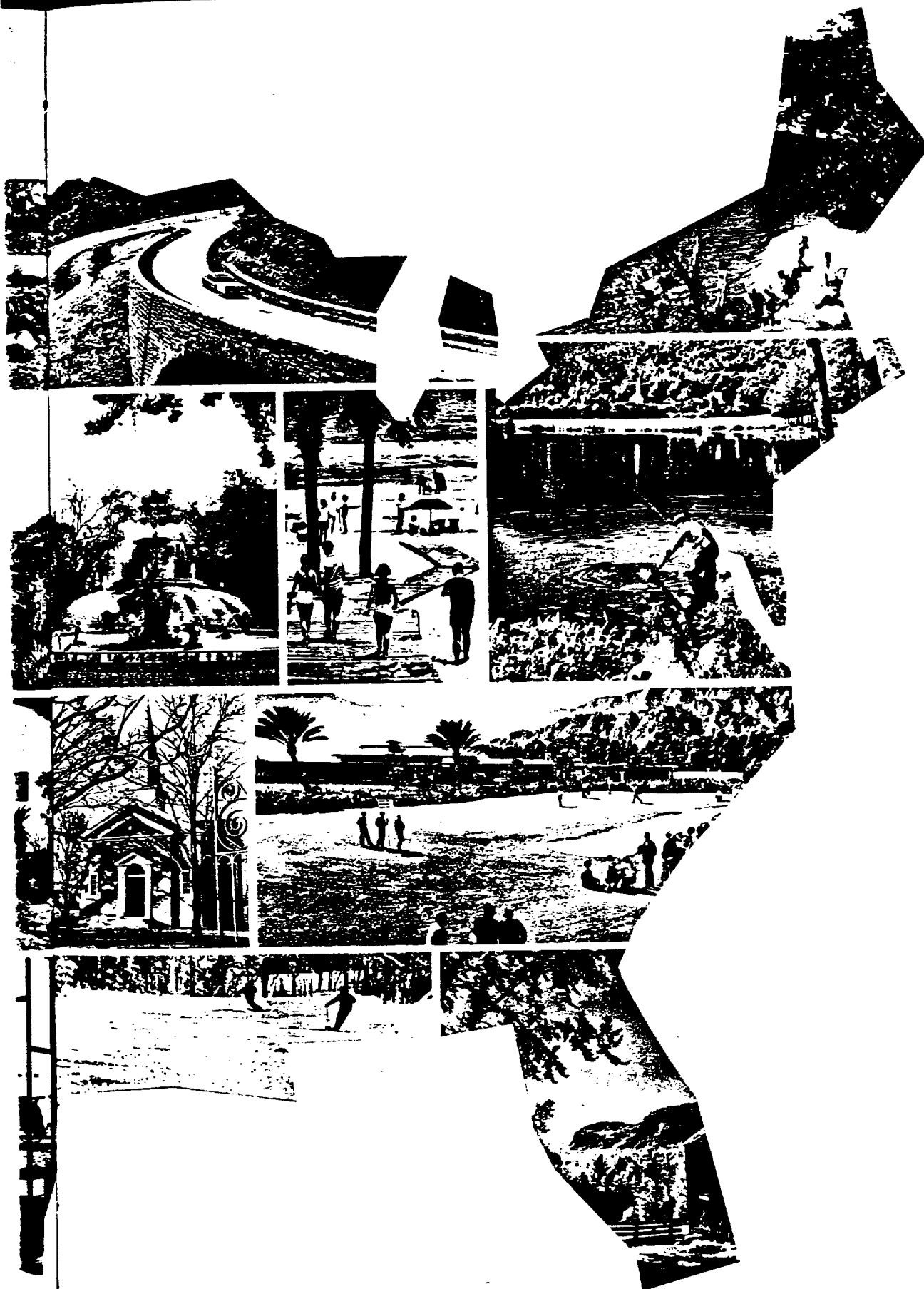
*Acting as a catalyst in encouraging more and better American travel films, television and radio programs, articles in newspapers, magazines and periodicals.*

Concurrently with the birth of the *Discover America* program, the President's Task Force on Travel, headed by Vice President Hubert Humphrey, was created to deal with the responsibilities the federal government had in solving these same problems.

*continued*

\* The photos in this map are not arranged by states; they are intended to show the scope and diversity of interesting places to visit in all regions of America.





*Discover America* began its task by calling together leaders of the industry—private commercial enterprises, associations or organizations in agreement with the objectives of *Discover America*—to encourage participation in the program. The founding members were Air Transport Association of America, Airframe and Aircraft Engine Manufacturers, American Petroleum Institute, Association of American Railroads, Automobile Manufacturers Association, the Hertz Corporation, Hilton/Leamington/Sheraton Hotels and Rubber Manufacturers Association.

Even before *Discover America* was formally organized, it entered into an agreement with NATO—the National Association of Travel Organizations—to utilize its experience and influence.

By adjusting its fiscal year to a calendar year, the first \$500,000 contributed to the program carried *Discover America* through the end of 1966 with a surplus of approximately \$150,000. With renewed contributions the organization entered 1967 with an authorized budget calling for expenditures of \$405,707.

This financial impetus and cooperation from the industry brought results. The Post Office Department was among the first to give its support by placing the *Discover America* logo on stamp cancellations for first class mail in major communities—placing the symbol on more than 20 million pieces of mail each day. The Advertising Council provided a radio and television campaign. The sponsors of travel motion pictures wove the *Discover America* theme and logo into their travel stories. One of the member airlines came up with a big *Discover America* sweepstake promotion. An oil company member joined forces with the University of Southern Illinois in sponsoring a travel writing contest for weekly newspapers. Chain and department stores came out with *Discover America* promotions.

One of the most unexpected tie-ins came from one of the biggest federal savings and loan associations in *Discover America's* home city of Minneapolis. The association spent more than \$40,000 on a promotion offering a *Discover America* vacation as a prize.

In 1967 the organization's campaign grew in intensity and response. The highlight of the year was the celebration of *Discover America* Vacation Planning Week. For five years previously, the American Petroleum Institute and *Mademoiselle Magazine* had worked cooperatively in a promotion to encourage department stores to decorate their windows with a travel theme during early spring. The best display won a prize.

The staff of *Discover America* recognized the immediate possibilities of a tie-in with Planning Week to stimulate national interest in travel and vacation planning. The board of directors approved the idea.

Subsequently, President Johnson issued a proclamation designating April 16-22 as *Discover America* Planning Week, as did 32 states and 23 municipalities.

The *Discover America* theme was adopted by department

stores, banks, luggage manufacturers, travel agents, festivals, boat shows, auto shows, youth organizations and numerous other groups.

A myriad of other programs centered around the Vacation Planning Week and the *Discover America* theme were generated for this occasion with some impressive results.

A \$10 million *Discover America* program was started shortly thereafter by a leading airline, with \$1 million spent in the week of April 16-22 alone. New *Discover America* car rental rates—seven days and 500 miles of motoring free of mileage charge for \$88—was introduced by a major agency. The Post Office carried *Discover America* posters on 55,000 postal vehicles during the months of April and May.

During the remainder of the year *Discover America* continued its efforts to saturate the media and other vehicles of communication to get its message across. With the cooperation of the Advertising Council and all advertising media, the organization launched a public service campaign with these results:

More than 400 television stations carried the *Discover America* theme throughout the year;

A total of 1,008 magazine and newspapers gave exposure to the program; and

Outdoor advertisers gave *Discover America* a total of 6,000 boards.

Additionally, as a public service, local television stations and regional and national networks televised half-time ceremonies of football games featuring college and high school band performances of *Discover America* musical arrangements and formations.

The rate of growth of the travel industry through 1967 (as reported in the organization's 1967-68 "Report To The President") from the inception of the *Discover America* program in August 1965 provide some indices of the effectiveness of the campaign up to that point and the impetus it helped give the travel industry.

The number of foreign citizens traveling to the U.S. (exclusive of Canadians and Mexicans) increased from 1,040,002 to 1,485,499 in 1967, an increase of 42.8 percent.

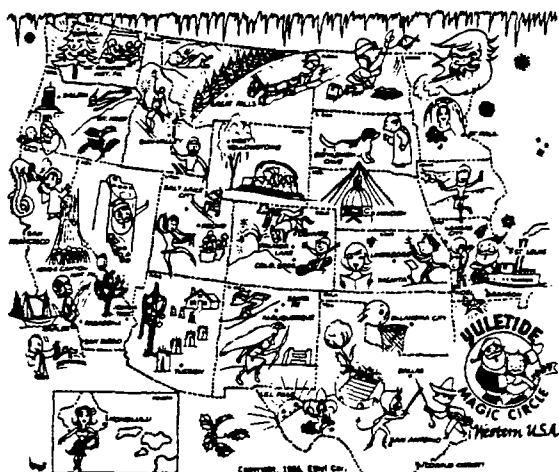
Domestic airline revenue passenger miles increased in 1967 to 75.1 billion, an increase of 45.5 percent over 1965.

Inter-city passenger miles for motor vehicles (auto) rose to 937 billion, compared with 861.3 billion in 1965, an increase of 8.8 percent.

Gross income for the nation's 65,850 hotels and motels hit a new high of \$5.2 billion in 1967, compared with \$4.95 billion in 1965. Occupancy also increased, averaging 64 percent.

Attendance at national parks exceeded 139.6 million visitors in 1967, compared with 121.3 million in 1965, an increase of 15.1 percent.

The current year brought an increased emphasis on the part of *Discover America* to improve our balance of pay-



Promoting travel by automobile throughout the United States is not new with Ethyl Corporation. Ethyl pioneered in such travel promotion starting back in 1954. Its success over the years has helped motivate much of the industry-wide programs that exist today.

Since 1961, the American Petroleum Institute's Travel Development Committee has been active in such promotion.

The Travel Development Committee's promotion has increasing impact each year. Recent focus is on "Heritage Trail" programs for sightseeing and vacation trips—the Hiawatha Pioneer Trail in Illinois, Wisconsin, Minnesota, and Iowa; and the Ozark Frontier Trail in Missouri, Arkansas, Kansas, and Oklahoma; as well as the New England Heritage Trail, The Dixieland Trail, the Lincoln Heritage Trail, and the Old West Trail.

Each "trail" is a recommended tour of 1,000 to 3,700 miles over main highways and secondary roads, including optional or alternate routes.

In all, the six trails, which cover a total of 20,000 miles in 25 states, help support regional, state and local travel promotional organizations as well as oil industry market expansion programs.

So from the ingenious "Magic Circle" developed by Ethyl Corporation, discovering America is becoming the thing for the automobiling-family to do.

ments by stimulating the flow of more foreign visitors to the United States.

To that end, the Board of Directors of the organization initiated a fact-finding-promotional mission to Europe in cooperation with the United States Travel Service. A conference was held from June 25 to 27 in Brussels with 200 representatives from 17 European countries and the United States.

Some rather interesting facts and new directives emanated from the conference. It was discovered, for example, that among Europeans there existed a strong desire to discover America, and an estimated 13 to 15 million had the means to do it. The need for increased promotional efforts in Europe on the part of the federal government and industry was recognized as essential to increasing European travel. Governmental barriers, language difficulties and improved reception facilities were singled out for concentration effort by the mission. And, finally, the self-effacing reality emerged that a conference of this nature could not resolve difficulties, but merely set the stage for closer cooperation in encouraging travel from Europe.

The most recent development in the growth of the *Discover America* program was the October announcement that the National Association of Travel Organizations had agreed in principle to merge with *Discover America*. The formal merger is expected in March 1969 following the formulation of merger details by a joint committee of the two groups.

At the third annual *Discover America* luncheon in Washington, D.C. this past October, Chairman Robert J. Murphy, Jr. commented on the proposed merger. "We feel this merger will create a strong organization capable of furthering the progress of the nation's travel industry and will stimulate a cohesive positive effort on the part of all segments of the industry."

What's ahead for *Discover America* and NATO? A myriad of industry problems. Consider:

The dazzling growth of air travel—a 26 percent increase reported last year—is threatened by choked airports, lack of hotel rooms in major cities and government concern over the U.S. balance of payments.

Foreign travel in the past 10 years in terms of consumer spending was exceeded by only one item in the American economy—private education. This market is also being threatened by possible government action to conserve U.S. holdings of gold.

The retailer of travel, the travel agent, is finding it increasingly difficult to operate at a profit. Administrative costs are rising rapidly, commissions are static, competition is increasing, and the ability to cope with a continuing flood of new information on air fares, new hotels and new destination areas make the agent's job a difficult one.

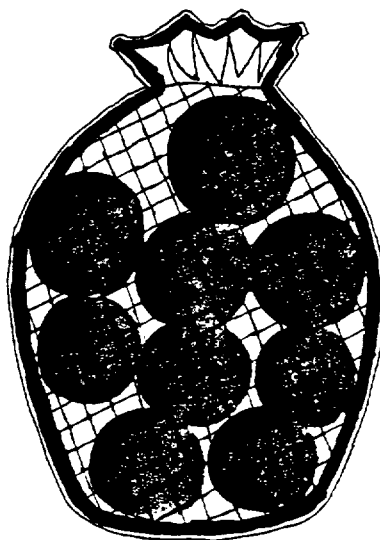
These are some of the challenges of the 70's faced by *Discover America*, NATO and the travel industry as a whole. They are formidable, but perhaps they are the challenges from which great opportunities arise. ■



## Think Big Think Small Think Shrink

Packaging methods have evolved rather dramatically in recent years from the days of herring wrapped in old newspapers and oranges offered in fish net sacks. Novel packaging materials seem to appear almost weekly, along with new applications and ideas.

One of the more recent developments has been the emergence of plastic films as a leading packaging medium and, in particular, polyvinyl chloride shrink film with its versatile range of consumer and industrial applications.





As its name denotes, shrink film shrinks around a package or product, whether a toy or a frozen pizza, to give a secure, contour fit and a neat, clear appearance. It can cover bakery items or processed meats, pharmaceuticals or books and blankets or candy with the same close wrap, gloss and strength.

This range of food products and packaging units which PVC shrink film can cover is, perhaps, its greatest advantage over other packaging media. Imagine a bunch of bananas wrapped in paper. The crinkled bag wouldn't make a striking appearance. The bananas wouldn't be identifiable without a label. Their quality couldn't be ascertained. Their bright, attractive look would be hidden. Other fruits, meat and food items also suffer the loss of consumer appeal, identification and freshness without clear film.

PVC film may be formulated for approval by the Food and Drug Administration for food packaging. This is the major impetus behind its burgeoning popularity in the packaging market. Today, along with fruits and meats, it is used to wrap chocolates, eggs, vegetables, frozen foods and countless other food items. At the same time, PVC shrink film offers greater strength and resistance to puncture, a major consideration in food packaging to guarantee freshness and appearance in the packaged item.

*continued*

If we consider the bunch of bananas again, we can see the merchandizing advantage for food packaging the film has in terms of higher gloss, greater clarity and printability. Its transparent, crisply printed finished surface can give food items a consumer appeal far superior to other materials.

Two of the qualities which account for PVC film's varied uses for shrink packaging in general are its ability to return to its original shape if it is distorted in shipping or handling, and its low temperature flexibility, which refers to PVC film's ability to retain its flexibility for contour fit, suspension and protection of products at temperatures which would crack or harden other packaging materials. The film's use in frozen food packaging, for instance, is a result of this low temperature flexibility.

In terms of shipping capabilities, PVC shrink film gives product suspension or shock protection in transport. It can also hold multiple unit or product sets in place, such as six-pack beverages and cosmetic sets. In combinations with other packaging media, the film can form part of a paperboard or metal-foil package, for instance.

Wrapping products with PVC shrink film offers distinct advantages in terms of ease of application. It requires less sophisticated machinery in shrink applications than other shrink film, such as polyethylene, and it performs on manual or automatic machinery. In addition, PVC film can be heat sealed either by electrical impulses or ultrasonically.

Apart from its shrinkability, PVC film can be readily modified with chemical additives to produce films tailored to specific requirements. This gives manufacturers greater possibilities for packaging applications.

The chemical make-up of and the various types of PVC shrink film which can be produced combine to give the film its wide applicability. It is a homopolymer type of vinyl film, which means it is made from one monomer or one molecule of plastic. Various types and quantities of plasticizers, which modify a plastic binder, can be added to attain a desired specification of film. Virtually all domestically produced films contain select plasticizers, which prevent the film from being too brittle at lower temperatures.

Plasticized vinyl film can be cast, extruded or calendered. For cast film vinyl chloride resin, plasticizer and stabilizer are dissolved in a solvent which is spread uniformly on a smooth surface and driven off in the pressure of heat. The residual film is stripped from the surface and wound into rolls.

Granulated resin, heated to the melting point and forced through a flat or circular die, produces extruded film. The film coming from the die is usually air injected to reduce its thickness.

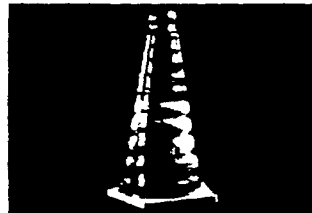
Heated pressure rolls provide the mechanism for producing calendered film. A mixture of resin and plasticizer are fed through the rolls, which determine the thickness of the film by the spacing between their surfaces. These manufacturing methods produce films which range from hard, brilliant films approaching cellulose acetate to the soft, flexible films similar in softness to polyethylene.



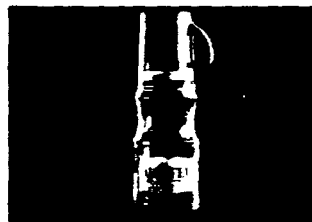
For Hardware Items. Makes multiple-unit packaging easy. Strong and puncture resistant.



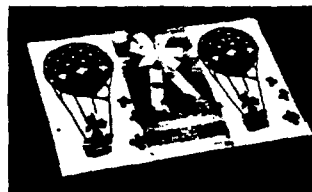
For Books and Business Forms. Speeds packaging operation to near printing press speeds. Gives visual inventory control. Cuts labelling costs.



For Toys and Novelties. Makes economical packaging easy. Protects against handling damage and provides lasting shelf life.



For Packaging Tie-In Premiums. Offers excellent opportunity to unify and display tie-in merchandising premiums.



For Textiles. Extends shelf life, retards deterioration, protects against dirt and dust.



Records and Stereo Tapes. Fast, easy sealing allows maximum machine speeds. Package integrity cuts rejects.



For Product Shipping. See-through wrapping makes inventory and stock-depletion counts easier to perform. And wrap protection helps keep merchandise fresher-looking, longer.



For Frozen Foods. Excellent low temperature flexibility; extremely well suited for wrapping frozen foods.

The heat-shrink characteristics for polyvinyl chloride film are added during manufacture. The vinyl film is stretched under accurately controlled temperatures and tension to change the molecular line-up within the film.

To utilize this stored shrink-energy, the package wrapped in the film is introduced into a hot-air tunnel and the heat therein causes the film to shrink back to its original unstretched condition or at least to the physical conformation of the units being wrapped. Its shrink temperature range varies between 250 degrees and 400 degrees F. Because of its 50 per cent or better maximum shrink capacity, PVC film is very desirable as the close fit on an odd-shaped product or for the shrink cover.

The superior advantages of vinyl shrink film have made it the fastest growing shrink film for packaging in the last two years. Its estimated use of 26 million pounds (Modern Packaging) for 1968 represents a six million pound increase over 1966, a greater volume and percentage advance than all other packaging shrink film. These figures point up its ability to meet the individual challenges and needs of the consumer, the packaging engineer, the marketing manager and management. Its superior qualities for shipping, merchandizing and protecting products make it a versatile and attractive tool for the packaging industry. ■



For Foods. Fresh produce keeps fresher, stays fresher, looks fresher.

# DEVELOPMENTS



Malcolm P. Murdock

## Malcolm P. Murdock Retires; Gill Heads Chemicals Group

After 35 years of service, Malcolm P. Murdock retired from Ethyl Corporation Jan. 1 as senior vice president and head of the Chemicals Group. He continues as a member of Ethyl's board of directors and is also serving as a consultant.

Succeeding Mr. Murdock as head of the Chemicals Group is James M. Gill, vice president. Mr. Gill will have overall responsibility for directing the operations of the Petroleum Chemicals and Industrial Chemical divisions.

Joining Ethyl in 1948 as a chemical engineer at Baton Rouge, Mr. Gill subsequently served in several supervisory positions in the Manufacturing department at Baton Rouge and on the West Coast. He was general manager of the Industrial Chemicals division prior to his appointment as vice president of the Chemicals Group in 1966. Mr. Gill holds BS and MS degrees in chemical engineering from Louisiana Polytechnic Institute and Louisiana State University respectively.

Mr. Murdock joined Ethyl in 1933 as a sales representative. In ensuing years he held positions of increasing responsibility, serving as assistant manager of the Los Angeles and Chicago divisions, sales manager of Ethyl Specialties Corporation, manager of the Central Region, assistant sales manager and general sales manager. Mr. Murdock was elected vice president in charge of Sales and a member of the board of directors in 1952,



James M. Gill

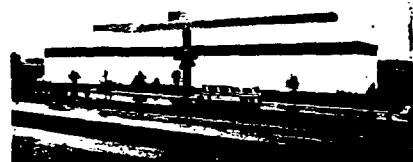
continuing as a director and becoming senior vice president following the Ethyl-Albemarle merger in 1962. Mr. Murdock holds a BA degree in economics from Cornell University.

Within the Chemicals Group, the Petroleum Chemicals division continues to be headed by divisional vice president Robert A. Douglass, and the Industrial Chemicals division by Merle L. Gould, divisional general manager.

## Ethyl Film Wraps A Building

Big things come in small packages, but not at R. J. Reynolds Co. The company recently put on a press show to introduce its new Development Center in Winston-Salem, North Carolina with a flare and imagination that Santa's little helpers could emulate.

Reynolds' engineering department "gift wrapped" the four-story building in 32,000 square feet of red and white "VisQueen" Polyethylene Film, a product of Ethyl's Plastic division. A 24-foot inflated red bow dressed the package. At a given signal, a copper wire covering the wrapping was



Reynolds' new Development Center, wrapped in VisQueen PE film. The bow is 24 feet wide!

charged with current and the melted film fell away from the Center.

This unusual operation began at midnight with the Reynolds engineers moving into action under glaring flood lights and peppering rain. A bucket crane lifted workers to points on the building impossible to reach from the ground or roof, while other workers draped the rest of the building. By 8 A.M. Operation Wrap-Up was completed.

The press on hand saw the operation executed flawlessly under a dry morning sky.

## Ethyl Plans New PE Film Plant at Carbondale, Pa.

Ethyl Corporation continues its trend toward growth and expansion with the announcement that it plans to open a plant at Carbondale, Pa., near Scranton, for the manufacture of polyethylene film.

The plant will be operated by the VisQueen division. It will cost in excess of \$1 million, and is scheduled for completion next spring.

Concurrent with the plant announcement, the Company also disclosed the appointment of W. Dekle Rountree, supervisor of Industrial Engineering at VisQueen's Terre Haute, Ind. plant, as plant manager at Carbondale. A former Marine and the holder of a BS degree in industrial engineering from the Georgia Institute of Technology, Mr. Rountree has been associated with Ethyl since 1966.

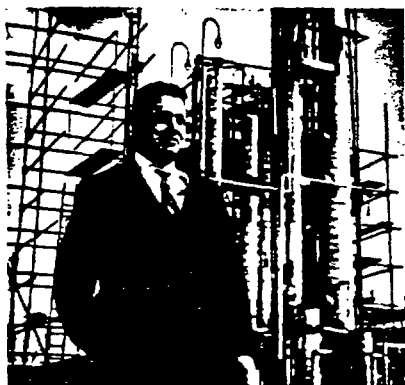
The new VisQueen facility is being constructed by the Carbondale Lackawanna Industrial Development Corp. Ethyl has purchased the shell building and a surrounding 4½ acre tract from CLIDCO, and will begin installing machinery as soon as the structure is completed. Initially, the plant will employ about 20 persons.

## Magazine Cites Dr. Gautreaux

Dr. M. F. Gautreaux, general manager of Ethyl's Research and Development Department in Baton Rouge, recently received national recognition for his achievements as an industrial chemist.

Chemical Engineering, a McGraw-Hill publication, named Dr. Gautreaux one of four recipients of the first bi-annual Personal Achievement in Chemical Engineering Award.

The awards are based on individual accomplishments of the engineer in



Dr. M. F. Gautreaux

the chemical process industries.

Dr. Gautreaux was honored for his outstanding career in process development and design. He was responsible for the development and commercialization of Ethyl's synthetic, straight-chain alcohols process now producing over 100 million pounds per year at Ethyl's \$20 million facility located within our Houston manufacturing facilities.

A Magna Cum Laude graduate of Louisiana State University, Dr. Gautreaux serves as the director of the Baton Rouge Section, American Institute of Chemical Engineers.

Chemical Engineering sponsored the Personal Achievement Awards "to give the engineer the recognition that is his due and to help bolster the general image of the engineering profession."



W. J. Rusher



John D. Saunier

### Ethyl Men Address Seminar

Last month two Ethyl Corporation executives were among the guest speakers at a seminar on the Greek economy attended by leading governmental, industrial and financial officials from Greece.

W. J. Rusher, president and managing director of Ethyl S. A., and John D. Saunier, manager-marketing of Ethyl's International Division, participated in the International Manage-

ment Orientation Seminar entitled, "GREECE—Business Opportunities in a Developing Economy."

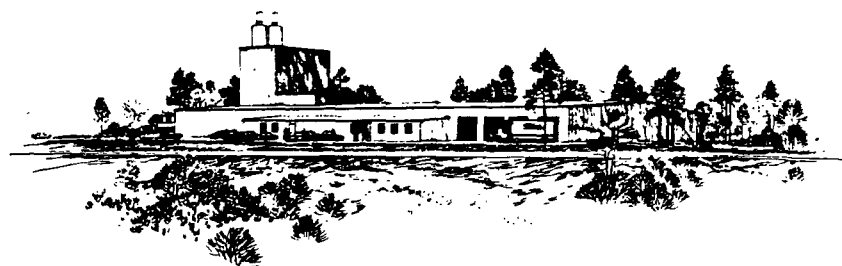
The executives discussed Ethyl's role in the development of the Greek economy. The seminar was held in New York City and sponsored by the American Management Association.

Mr. Saunier was also a featured speaker during a panel discussion on marketing in Greece, and participated with Mr. Rusher in the workshops on

operational problems in Greece and Greece's world-wide market position.

Among the Greek leaders at the seminar was Costa P. Caranicas, economic minister, Royal Greek Embassy, Washington, D. C.

The AMA-sponsored seminar also included discussions on the Greek economy as a whole, official policies on foreign investments and industrial development, as well as a film presentation entitled, "Greek Industry."



An architect's rendering of the new Tiptonville plant.

### Ethyl Corporation Builds Plant in Tennessee

Last month Ethyl Corporation began construction on a \$2 million plant in Tiptonville, Tennessee which will produce a broad line of polyvinyl chloride compounds.

Completion of the 40,000 sq. ft. facility is expected during mid-1969. It will occupy 40 acres fronting on the Mississippi River.

The new plant will house modern compounding equipment to produce a wide range of PVC compounds used for such products as rigid PVC bottles, PVC pipe and conduit house siding, shutters and gutters and appliance and business machine housings.

Henry G. Smith will be the plant manager. Mr. Smith joined Ethyl as a chemical engineer in 1951 and in the ensuing years held various positions in the company's principal manufacturing and research and development center in Baton Rouge. In 1960, Mr. Smith was appointed supervisor of PVC Operations—the post he held until his present promotion.

Harry M. Zimmerman, general manager of Ethyl's Polymer division, made the joint announcement regarding the plant, with County Judge Richard Helton.

## PRODUCTION NOTES

**PRINTING/** This issue of Ethyl Magazine was printed by offset lithography on a #61 Miehle, four-color, 43x60, press at 5,500 impressions per hour. Color sequence was yellow, blue, black and red. **TYPOGRAPHY/** Body copy set 9/10 Optima with semibold and italic. Pages 30, 31 set 9/10 Melior. **PAPER STOCK/** The paper, Sheerwhite Opaque, was produced by Oxford Paper Company, an Ethyl Corporation division, at mills in Rumford, Maine and West Carrollton, Ohio. Made by the Fulcote process, Sheerwhite opaque provides a matte coated printing surface visibly whiter and brighter than competitively priced papers. It is also the only paper in its competitive grade range that is made and stocked in a full weight range from 50 lb. through 146 lb. Consult your Oxford Merchant Representative for additional information about Sheerwhite Opaque and the entire line of Oxford papers. **CREDITS/** Front Cover: Irving J. Olson, Akron, Ohio/ Page 3: NASA/ Page 8: H. Armstrong Roberts/ Pages 22 and 23: The American Petroleum Institute.

**STILL Changing...  
to Serve a Changing World**

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Ethyl's appearance in the *FORTUNE* listings during the four years since the corporate merger has steadily increased—Ethyl ranked 247th for 1963, 222nd for both 1964 and 1965, and 204th for 1966.

# Ethyl

MAGAZINE

TWO/1969



ETC 17983

TWO/1969

# Ethyl

MAGAZINE

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Alton W. Becker, Jr.  
Acting Editor

George J. Brogan  
Contributing Writer

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ILLUSIONS, another cover photograph by Irving J. Olson. Deceived by shadow patterns, the human eye fails to see at first that these gears are meshed. In the same way can illusions of the mind obscure from man's vision such important developments as the partnership of industry, government and the universities in man's quest for solutions to environmental problems. See page 13.

## ETHYL CORPORATION/1969

One of the key factors behind the historic merger which produced Ethyl in 1962 was the desire to strengthen a paper company through an acquisition in the chemicals and plastics fields.

In the seven eventful years since then this spirit of growth and advancement through purposeful change has been central to Ethyl's performance worldwide. Enhancing and enlarging its established position in petroleum products, the Company has also branched out strongly into such new areas as industrial chemicals, plastic resins and products, fine printing papers, aluminum extrusions and packaging.

Two recent events underscored the vitality of our corporate evolution. One was the sale of the paper company involved in the original merger. The other was an announcement that Ethyl's net sales last year surpassed half a billion dollars for the first time, making us one of America's 20 leading chemical companies.

Growth and change are more than just words at Ethyl. They are a continuing reality, made possible by expanding capabilities and the kind of imaginative thinking and research that is so indicative of our creative economy.

*A creative economy  
is the fuel of progress.*  
—Ralph Waldo Emerson

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**Ethyl**  
Corporation

*Changing... to Serve a Changing World*



The awesome transfer of Presidential power occurred in the ten seconds or so it took for Richard Nixon to say the Oath of Office.

## ***Ten Seconds to the Presidency***

In the stark suddenness of about ten seconds, Richard Nixon took the oath of office as 37th President of the United States last January and instantly replaced Lyndon Johnson at the summit of global and domestic affairs.

Although it is often overlooked amid the pageantry of the ceremonies and the glitter of inaugural balls, there is an awesome quality—almost a mystique—about the investiture of a new American President.

In a few fleeting seconds on that stand in front of the Capitol the vast powers and enormous responsibilities of the mightiest political office ever known to man change hands simply, and in a spirit of harmony and good will.

The recitation of 35 hallowed words returns one man to private life and entrusts to the other the destiny of the free world.

Perhaps no other event in American life better illustrates the sovereignty of the people and the transitory nature of political power in our democracy than the swearing-in of a new President. The ordinary citizen of one moment becomes the head of the world's most powerful nation the next—placed there not through coercion or armed force or accident of birth, but by the votes of millions of fellow countrymen cast in a free and open election.

There have been 46 such Presidential Inaugurations in the history of our Republic, beginning in 1789 with George Washington and continuing uninterrupted every four years since then. Thirty-six men have ascended to the nation's highest office during these ceremonies, and control over the reins of government has changed hands between the major political parties 18 times.<sup>1</sup>

But the true meaning of what takes place on Inauguration Day transcends the personalities and parties involved. It focuses instead on the will of the people, which the Constitution makes sovereign and inviolable. And it centers as well on the continuity and stability which this great charter has given to our republican form of government.

The principle that all power derives from and rests finally with the people is, in America, the very essence of political activity. It is the foundation upon which rests the whole structure of government—federal, state and local

—and is the element that binds all Americans together, regardless of partisan differences.

In the inauguration of a President this abstract conception of popular sovereignty becomes something tangible for all citizens to see and appreciate. Far from being a strictly political affair, it is a symbol of our liberty, as was pointed out by President Nixon in the eloquent opening passage of his Inaugural Address.

"I ask you to share with me today the majesty of this moment," he declared. "In the orderly transfer of power, we celebrate the unity that keeps us free."

The symbolic nature of these ceremonies was defined somewhat differently by Franklin Delano Roosevelt in his Third Inaugural in 1941. "On each national day of Inauguration since 1789," he said, "the people have renewed their sense of dedication to the United States."

Whether expressed in terms of national unity or a spirit renewed, the basic meaning of an Inauguration remains what it has always been—the execution of the popular will. That is why, in composing their inaugural speeches, two such different men as Presidents Nixon and Roosevelt might easily have subscribed in principle (and with equal conviction) to the words of another famous political figure, Daniel Webster, who reminded his fellow senators in 1830 that "We are all agents of the same supreme power, the people."<sup>2</sup>

From a purely legal standpoint, the idea of the body politic as politically supreme draws its legitimacy from the Constitution. But philosophically, it owes much more to the Declaration of Independence, and to the principal author of that document, Thomas Jefferson.

An ardent libertarian and spirited believer in what the Enlightenment termed the natural rights of man, Jefferson had been profoundly influenced as a young man by the writings of the English philosopher and theoretician, John Locke.

Deeply moved by the forces at play in the English Revolution of 1688, Locke published in the last decade of the 17th century two cogent studies of the meaning of government and its relation to man. In these books Locke maintained that men are "by nature all free, equal and independent" and have an inherent

right to "life, liberty and estate." Pointing up the evils of "absolute arbitrary power," he exulted in the "common good" and the "consent of the majority." Governments, Locke asserted, are "...designed for no other end ultimately but the good of the people."<sup>3</sup>

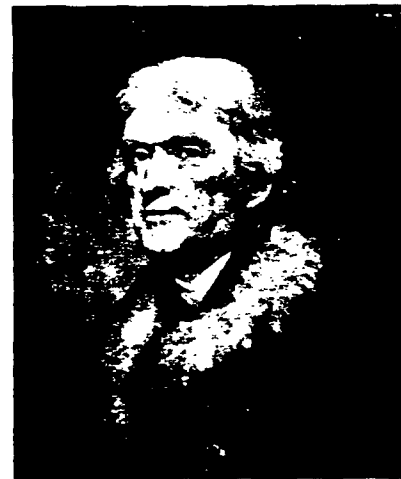
All of this made a lasting impression on Jefferson, who discerned in Locke's reasoning an irrefutable logic as well as great wisdom and truth. Ironically, a British philosopher provided the inspiration for the man who was to give such eloquent expression to America's grievances against the Crown.

In June 1776 the Continental Congress reached general agreement that it would assert the independence of the colonies, and it appointed a five-man committee, headed by Jefferson, to prepare an appropriate declaration. However, the task of actually drafting the statement was Jefferson's exclusively, chiefly because of his stature in the colonies and his reputation as an articulate and persuasive advocate of his views.

Even though some portions of Jefferson's original draft were later revised by the Congress (much to his distress, incidentally), almost all of the crucial passages were left substantially unchanged. Certainly there was no attempt to alter the basic philosophical outlook which Jefferson had expressed. The document he produced was a ringing affirmation of democratic principles,



John Locke



Thomas Jefferson

and so was the version finally adopted. From the tone and phrasing of the Declaration, it is clear that as Jefferson composed it Locke's teachings were not far from his thoughts. Especially is this true in regard to the source of ultimate power.

Says the Declaration: "We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed."

Whereas Locke spoke of the "consent of the majority," Jefferson used the phrase "consent of the governed." But the substance of the two thoughts is just about the same, and it had a great impact on the men who gathered in Philadelphia in 1787 to write the Constitution.

The concept of a sovereign people was strongly reflected, for example, in the famed *Federalist Papers* written by Hamilton, Madison and John Jay during the struggle for ratification. Madison explained that a republic can be defined as "a government which derives all its powers directly or indirectly from the great body of the people, and is administered by persons holding their offices during pleasure, for a limited period, or during good behavior."<sup>4</sup>

Washington made a simpler reference to the idea in his First Inaugural when he drew attention to "... the experiment entrusted to the hands of the American people."

So firmly rooted did this idea become in the American consciousness, so pervasive was it in our society, that even visitors to this country from abroad could not help but perceive it. The Frenchman de Tocqueville wrote in one of his great essays on America in the 1830's: "Elected magistrates do not make the American democracy flourish; it flourishes because the magistrates are elective."<sup>5</sup> And Alexander Mackay, a Scot who toured this nation in the 1840's,

remarked: "It is the people in reality that rule..."<sup>6</sup>

In the 193 years of our Republic's existence many Americans have referred touchingly to this most basic of our political beliefs. Two of the most memorable expressions have come from Daniel Webster, the Massachusetts senator, and Abraham Lincoln.

"It is, sir," said Webster in Senate debate, "the people's Constitution, the people's government, made for the people, made by the people, and answerable to the people. The people of the United States have declared that this Constitution shall be supreme law."<sup>7</sup>

And Lincoln, in his Gettysburg Address, described government in America as being "of the people, by the people, for the people..."

The fact that American government possesses a continuity and stability unparalleled in the world today can be attributed in no small degree to public confidence in the justice and viability of our political system. And this confidence flows and draws sustenance from the knowledge, supported by nearly two centuries of experience, that in the hands of the people is held the true reins of power; that in the final analysis, it is the people who will decide by means of the ballot.

Because of this confidence, our governmental system has had the resiliency to endure great strains—even the convulsion of a Civil War. Despite the assassination of Presidents, the clouded outcome of crucial elections and the assertion of the right to secede, the basic fabric of our system remains in tact. In other parts of the world, such events have led to coups d'état, political turmoil, violent revolution, tyranny. That America has experienced none of these in its moments of domestic crisis underscores the confidence our people have in the spirit and letter of the words, "consent of the governed."

Historian Bruce Catton has eloquently touched upon the importance of this feeling in writing of the Presidential election of 1864.

"No matter what the election said,

the mere fact that it was being held was significant," he observed. "It was an act of faith, an affirmation that even war itself must at last be subject to a decision reached at the polls. Perhaps the strangest thing about this strangest of all elections was that it never occurred to anyone not to have it. Whether any nation so conceived and so dedicated could long endure... well, they would vote."<sup>8</sup>

It is the sovereignty of the people, then, and the stability which it confers upon our government, that makes an Inauguration so meaningful and, as Mr. Nixon said, majestic.

"The essence of freedom," noted the President in his Inaugural, "is that each of us shares in the shaping of his own destiny."

To witness the swearing-in of a new President is to renew ones faith in the truth of that statement in America. ■

<sup>1</sup>Grover Cleveland, whose two terms were interrupted by the incumbency of Benjamin Harrison (1889-1893), is the only man to be considered two Presidents, the 21st and 23rd. Thus, while Mr. Nixon is our 37th President, only 36 men actually have held the office.

<sup>2</sup>From Webster's noted second reply to Sen. Robert Y. Hayne of South Carolina in Senate debate, Jan. 26, 1830.

<sup>3</sup>Henry Steele Commager, ed., *Living Ideas in America* (New York, 1951), pp. 117-120.

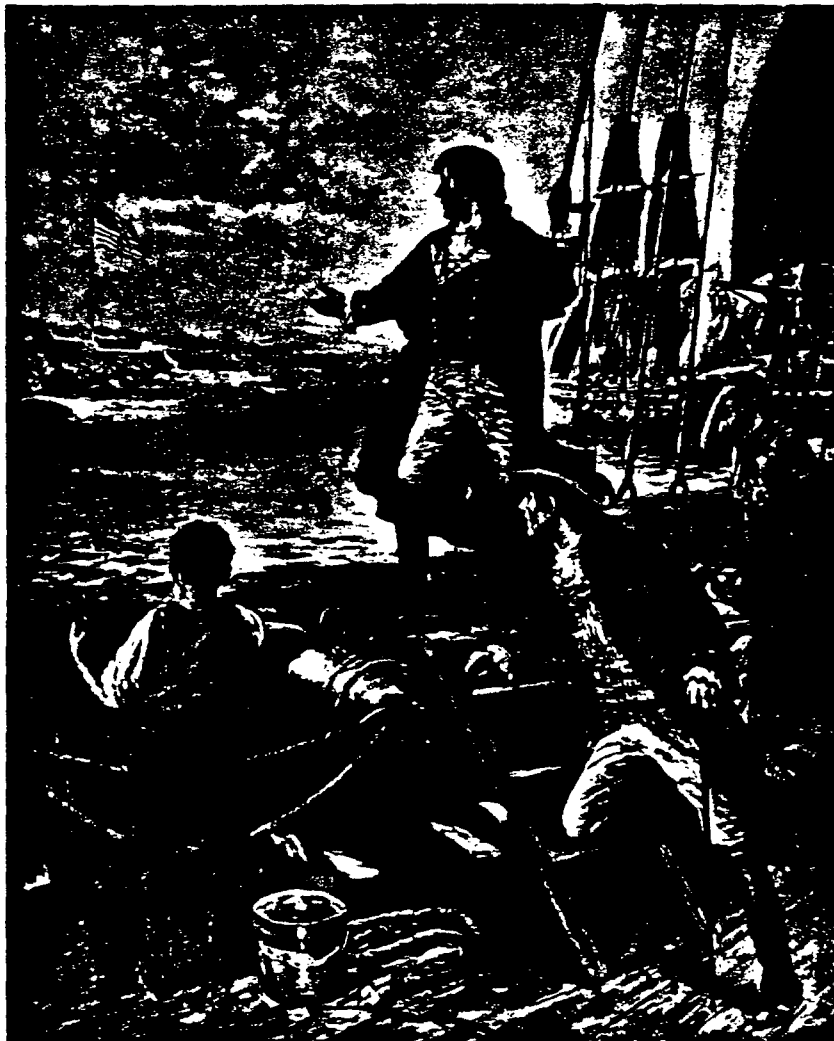
<sup>4</sup>From Number 39 of the *Federalist Papers*.

<sup>5</sup>Alexis de Tocqueville, *Democracy in America* (Vantage Books edition, New York, 1955), p. 112.

<sup>6</sup>Commager, p. 231.

<sup>7</sup>Also from Webster's second reply to Hayne.

<sup>8</sup>Bruce Catton, *Never Call Retreat*, v. III, *The Centennial History of the Civil War* (Garden City, N.Y., 1965), p. 369.



"By Dawn's Early Light" by Edward Percy Moran, 1913-1913

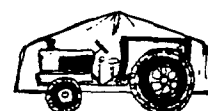
### "WHAT SO PROUDLY WE HAILED"

This Percy Moran painting captures the electricity of the moment in the War of 1812 when Francis Scott Key, seeing our flag still aloft over Fort McHenry, Baltimore, was moved to write The Star-Spangled Banner.

Many Americans before and since Key have been just as deeply touched by the sight of Old Glory. But few have expressed the meaning of the flag more eloquently than the late Dwight David Eisenhower just before his death.

"Today," he said, "we urgently need a new commitment to the basic principles that made our nation great. Our flag is the symbol of these principles, and I would hope that all of us might find some way to display it, not merely on patriotic holidays but every day in the year. Such a visible upsurge of respect for flag and country will do much to help bring about a new national solidarity, a renewed pride and faith in America."

# the breakaway thing at Ethyl



There are numerous corporate slogans designed to convey a message. Ethyl, too, has a slogan and a message to convey.

"Changing . . . to serve a changing world." That's the way Ethyl says it. And this message is perhaps best exemplified by Ethyl's Plastics division.

The division was formed a scant five years ago. Since then, its sales have soared from a base of zero dollars to more than \$100 million projected for 1969.

This phenomenal growth has made Ethyl a leading producer of plastics raw materials and end products, manufactured in 24 plants in the U.S. and Canada. Today polyvinyl chloride (PVC) resins and compounds, polyethylene and PVC films, polyethylene and PVC containers and PVC pipe are all produced by Ethyl and carry Ethyl's quality trademark.

What accounted for this meteoric plastics development at Ethyl? The answer, very simply, lies in Ethyl's philosophy of change by design for continuing growth as expressed in its slogan.

One of the prime indicators of this philosophy of "Change . . . to serve a changing world" was Ethyl's entrance into the plastics field.

As early as the 1950's the company

had set its sights on the burgeoning plastics market. But the impetus to bring Ethyl into the field first came with the acquisition of Ethyl by the Albemarle Paper Manufacturing Company in late 1962. The new Ethyl formed at this time, with its strong diversification and growth philosophy, provided the essential base for the rapid growth which followed.

In early 1962 Ethyl first entered the plastics arena with a know-how and licensing agreement with Imperial Chemicals Industries Ltd. (ICI) and Solvay et Cie of Europe for PVC technology—an agreement made possible by earlier R&D development in the production of vinyl chloride monomer, a key plastics raw material.

On June 24, 1964, the company officially announced that it would build a plant in Baton Rouge for the production of polyvinyl chloride resins and compounds at a cost of approximately \$10 million. At the same time, Ethyl formed its Polymer division to coordinate the corporation's activities in the PVC resins and compounds field.

Prior to these developments, Dr. Clarence M. Neher had been given the special assignment to develop the base for entry into the plastics industry and lay the groundwork for the formation of the Plastics division. And, paralleling the

announcement of the PVC plant, a culmination of his efforts, Dr. Neher was named vice president and general manager of the new Plastics division under the direction of Mr. B. C. Gottwald, executive vice president and secretary of the corporation.

Dr. Neher, 53, had been with Ethyl since 1941 after his graduation from Purdue University with his Ph.D. in chemistry. He had broad experience in Ethyl's research and development activities and also served as manager of several expansion programs. Before becoming general manager of the newly formed Plastics division in 1963, he served as director of Commercial Development in Baton Rouge for six years.

Dr. Neher's appointment proved to be a significant part of the plastics development story at Ethyl. He assembled an executive team whose vision, planning and teamwork have accounted for Ethyl's prominence in the industry.

The first Polymer division facility became operational in late 1965 and had hardly begun turning out new compounds and resins, when the second phase of PVC expansion in Baton Rouge began early the next year. The \$4.8 million addition at Ethyl's principal manufacturing center provided additional top quality PVC standard and

# PLASTICS PLASTICS PLASTICS PLASTICS PLASTICS



specialty resins, as well as versatile compounds in uniform blends and cubes for the mushrooming market.

To support growing polymer demands, Ethyl announced a concurrent program for substantial capacity increases at both Baton Rouge and Houston for the manufacture of vinyl monomer, the intermediate from which the PVC is made.

The first phase of its multi-million dollar monomer programs started in the spring of 1966 and represented another step in Ethyl's diversification efforts toward a fully integrated product operation in certain plastics areas.

Today, construction is proceeding on a new plant to produce compounds in Tiptonville, Tennessee, and on further PVC resins expansion in Baton Rouge.

The \$2 million compound facility is scheduled for completion in a short time and will house modern compounding equipment to produce a broad line of PVC compounds tailored to meet end product demand, including PVC bottles, PVC film, PVC pipe and conduit, house siding, shutters, gutters, and appliance and business machine housings.

The two-part resins expansion, with one leg to be completed by the first quarter of 1970, the other in mid-70, will supply Ethyl's rapidly expanding merchant demand and internal needs.

Shortly after Ethyl launched its initial assault on the plastics field with the acquisition of PVC technology, the company heralded its entry into the converting sector of the industry with the acquisition of a major portion of the polyethylene film operations of Union Carbide's Visking division on November 30, 1963.

Visking at the time was the nation's largest manufacturer of polyethylene film and was its first major producer in the United States. It had a nation-wide sales force serving the packaging, building materials, agricultural and industrial fields.

Ethyl obtained three Union Carbide polyethylene film plants in Flemington, New Jersey, Terre Haute, Indiana, and Fremont, California. Also, the company had exclusive right to the "VisQueen" trademark, under which the divisions products were sold. Ethyl has continued the sale and production of the quality film as "VisQueen" polyethylene film.

Construction of one of the newest operational facilities in Ethyl's nationwide network of manufacturing installations began in January, 1965. The company's polyethylene film plant in La Grange, Georgia went in commercial production in December of that year.

Today, construction is proceeding on

a new plant in Carbondale, Pennsylvania for the manufacture of polyethylene film. The plant, which will be operated in Ethyl's VisQueen division, will cost in excess of \$1 million and be in production soon.

An entirely new plastics area opened up for Ethyl in October, 1964, when Ethyl executive vice president, Mr. B. C. Gottwald, announced its entrance into the PVC plastic container field through the creation of a jointly-owned company, Vypak Corporation.

The unique name, incidentally, originated from Dr. Neher's secretary, Miss Patty Ruth Carroll, who combined the idea of vinyl packaging into the contraction Vypak.

Vypak was formed with Solvay et Cie of Belgium to develop, manufacture and sell plastic bottles and other containers made from polyvinyl chloride.

At the time, Mr. Gottwald said about Vypak, "The development of polyvinyl chloride containers on a broad commercial scale in the United States represents a major competitive challenge..."

To meet the challenge, Vypak became the target of an expansion effort in early 1965. Construction of a new plant in Rockaway, New Jersey for the

production of polyvinyl chloride bottles and containers began. This was Vypak's first major increase in capacity since it was organized.

The plant, with an initial capacity of 50 to 100 million bottles per year, began commercial production of blow-molded PVC bottles and containers for packaging a wide variety of consumer products in September, 1965.

At the time Vypak also consolidated its research and engineering, customer service laboratories and corporate headquarters at the new site.

On February 2, 1967 Ethyl became full owner and operator of the Vypak Corporation and named Mr. R. F. Sands president.

Expansion continued. On January 16, 1968 the company announced the opening of a second Vypak plant in Louisville, Kentucky to manufacture PVC blow-molded bottles.

Six months later, Vypak achieved a landmark in the packaging area with the introduction of the first PVC bottle to be used commercially in the packaging of food products in the United States. The bottles were used for "Sugarine," a low-calorie sweetener.

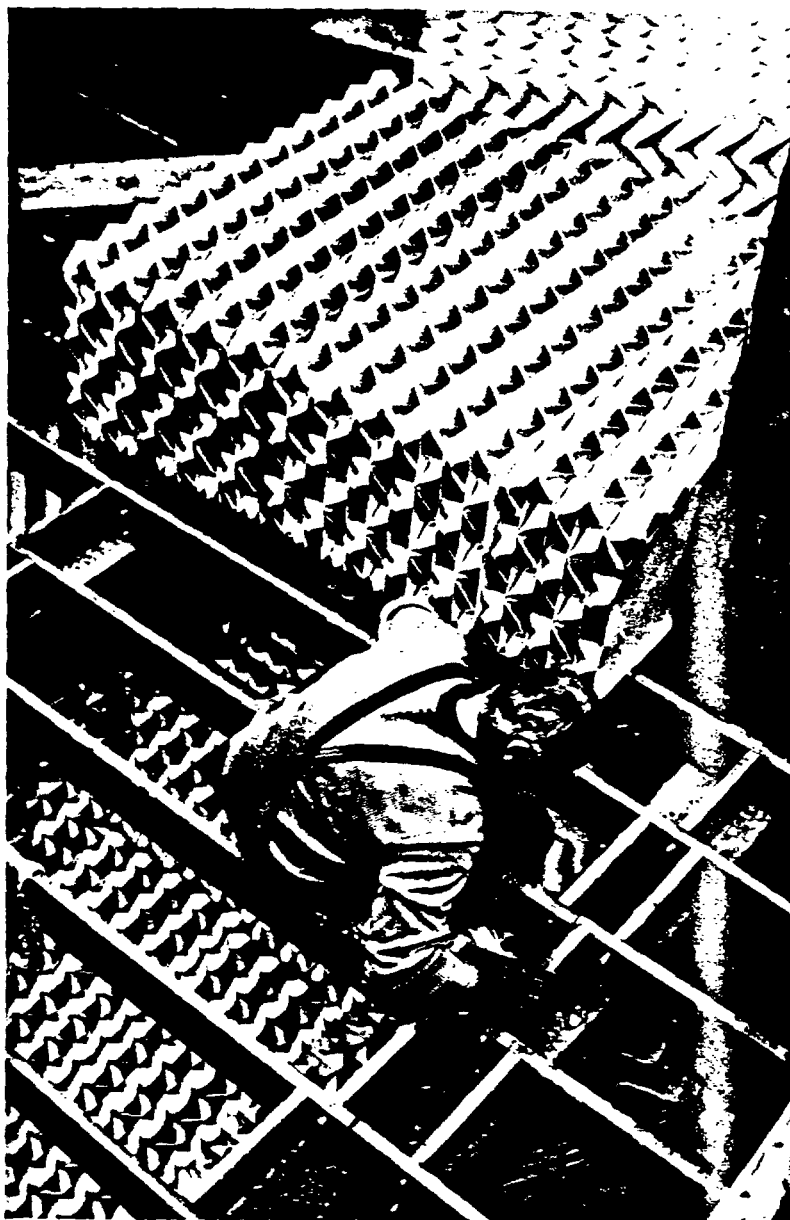
In keeping with its continuing growth and diversification, the company completed the purchase of the Imco Container Company from Rexall Drug & Chemical Company and El Paso Products Company for approximately \$25 million on July 31, 1968.

At the time Imco was a leading producer of polyethylene bottles and containers for use in packing toiletries and cosmetics, with a similar product line for packaging a wide range of detergents and household chemicals, pharmaceuticals, foods and beverages.

Under the terms of the sale, Ethyl acquired the Imco bottle making plants in seven of the United States and one in Canada and an equipment manufacturing plant located in Kansas City, Missouri, Imco's headquarters. Included were two closure or cap plants in South Grafton, Massachusetts and Excelsior Springs, Missouri.

The Imco operations became part of the Plastics division and is now known as the Imco Container Company, division of Ethyl Corporation. Vypak was absorbed into Imco and became part of its operations. Mr. Sands became executive vice president reporting to Imco's president, Mr. R. V. Vosburgh.

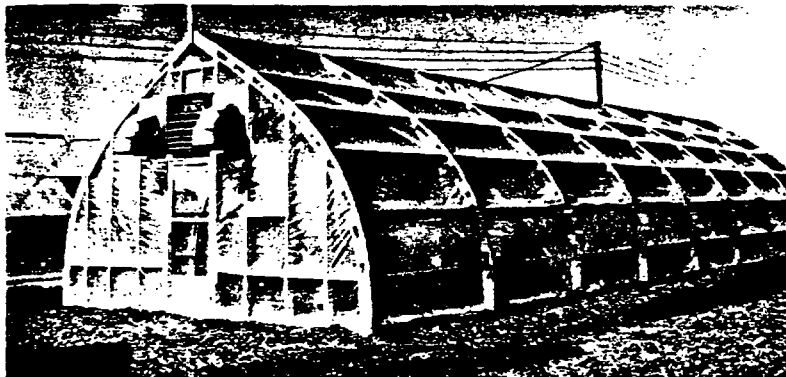
Continuing its strong expansion efforts, Ethyl announced the beginning of construction on a new, modern plastic bottle operation in March of this year. Vandalia, Illinois will be the home of the twelfth Imco plastic bottle plant in the country.



"Flocor" is Ethyl's honeycombed PVC filtering media for treating sewage & industrial wastes.



Reservoir linings—an important use for PE film.



Polyethylene film covers greenhouses.



Packaging bread with Ethyl's polyethylene film.



Our PVC shrink film in action.



Ethyl PE film makes excellent mulch.

In a busy 1965 for Ethyl plastics, inroads into another plastics product area were made when the VisQueen division introduced PVC packaging film for the first time. The film has become a leading packaging material for red meat, fresh produce and industrial applications and has since been separated as a distinct divisional entity within the Plastics division.

In Ethyl's home city of Richmond, Virginia, the PVC film and sheeting division is constructing a new film plant which will be completed in the fourth quarter of this year at a cost of \$2 million.

The plastics program followed another avenue of diversification with the acquisition of the plastics product division of Texacon Industries in May, 1964. The purchase included the machinery, equipment and assets of a small plant in Kearny, New Jersey, which made PVC pipe, conduit and related products and served as a nucleus for PVC pipe production.

Ethyl melded the operation into the VisQueen division at the Terre Haute, Indiana facility.

This acquisition, with Ethyl's license of a new development in PVC pipe, a unique "Bell:Ring" joint system from the largest PVC pipe company in Germany, launched Ethyl into the PVC pipe market. The new "Bell:Ring" and pressure pipe led Ethyl into the field of portable water systems and represented a major product advance.

In early 1967 Ethyl entered another new product area with introduction of its "FloCor" PVC filter media for water treatment plants. Technology was obtained from I.C.I. in England, but Ethyl's research and development efforts have made significant improvements.

This new plastic media for the biological oxidation of sewage and industrial wastes signaled Ethyl's entrance into the waste water purification field, an important area relating to the reduction of water pollution.

In terms of capital expenditures in plastics operations, increased sales within the division and dramatic new product developments, 1968 proved to be Ethyl's biggest year.

The Vypak expansion at Louisville, the significant acquisition of Imco, the PVC expansion in Tiptonville and the Carbondale polyethylene film plant highlighted the year.

The sales picture for 1968 proved as productive as the Plastics division's construction program. Sales of PVC resins and compounds in 1968 were double their 1967 level, as compared with an industry growth rate of only 10%. In

total plastics sales, the division jumped from \$40,110,000 in 1967 to \$63,034,000 in 1968. Moreover, significant progress was made in improving plant efficiency and reducing production costs.

This meteoric growth and development of Ethyl's plastics operations in five short years is a reflection of the Ethyl idea of change and diversification.

Will the plastics future at Ethyl reflect the same dynamism as its past?

According to Ethyl Executive Vice President B. C. Gottwald, the company is counting on the same kind of performance which Dr. Neher's team has delivered in the past.

Dr. Neher himself feels that the plastics picture looks even bigger and more profitable than the past.

It is expected that, if the current progress continues, within five years the Plastics division alone will reach a sales volume greater than that of Ethyl Corporation when it was purchased by Albemarle in 1962. (That's some \$200 million, by the way.)

Plastics division management has the goal of being a future leader in other areas as the division is today in packaging.

The foresight, leadership and teamwork within the Plastics division have earned Ethyl the leadership in the plastics industry which it enjoys today.

And, like the corporation as a whole, the Plastics division will continue to "Change . . . to serve a changing world."



Bubble of PE film at Ethyl manufacturing plant.



Installation of light-weight Ethyl PVC pipe.



A food-grade PVC bottle by Ethyl.



We make a whole spectrum of plastic closures.

Through perceptive and energetic research, people from industry, government and the universities are making significant headway in the fight against air pollution. Unquestionably, much remains to be done, but the broad outlines of ultimate success are now coming into view—in large measure because industry and other groups in our society have pledged themselves to



# The Clean air Commitment

George F. Kirby, Jr. is president of Ethyl Corporation and was named by former President Johnson last year to the Air Quality Advisory Board, a newly-organized body created to help the federal government in the nation-wide fight for cleaner air. A board member at Ethyl, Mr. Kirby is also a director of the American Petroleum Institute, the Louisiana Board of Nuclear Energy, the Louisiana State University Foundation, the Texas Eastern Transmission Corp. and the Louisiana National Bank.

On a national scale this quest for air purity is relatively new. Yet, even within the brief period of 10 years, notable progress has been achieved. Some of the factors behind this forward movement were sketched by Mr. Kirby last December in an address before the New England Conference on Air Pollution at Colby College, Waterville, Maine—a conference headed by Sen. Edmund S. Muskie, the 1968 Democratic candidate for Vice President and chairman of the Senate Subcommittee on Air & Water Pollution.

In his speech, Mr. Kirby drew attention to the joint efforts of industry, government and the universities in working toward air conservation. Together, he said, these three groups have forged a "meaningful partnership for cooperative action" which has made perceptible inroads in the air pollution campaign. Attributable to this unity of purpose and action, Mr. Kirby observed, is the fact that America today possesses "a coherent program, worthy of being viewed in longer perspective, and having the potential to fill the critical needs of our urban and industrial centers." By continuing and enhancing this cooperative approach, he said, the nation can bring its clean air objectives nearer to fulfillment.

So that the public may have a broader understanding of the air pollution problem, and an improved perspective of efforts to solve it, Mr. Kirby's speech is presented here in its entirety. We urge that you read it carefully, and give thoughtful consideration to its message.



## The Clean air Commitment



I am pleased to be present at this important conference and to discuss industry's role in combating air pollution. I want to avoid the impression that I am in any sense a "spokesman" for all industry. This is a bit too heavy a responsibility in view of the breadth, the complexity and the emotionally charged nature of the air pollution problem. However, most of us in industry have our areas of direct concern, and since my company is involved in some degree with paper, chemicals, fuels and automobiles, I would like to direct most of my comments to activities in these fields.

There is ample evidence of increasing national concern over the air pollution problem that grows out of our urbanized and industrialized society. So, it is well that there is hope for practical and effective solutions. The outlines of a meaningful partnership for cooperative action by government, industry and the academic community can already be seen in many areas. This conference is such a partnership, and I am confident that it will accelerate progress.

Any objective observer would acknowledge that cooperative action has in the past sometimes been delayed by self-interest and inattention on the part of all of the groups concerned. Too often a crisis has had to occur before programs of correction have been generated. But out of these often half-hearted and ineffectual efforts—developed from day to day and emergency to emergency—has come now a coherent program, worthy of being viewed in longer perspective, and having the potential to fill the critical needs of our urban and industrial centers.

The public is now fully aware of this national problem and the legislative framework now exists within which solutions can be sensibly sought. Both public awareness and the law have been to a large extent the achievement of our Chairman, Senator Muskie. Industry has an important place in this framework and a major job to do in fulfilling the needs of the country for clean air.

The programs of the present and future are now quantitatively concerned with what levels of cleanliness are needed and how much we will have to pay for the improvement sought. The first of these criteria—what levels of cleanliness

are needed—can perhaps best be advocated by government. The second, which involves technology and cost, requires evaluation and action with industry participation.

I believe that the industrial community supports sound air quality requirements. It has voluntarily invested hundreds of millions of dollars over the years to conform to accepted or prescribed needs. It has explored ways of developing new and meaningful data to get at the root of air contamination and to help bring it under control. But it is a responsibility of industry to stay in business. So, any solutions must ultimately be economic and practicable. Pollution can obviously be stopped by shutting down plants and closing up shop. But this is too drastic an answer, and much better ones can be found.

We must be mindful that scientific management of our air resources is still in its infancy. It has been little more than a decade that national (as contrasted with local) attention has been focused on air pollution. It was in 1955 that Congress first appropriated a modest sum of money, and subsequently authorized the U.S. Department of Health, Education and Welfare to conduct an air pollution research program. These small beginnings eventually led to the first Clean Air Act in 1963 and to our present more comprehensive Air Quality Act of 1967. It is a matter of record that the industrial community worked with government throughout these legislative developments.

If we have been fortunate in having the Air Quality Act developed as a major legislative achievement under Senator Muskie's influence, we have also been fortunate in having its implementation guided by Dr. John Middleton. He has assembled a highly competent staff in HEW who are conscious of the urgent needs of our time. They are not unmindful of the fact that industry does sometimes have to be needed and urged, but they respect what it can achieve. Industry has consequently recognized the assistance government can offer, as well as sanctions it can apply. The boards and committees covering almost every aspect of implementation have been staffed with care—good men from every sector. They provide assurance that solutions will be sought and found and that



cost will be measured against effectiveness in enforcement and control. Industry has supplied many of these men. Sensible action will be taken, and it will not be dragged out.

The year 1968 will mark the beginning of the development and issuance of criteria documents for specific pollutants. They will provide the scientific basis for control and regulation. We expect these documents to be comprehensive, objective and organized scientific reviews of all information pertinent to pollutants and their control problems. The air quality standards of each pollutant which will shortly follow the criteria documents should therefore be more soundly based than any such regulatory standards in any country up to this time. Health and environmental control authorities in many countries are awaiting with interest the unfolding of this program.

It is accepted that air pollution requirements will be continually changing as new needs are recognized and new information is developed, and that the American program may well be the basis for the first world-wide concepts relating to international standards for air quality.

The broad outlines of this national program are soundly conceived. While problems will no doubt be encountered, it should nevertheless be possible to see a continuation of real progress during 1969 and future years if all of the concerned groups continue to work together effectively. Air quality standards must, of course, be considered, established and enforced with care. There is every reason to believe that this will be the case.

The effectiveness of this program will be measured to a large degree by the performance of industry in adopting measures of compliance. In many cases, this will not be done



without difficulty and cost. One aspect of the present law which will be of great help is the flexibility allowed by state and region. In my own company, for example, we operate a large paper mill at Rumford, Maine and a chemical plant in Houston, Texas. Rumford is a relatively small town surrounded by the beautiful Maine woods and countryside, with little industry other than the Oxford Paper operation. Our plant at Houston, on the other hand, is part of a major concentration of chemical industry, closely surrounded by industrial neighbors and heavily populated municipalities. Each plant has problems to cope with, but they are far different. The chemical processes in each have to be designed so that the many different potentially harmful or disagreeable types of atmospheric effluent are controlled scrupulously to protect the neighbors involved. The situation may be different in Maine than in Houston, but in each case the requirements can be quantitatively determined for each pollutant, and control measures applied and maintained.

Many industries have been alert, and responded early, to join the search for ways to meet the new needs for air quality.

In the chemical industry, improved processing, over the years, has resulted in greater outputs of desired products, while reducing unwanted airborne effluents. The chemical industry has spent an estimated 300 million dollars for air pollution control equipment in the past five years, and this expenditure could double in the next decade. Moreover, it is spending approximately 50 million dollars annually to operate and maintain the facilities. In the large companies air control considerations are an integral part of research and development programs on new products and processes. This greater emphasis on air conservation in such research and development programs will yield even greater progress toward clean air in the future.

Like the chemical industry, the paper industry's concern with pollution is not new. It joined early in the drive on air pollution abatement.

The atmospheric emission problems in the paper industry range from those shared with all industrial operations generating steam through burning fossil fuels, to highly specific ones associated with kraft pulp mills. Various methods such as processing changes, control equipment and the phasing out of outmoded operations have been employed to bring pollution under control. Particulate collection devices, for example, have been installed in roughly 98 percent of all the nation's kraft mills. This industry has spent more than 75 million dollars in abatement and control equipment, and is expected to invest an additional 60 million dollars over the next four years. These figures, incidentally, do not include capital expenditures for process changes.

Appreciable progress has also been made in reducing odors, which fall more correctly into the realm of esthetic rather than a health problem. Early next year, for instance, at least half of the nation's mills will have added processing units which reduce odorous compounds emissions. While work is continuing to bring this problem under control, it is complicated by the fact that odorous compounds are detectable by humans down in the range of one part per billion parts of air.

Our industrial civilization and our high standard of living is based on the use of energy derived from fossil fuels—oil, coal and natural gas. The consumption of these fuels increases year by year and there is no prospect for a major change in this trend any time soon. It is apparent therefore that control of much of our air pollution will be concerned with effluents from these fuels burned to produce power to heat or to provide transportation.

In the last decade the electric power industry, which burns a great deal of fuel, has spent close to a billion dollars on pollution abatement. Most electric utilities are installing new control equipment and introducing new production methods. Attempts are also being made to reduce effluent production through the use of fuel additives and selectively





purchased fuels of low sulphur content.

The petroleum industry, with which my company is closely allied, supplies fuels for everything from power plants to automobiles. It will spend 160 million dollars during 1968 alone on air conservation programs. The petroleum industry is giving high priority to sulphur oxides control in its research efforts. A recent survey showed that last year nearly 8 million of the petroleum industry's research and development dollars went into sulphur oxides research. New Technology has made it possible to materially reduce the sulphur content of heavy residual fuels. Some oil companies are currently constructing new and advanced refining facilities, both domestically and overseas, that will apply the new technology and place more low-sulphur fuels on the market in the near future.

The largest use of fossil fuels in this country is in automobiles. In terms of total quantity of pollutants, it is generally accepted that the automobile is a major contributor. Consequently, both the automobile and petroleum industries have extensive programs under way to reduce air contamination by automobiles. Recognizing that the growth of their respective industries will depend upon control of vehicle emissions, they have accepted the solution to this problem as one of their major responsibilities. They have developed joint programs and are combining their technical capabilities.

One major research program is jointly sponsored by HEW, the American Petroleum Institute and the Automobile Manufacturers Association. This multimillion dollar study is exploring the engineering aspects of vehicle emissions, studying subsequent atmospheric reactions, and seeking to determine the effects of emissions on health. A second such program is the Inter Industry Emission Control Program run by an international association of eleven automobile and oil companies, and a third is the joint effort of Standard Oil Company (New Jersey) and Chrysler. These latter programs are aimed at developing an essentially emission-free automobile.

Both government and industry have been working effectively to reduce automobile emissions for a number of years. Substantial progress has been made already. New model cars give off only one-third as much hydrocarbons and carbon monoxide as cars built six years ago as a result



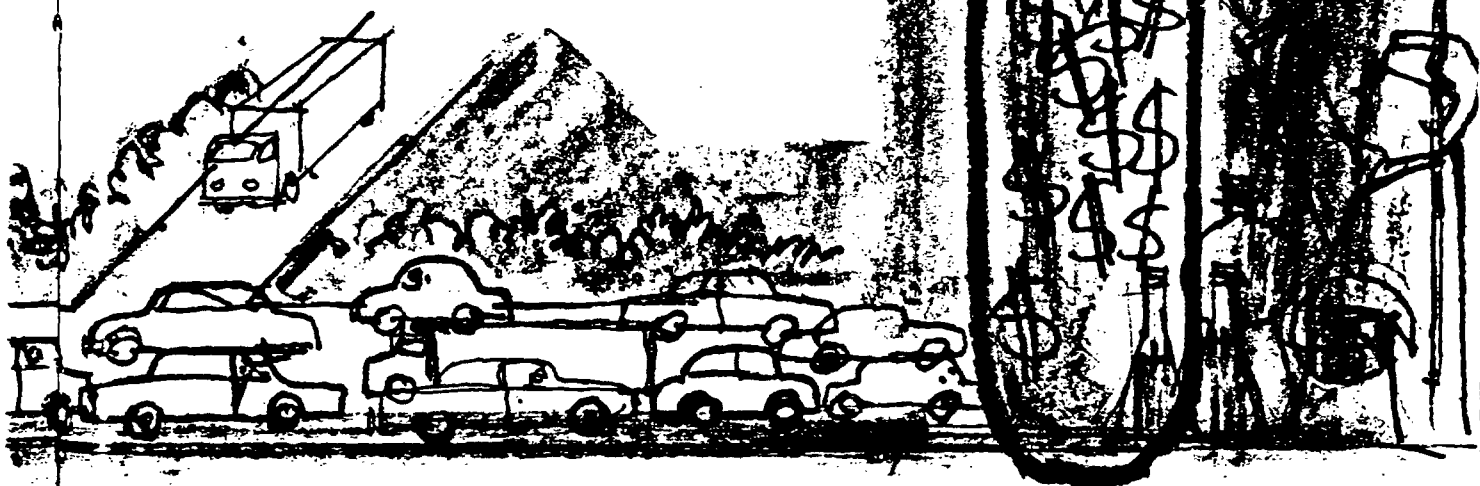
of control systems developed up to this time by the automotive industry. The automotive and petroleum companies also continue extensive experimental work to control the third major automotive pollutant—nitrogen oxides—as well as to reduce further hydrocarbons and carbon monoxide.

A more specific example of the involvement of the business community is this effort that has to do with my own company—Ethyl Corporation. As a producer of motor fuel additives, and more particularly lead antiknock compounds, Ethyl has had extensive research underway for years, looking for ways of reducing automobile emissions. Ethyl's concern in this area is two-fold. Questions have been raised as to the role of lead as a contributor to air pollution and a danger to public health. Also, as a supplier to the petroleum industry, our interest is served by assistance in all efforts to reduce emissions from gasoline-powered vehicles.

Much work has already been done on lead in air, and the results are reassuring. A cooperative program carried out five years ago, and now known as the "Three Cities Survey," has indicated that in three urban areas there is no present health hazard due to lead in air. This extensive study was a relatively early example of the type of government-industry-university cooperation which is becoming common in this field. The participants were the Public Health Service, the State of California, the American Petroleum Institute, and the major antiknock producers, assisted by such university-connected groups as the Kettering Laboratory of the University of Cincinnati. Now, to be sure that the results are still valid, a new survey to cover six urban areas is underway, and it will soon be possible to determine whether in five years there have been significant changes in lead levels in air or people as a result of present patterns of lead use. This carefully designed work will determine whether there is now a problem, and it will provide a basis for developing action to correct it if a problem exists.

Meanwhile, we and other antiknock producers continue active work to develop filtering or trapping devices which will reduce or eliminate lead and other particulates from automobile exhausts in the event that they are needed in the future.

My company has also been concerned with automotive emissions other than lead. Ethyl developed a catalytic



muffler system in the 1960's that met the performance requirements then specified by California. Since that time, our work has been concentrated mainly on engine modifications as a more practical approach to lower emissions.

In close communication with the automotive industry, we have developed engine modifications which significantly reduce emissions. We are now operating, on an experimental basis, automobiles which, after many miles of operation, are emitting hydrocarbons and carbon monoxide well below the 1970 Federal standards, and which also show marked reductions in nitrogen oxides below levels from current cars. These demonstration vehicles do not require excessive maintenance, and their drivability is good.

We know that low-emitting cars of similar performance have been developed by the current programs of others in the automotive and petroleum industries. Concept cars, designed to move toward virtually eliminating these three pollutants, have been built and are being tested. In fact, it is quite clear on the basis of work to date that the internal combustion engine can be made practically non-polluting if this is required to meet the air quality needs of our urban centers in coming years.

This is a remarkable example of what can be done by the unified research efforts of major industry groups when the needs of the future are defined by the government agencies concerned with our environment. The enlightened self interest of industry is obviously served by trying to meet the atmospheric needs of the future by whatever means are most effective and practical. To demonstrate our belief in cooperative research in this field, we in Ethyl will continue to make our developments on improved automobile engines freely available to others working in this field. We hope that such an exchange of knowledge will result in quicker answers.

To solve current environmental problems and prevent the occurrence of new ones, the Air Quality Act points the way to mechanisms for doing three important things: First, establishing promptly standards based on the best information available, to be applied until better and more permanent ones can be derived; second, stimulating research and development in the field of air quality to add to the

meager technical resources upon which we must now sometimes depend; and third, developing sound, longer-range standards based on research programs designed to meet the air quality needs of the more distant future.

It has been suggested that along with the already extensive boards and committees designed to aid the Air Quality program, one additional committee might be considered. This would be an extra-governmental group of representatives from professional associations and societies to act as a board for review of air quality standards after they have been tentatively established by the public authorities. Since it will be necessary in the beginning to apply the best judgment to imperfect and incomplete information, such a group should be useful in speeding up the adoption of standards where questions of judgment must be dealt with. This type of procedure has proved effective in defining standards for protection from ionizing radiation. Further consideration will no doubt be given to this suggestion by the congressional and executive monitors of the Air Quality Act.

If emphasis can be maintained on facts as a basis for action and research as the key to future progress, industry cooperation will be encouraged and compliance will be accelerated. We have learned the advantages of cooperative programs with each other in industry and with the government, and future programs should be more efficient than current ones. We have found that government participation in many of our programs can add to the completeness of the results and to the effectiveness of planning and execution.

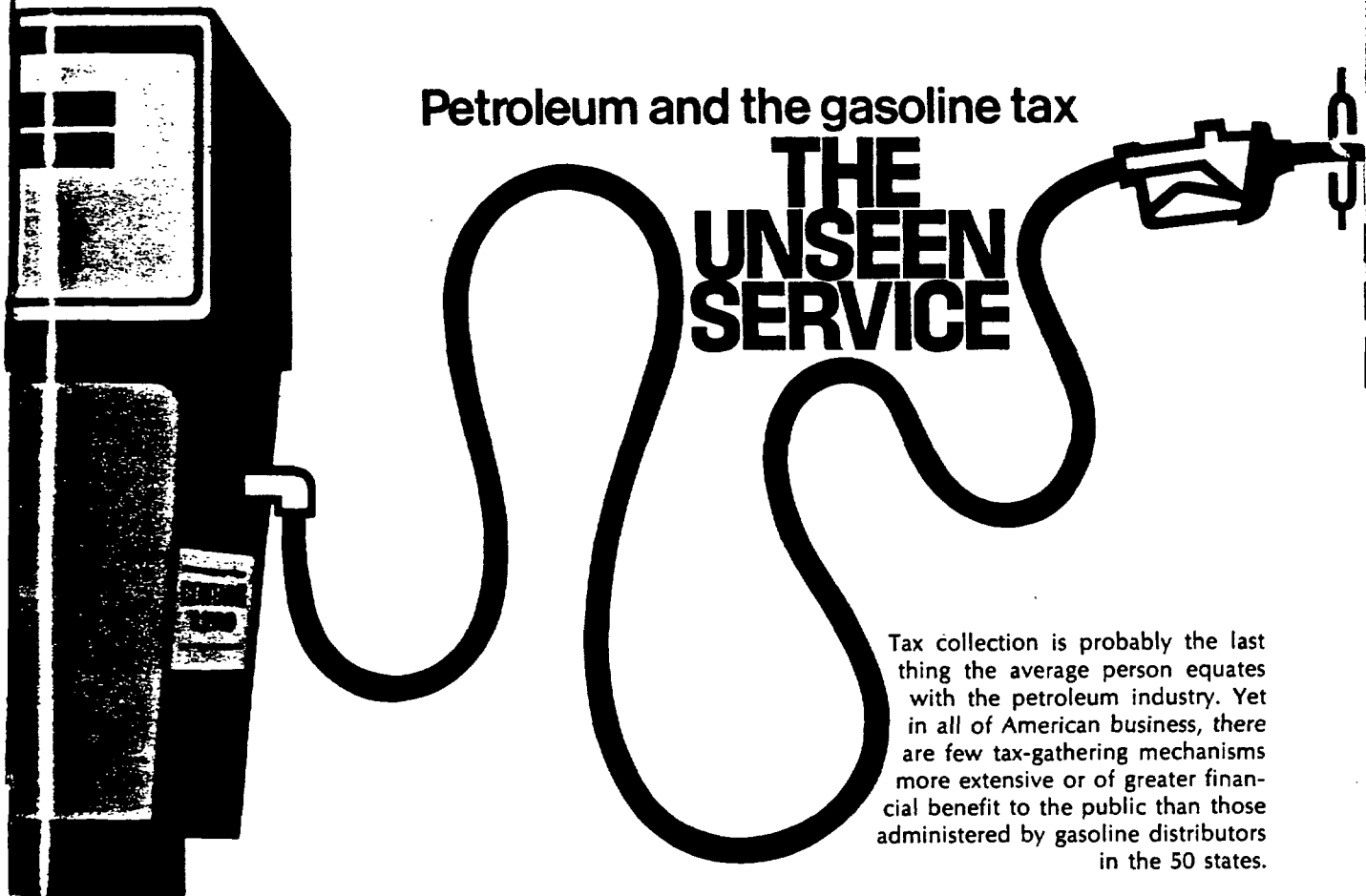
It is well that we have learned to work together because the campaign for clean air will not be a short one. It will be with us as long as we have an industrial civilization with an increasing population and a rising standard of living. But we are beginning to see that the outcome can be favorable at a cost which we can afford. ■

## *The Clean air Commitment*



Petroleum and the gasoline tax

# THE UNSEEN SERVICE



Tax collection is probably the last thing the average person equates with the petroleum industry. Yet in all of American business, there are few tax-gathering mechanisms more extensive or of greater financial benefit to the public than those administered by gasoline distributors in the 50 states.

Providing what might well be termed an "unseen service" to the public, these distributors each year save state governments many millions of dollars by directly collecting the taxes which motorists pay on gasoline. An insight into the magnitude of this operation can be obtained by considering that the nation's daily gasoline tax bill approaches \$22 million. To collect these vital revenues as quickly and efficiently as the petroleum industry, the states would have to hire thousands of new employees—and, of course, increase budget appropriations.

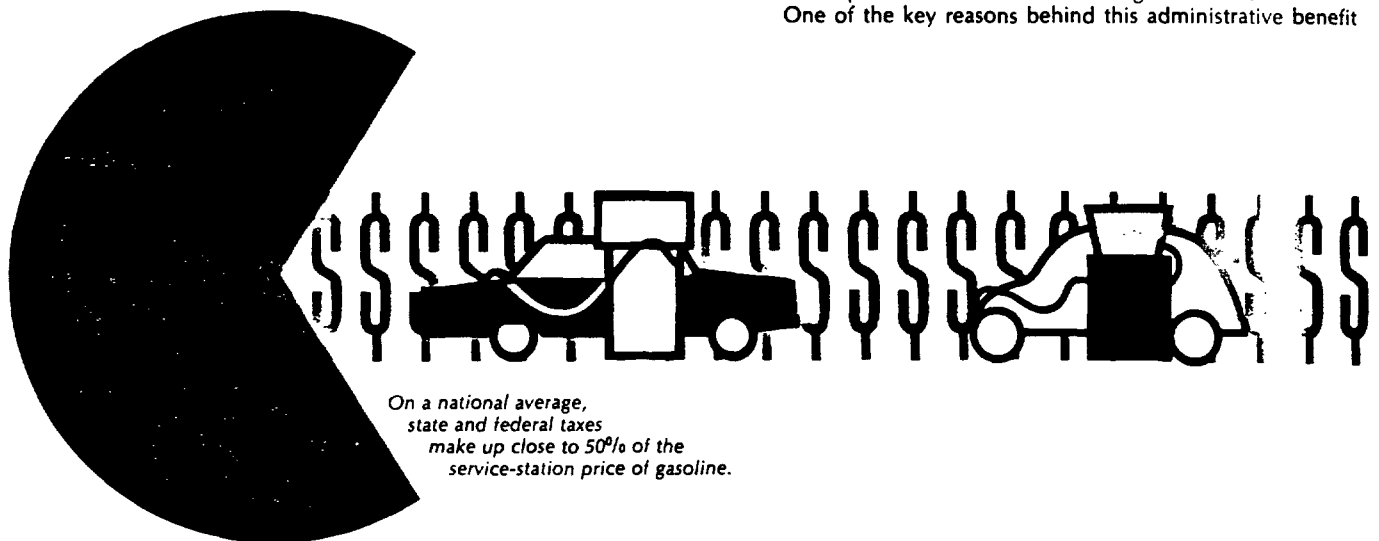
Gasoline taxes (federal and state) are essentially consumer taxes. But because the levies are "hidden" in the overall

the states, fuel tax revenues account for a major portion of roadway expenditures.

Abundant though this source of money is, there is another aspect of the gasoline tax program that is every bit as significant, as far as the states are concerned: namely, its impressive cost efficiency.

In a detailed study of consumer tax programs in a 13-state region, a recent survey discovered that the average cost to the states of collecting motor vehicle taxes was 10.5% of the funds derived. The expense figure for alcoholic beverages, it found, was 5.5%. On the other hand, the gasoline tax required an expenditure of only 1/2 of 1%, projecting it into a position as one of the most inexpensive revenue producers available to state governments.

One of the key reasons behind this administrative benefit



price of gasoline, few consumers ever realize that the tax is being paid. The irrefutable facts are, however, that on a national average, state and federal taxes constitute close to 50% of the service-station price of motor fuel.

According to the most recent statistics, there are on America's highways today approximately 100 million vehicles—buses and trucks as well as cars—consuming nearly 80 billion gallons of taxable gasoline a year. In 1967, these sales yielded about \$8 billion in state and federal tax revenues, a sum greater than the total tax receipts collected by the federal government for any year up to 1942.

Furthermore, state and national budget officials are in almost unanimous agreement that the funds brought in by motor fuel taxes are crucial, particularly as a means of financing highway projects. The 4-cent per gallon federal gasoline tax, for instance, has provided more than 75% of the money spent by the national government on the national highway program of interstate and "ABC" highways. And in

has been pointed up by Dr. Finla G. Crawford of Syracuse University, an acknowledged expert in the field of gasoline taxes. The low cost of collection is attributable, Dr. Crawford observed, to the fact that "the relatively few distributors have acted as tax collectors for the state and have assumed the responsibility of turning over to the state the taxes actually paid by the innumerable consumers."

The state gasoline tax had its inception in Oregon in 1919. Under that pioneer program, state officials did the collecting themselves. However, they rapidly discovered that such a system, involving as it did direct contact with every local gasoline dealer, was both cumbersome and impractical. The number of service stations was multiplying almost weekly, making the establishment of an orderly tax-gathering system next to impossible.

Searching for a solution that would permit the state to retain this new and lucrative source of revenue, Oregon instituted an innovative tax law which authorized licensed gasoline distributors to collect the duties for it. So well did the system work that other states soon followed Oregon's

lead. In one form or another, the procedure is now in use throughout the country.

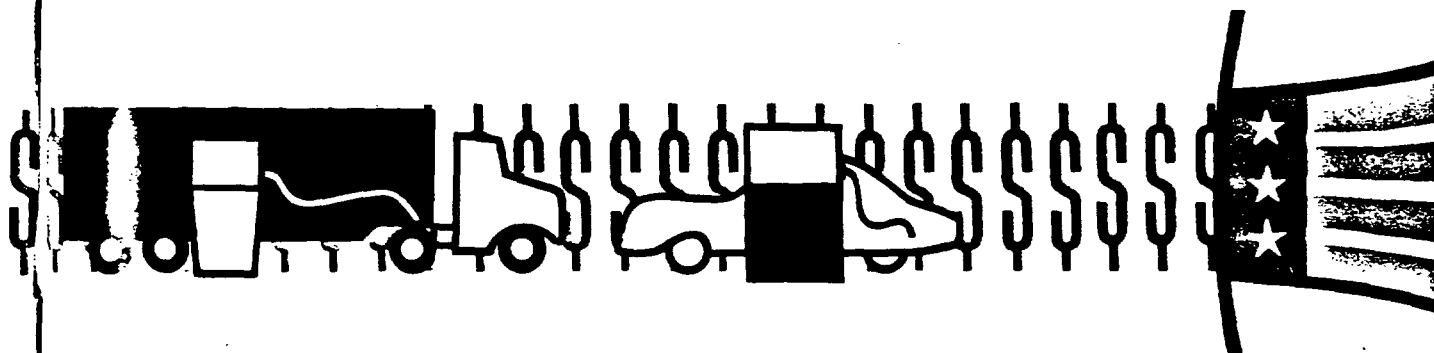
Gasoline distributors function, in effect, as unpaid agents of the states, performing the enormous task of collecting the duties paid on gasoline at every local service area throughout the states. This serves to centralize—and greatly simplify—the job of state tax collectors, who need to deal with only a relatively few people. It also translates into a formidable savings for state governments because only a comparatively small administrative staff is required to oversee the tax program.

For distributors, however, the story is much more complicated. The sheer size of the collection task makes a separate gasoline tax department imperative. And this involves not only the cost of salaries and benefits for these numerous employees, but also the expense of office facilities and equipment.

licensing requirements. The distributor is thus faced with the perplexing task of not only satisfying the many regulations, but adjusting to variations among states.

Moreover, under one type of collection system—the “receipt” method—the distributor is subjected to a double financial risk. Here the distributor is required to pay the gasoline tax, *in advance of sale*, on all of the fuel either shipped to him or refined within the particular state. What this means is that the distributor does not recover the funds he has paid out in taxes until the gasoline is actually sold. But because of evaporation, he will have less fuel for delivery to service stations than the amount for which he was taxed. So the distributor incurs a double loss: the fuel itself, and the tax dollars it represented. Of course, if one of the dealerships fails the chances are that the distributor will never entirely recover his original investment in taxes.

To at least partially compensate distributors for the sub-



Nor is this the full extent of the industry's involvement. Often, employees in the credit, operating and transport departments are drawn away from their normal assignments to deal with gasoline tax matters, and even tank truck drivers must spend some time doing paperwork on taxes. Indeed, almost every phase of a distributor's operations is touched at one point or another by tax-related activities.

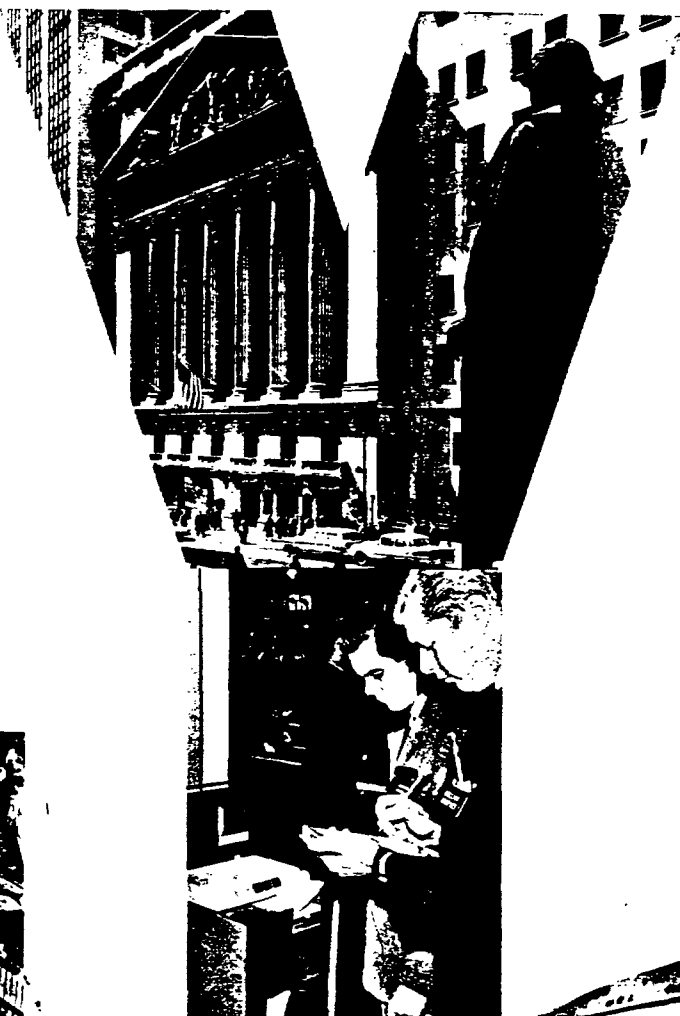
Every state demands that gasoline distributors post a bond guaranteeing that they will transfer all of the taxes paid on the fuel they sell. The distributor who finds this bond beyond his means must, under the law, post a surety bond based upon prompt filing of reports and payment of the fuel tax. It is not unusual for premium payments on surety bonds to run in excess of \$200 a year.

The absence of uniformity in the laws governing gasoline tax collection is another problem area for the distributor. Some states exact a duty on sales while others tax receipts. And some even give the distributor the option of choosing whichever method he prefers. Aviation fuel is taxed only in certain states, and there are differing legal provisions covering exemptions, refund procedures and bonding and

stantial costs involved in gathering and transferring gasoline taxes, 42 states and the District of Columbia currently provide the petroleum industry with some kind of monetary allowance. As a rule, it amounts to a specific percentage of the tax revenues collected. But while the motor fuel distributor's expenses far exceed those of any other non-government tax collector, the size of his allowance is comparatively the smallest in existence.

There is absolutely no remuneration for fuel distributors in eight states, and only 16 others grant allowances covering both collection costs and gallonage losses. Of the remaining states, 18 and the District of Columbia give an allowance for gallonage losses only and eight allow exclusively for collection costs.

Although the petroleum industry's work as a tax agent may, indeed, seem to be an “unseen service” to the average person, its vital importance has been publicly acknowledged by scores of state officials throughout the nation. One director of a motor fuel tax division noted that information provided by bonded petroleum distributors had enhanced the efficiency of his operations. And he added that the allowance provided to distributors for tax collection activities is “the best money the state ever spent.” ■



# FROM BUTTONWOOD TO "BIG BOARD"

## THE STORY OF THE NEW YORK STOCK EXCHANGE

To bring order and stability out of the economic chaos created by the Revolutionary War, Treasury Secretary Alexander Hamilton decided soon after taking office in 1789 to consolidate America's war debts into an \$80 million bond issue.

Meeting in a small legislative hall on Wall Street in New York City, which was then the nation's capitol, the First U. S. Congress approved the plan and the bonds went on sale in 1790-1791. But the number of buyers was few. This reticence was due in large part to a feeling, then generally prevalent, that the lack of a central marketplace for securities made investment in stocks and bonds too risky.

If this problem was apparent to the average person, it was especially clear to the men who traded in securities, and on May 17, 1792 twenty-four of these businessmen gathered to resolve the situation. Entering into what became known as the "Buttonwood Agreement," these merchants and auctioneers pledged to meet daily beneath the buttonwood tree in Wall Street to deal with each other in stock and bonds. With this accord they gave definite institutional form and substance to the concept of a central securities marketplace. Today, that institution—more vibrant than ever at age 177—is the New York Stock Exchange, the "Big Board" of Wall Street parlance.

If they could somehow see their institution today, the "founding fathers" of the Stock Exchange would be as astounded by its size and scope of activity as Washington and Jefferson would be to gaze upon modern industrial America.

From that modest beginning under the buttonwood tree, the Exchange has grown into an organization of international reach and significance. More than half a million miles of telephone and telegraph wires connect the trading floor with 4,300 offices of member firms in all of the 50 states and abroad. The membership roster has grown apace, increasing from the original 24 founders to a current total of 1,366. The Exchange itself employs 3,700 people, 700 of whom actually work on the trading floor. With 18 trading posts situated over an area two-thirds the size of a football field, the Stock Exchange trading floor, square foot for square foot, is one of the busiest points in the nation.

During an average day's trading, approximately 110,000 buy or sell orders worth about \$600 million come into the

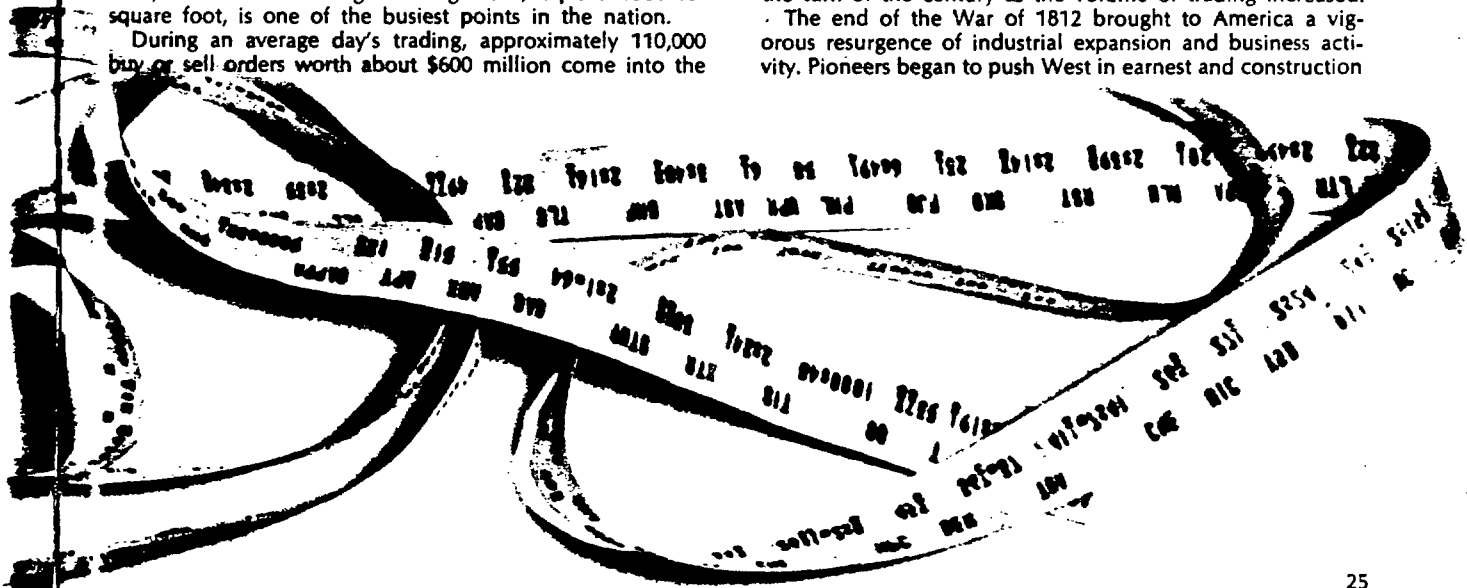
Exchange for execution. Indeed, the value of a single hour's trading on the Big Board often exceeds the \$80 million which Alexander Hamilton sought in his bond issue. But the real measure of how far the Exchange has come is found in its daily and annual volumes of trading. Average daily volume, as of February 1969, was 11.9 million shares. Total volume in 1968 was 3.3 billion shares worth over \$145 billion.

When they first gathered for trading, the buttonwood associates dealt in only a handful of securities. Besides the new bond issue there were shares in a few insurance companies, the Bank of North America, the Bank of New York and the First United States Bank, which was another of Hamilton's projects. In contrast, there are today more than 13.5 billion shares eligible to be traded on the Exchange. These shares are issued by the NYSE's 1,275 listed companies. Although numerically they represent only a fraction of America's corporate population, the companies of the Big Board nevertheless account for a major portion of the country's industrial and financial might. For example, they produce 99.9% of the nation's passenger cars, 98% of its aluminum and 93% of its petroleum and steel. On a slightly lesser note, they manufacture 1/3 of our shoes, 1/2 of our coal and 1/4 of our beer. Employing 20% of the American work force and accounting for 40% of all sales and revenues, this select group of enterprises has an annual aggregate tax bill surpassing \$15 billion.

Ethyl Corporation joined the Exchange's family of listed companies on October 14, 1965 when the first round-lot sale of its common stock moved across the tickers under the symbol "EY." There are more than 10 million shares of Ethyl stock outstanding.

As a center of trading activity, the storied buttonwood tree retained its prominence for only a few months. In 1793 the Tontine Coffee House was completed at the northwest corner of Wall and William Streets and the brokers moved indoors. They relocated to a larger meeting room at 40 Wall St., across from Alexander Hamilton's home, shortly after the turn of the century as the volume of trading increased.

The end of the War of 1812 brought to America a vigorous resurgence of industrial expansion and business activity. Pioneers began to push West in earnest and construction



began on some of the great canal systems. At the same time, securities trading became an integral part of America's financial structure, indicating to the brokers that their activities would have to be structured more formally. Thus, on March 8, 1817, the buttonwood associates adopted the Exchange's first formal constitution. Among other things, the document provided for a president and secretary, set fines for those who broke rules, instituted a system for admitting new members and set forth some key trading procedures. It also gave the association a new name, the New York Stock and Exchange Board, an identity that survived until 1863, when it was shortened to its present form.

An outbreak of Yellow Fever in 1819 forced the Exchange to abandon the Lower Manhattan area for the first and only time in its history, the brokers taking up trading in Washington Hall at Broadway and Reade Street. They soon returned to the incipient financial district, however, and met at more than a dozen different locations in the decades leading up to the Civil War.

Meanwhile, economic growth in America had solidly taken root and was gaining momentum, spurred on in no small way in the 1840's and 1850's by territorial expansion under "Manifest Destiny." This quickening pace of industrialization was reflected in the Stock Exchange. By 1827 the Exchange's listings included 12 banks, 19 marine and insurance companies, the New York Gas Light Company, the Merchants' Exchange and the Delaware & Hudson Canal Co. In the 1830's the Mohawk & Hudson Railroad, later a part of the New York Central system, became the Exchange's first railroad listing. Before the decade ended, nine other railroad stocks were being traded, and the average daily trading volume was well over 6,000 shares.

The years of searching for a permanent home ended for the Big Board in 1863 when it settled on a part of its present location at Wall and Broad Streets. The Broad Street Building now in use was erected in 1903 and contains most of today's trading floor. The adjoining office building at 11 Wall Street was built in 1922. A new building at 20 Broad Street houses the bond trading room and the public Exhibit Hall of industry and investment.

With the problem of its headquarters settled at last, the Exchange membership turned increasingly in the post-Civil

War era to the questions of operating efficiency and self-regulation. The first tickers were introduced in 1867. A year later memberships became purchasable, and in 1878 the first telephones were installed. Major progress in voluntary regulation was made in 1869 when the Exchange strengthened its listing standards and established a stock list committee.

Still another significant reform was enacted in 1871 when the Exchange abandoned its traditional "call system" for what became known as "continuous trading." The constitution of 1817 had provided that each issue would be called out individually, at which time brokers could make bids and offers. But the tremendous increase in the number of securities being traded made this system inadequate and obsolete, so the Exchange reverted to a continuous market, which allowed brokers to trade in any issue at any time during the regular trading session.

An interesting corollary of this action was that it also did away with the institution of the Exchange "seat." In the days of the call system each member actually was assigned a seat from which he did his trading. With the advent of the continuous market, however, this was no longer practicable and the seats, as such, were eliminated. But the term survived and members of the Big Board are still said to own a "seat" on the Exchange. The price of a "seat"—or membership—fluctuates, much as do the prices of securities traded on the Exchange floor. The going value right now is about \$400,000. In 1929 a "seat" was sold for \$625,000, but it included a quarter "right" to a new seat.

American industry and commerce made a major thrust forward in the 1880's and 1890's as the modern corporation came into being. In 1886 the Stock Exchange registered its first million-share trading session; and in 1892, as the Big Board celebrated its 100th anniversary, the daily average trading volume exceeded 500,000 shares.

Further strengthening its stringent set of standards, the Exchange decided in 1910 to discontinue trading in unlisted stocks. In effect, this meant that all companies whose securities were traded on the Exchange would have to comply with Exchange regulations. In 1915, the basis of quoting and trading in stocks was changed from percent of par value to dollars.



The 17th Century Dutch wall from which Wall Street derives its name.



Founders of the Exchange trading beneath the buttonwood tree.

The Exchange experienced its most crucial test in 1929. On October 29, prices fell sharply as more than 16 million shares were traded, an all-time record. The upheaval—part of a worldwide economic depression—helped pave the way for passage by Congress of the Securities Acts of 1933 and 1934, which brought tighter control over the securities industry.

And in 1938 the Big Board undertook sweeping organizational reforms of its own. A key element in that historic program was the creation of a full-time paid presidency for the Exchange. William McChesney Martin, Jr., now chairman of the Federal Reserve Board, was the first man to hold the important new post. He served from 1938 until 1941, when Emil Schram was appointed to the position. G. Keith Funston became president in 1951, and was succeeded in January of 1968 by Robert W. Haack.

Although the Stock Exchange grew at an impressive rate during the first 150 years of its existence, its growth over the past quarter century or so—and particularly over the last 15 years—has been unprecedented. The number of total yearly transactions on the trading floor has climbed from 142,937 in 1945 to more than 1.3 million in 1967. The average daily volume in shares at the close of World War II was 1.4 million. Today it is over 11 million.

As the nation's largest organized securities market, the New York Stock Exchange holds a place of eminence in the American economic and financial structure. It provides, as the buttonwood associates intended it should, a central marketplace where ownership in the nation's leading companies can be easily bought and sold. This is a vitally important function in a free-enterprise system such as ours, where every person has the right to own a share in the means of production.

Most people have a fairly accurate notion of what the Stock Exchange is for. But few really understand what it is.

The Exchange is not a company; nor is it structured to be a profit-making organization. Very simply, it is an unincorporated association of brokers in securities who provide, through facilities such as the Big Board's trading floor, a central means by which people may buy and sell stocks and bonds conveniently. None of the securities listed on the Exchange are bought or sold—or owned—by the Exchange

itself. Neither does the Exchange set prices of securities. Price levels are determined by the individual decisions of millions of investors throughout America and the world.

The cost of operating the Exchange, including salaries and wages, is about \$40 million a year. The revenue to pay for this comes from fees paid by listed companies, members' dues and various service charges. In 1967, for instance, the Exchange received \$2 million in dues, \$9.6 million from listed firms, \$15.1 million in service charges and about \$15.7 million from charges on commissions received by members for transactions completed on the trading floor.

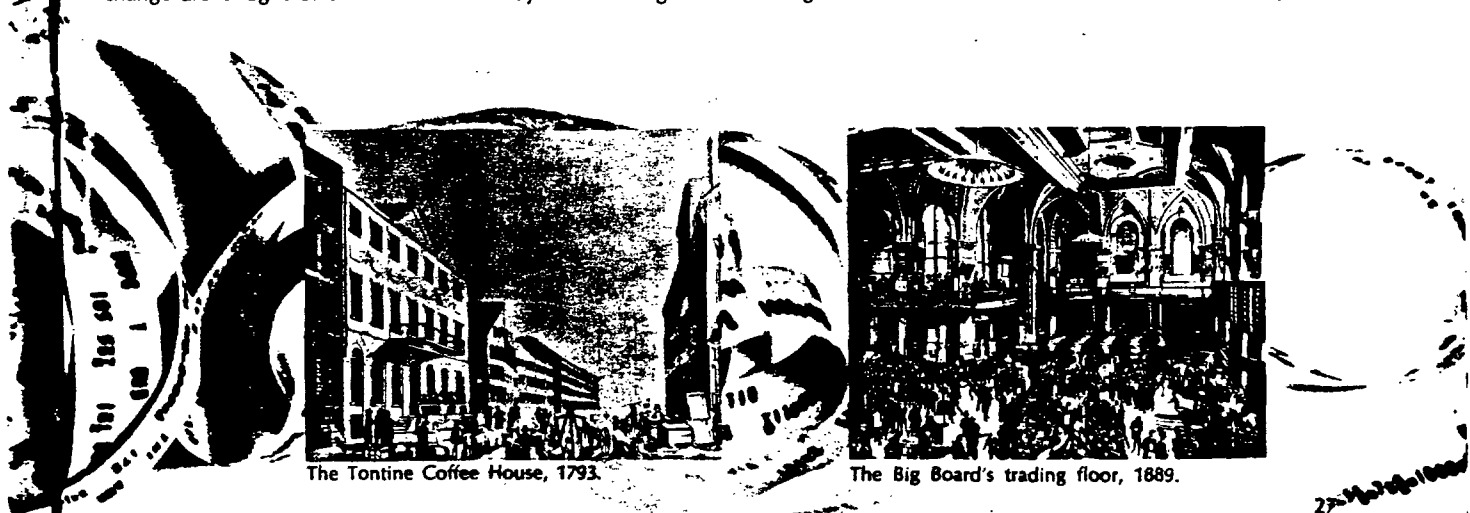
Full memberships in the Exchange currently are held by 1,366 individuals, each of whom, as we have seen, owns an Exchange "seat." To be a member, one must be a general partner or holder of voting stock in a brokerage concern. Members are entitled to deal in securities on the trading floor, and their concerns become known as member firms or member corporations. Right now there are 647 of these concerns—462 partnerships and 185 corporations. From 1792 until 1953, corporations were excluded from membership. But then the Exchange broadened its constitution to include them—provided the corporation is engaged principally in the securities business as a dealer or broker. There are member organization offices in 977 U.S. cities, Puerto Rico, the Virgin Islands and in 58 cities overseas.

In addition to its regular members the Exchange also has allied members. These are the 3,200 partners of member firms and the 2,365 holders of voting stock in member corporations. Allied members may not do business on the trading floor, but they are subject to all of the Exchange's stringent regulations.

The Board of Governors of the Stock Exchange is the body which determines the rules and regulations governing the conduct of members and allied members. Within its purview are broad policymaking and disciplinary powers.

The board's chairman is elected annually and must be a member of the Exchange. The president of the Exchange is appointed by the board and is also a member of it; however, he can be neither a member of the Big Board nor a partner or stockholder in one of the member organizations.

Reflecting the genuinely national character of the Stock Exchange is the fact that the Board of Governors is composed



The Tontine Coffee House, 1793.

The Big Board's trading floor, 1889.

of members and allied members from every region of the country. In addition, three members represent the general public and have no direct connection with the securities business. They give the board greater balance and bring to its deliberations a broad outside viewpoint.

Implementation of the board's policies, and actual operation of the Exchange itself, are in the hands of the administrative staff, headed by the President. The Department of Stock List examines applications for listing before final consideration by the Governors. Overseeing the regulations which bear upon the conduct and financial condition of member concerns is the Department of Member Firms. The Floor Department deals with matters regulating trading on the Exchange floor, and Public Relations and Investor Services interprets the Big Board's functions to the public. Another branch of the administration is the Office of the Secretary, which processes applications for membership and allied membership and administers arbitration facilities.

The Exchange also has subsidiary companies for dealing with such matters as its real estate property and expediting the receipt and delivery of securities following transactions on the trading floor. One major subsidiary is the Electronic Systems Center, which coordinates all of the Exchange's elaborate computer operations. In 1965 the Big Board's "900" ticker system—it has a capacity of 900 characters per minute—was linked to the computer operation, thus giving investors the most advanced special-purpose communications network in the world. This system was further enhanced in 1966 with the installation of optical "card readers" at all 18 trading posts on the floor. Superseding voice and pneumatic-tube communication, the "card readers" pass information about stock transactions directly to the computer center, reducing from minutes to mere seconds the time it takes to put a sale or purchase on the tickers. In this way a member concern office as far away as San Francisco, or even Hong Kong, may learn that one of its orders has been executed almost instantly after it takes place at Wall Street.

So that investors could have a comprehensive measurement of general market price movements, the Big Board established in 1966 the NYSE Common Stock Index. The Index provides averages on a daily, hourly and per-minute basis.

Also widely used as a measurement of Stock Exchange trading is the Dow-Jones industrial average of 30 common stocks, which is the best known index of the trend of stock prices.

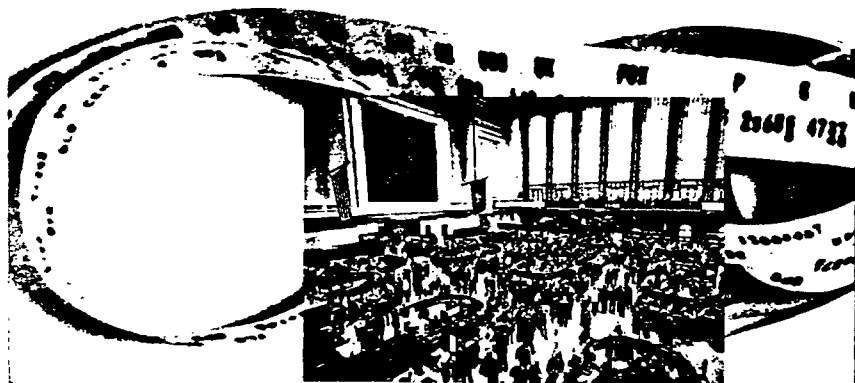
How does a company become listed on the Big Board? And what are the benefits of being listed?

Any company which believes itself to be of sufficient size and national stature may apply for listing. The application is reviewed first by the Stock List Department, which conducts an extensive study into the firm based upon certain strict criteria. If this test is met successfully, the application is forwarded to the Board of Governors for final action. A firm accepted for listing is assigned to one of the Exchange's trading posts, where all buy and sell orders in its shares will be transacted. At the same time, one of the "specialists" on the trading floor is designated to execute orders in the issue, and the new firm is given a stock symbol—such as Ethyl's "EY."

The Exchange, however, is highly selective about who may be listed on the Big Board, as is indicated by the fact that of 1.4 million firms filing reports with the Treasury Department, only 1,275 are listed. In deciding about a particular concern, the Exchange takes many factors into consideration, chiefly the degree of national interest in the firm and its size in terms of assets and demonstrated earning power. As a rule, for example, a prospective listed firm should have earnings after taxes of at least \$2.5 million and a minimum of one million shares of common stock held by not fewer than 200 stockholders. All listed companies must comply thoroughly with the Exchange's rules and regulations.

In light of the impressive array of national and international firms whose shares are traded on the Exchange, there is obvious prestige value in being among the listed companies. But apart from this, there are five other basic reasons why companies want to be listed: to broaden and diversify the ownership of their stock, to project the company identity on a national scale, to facilitate expansion of overseas operations, to lower the cost of raising new capital and, finally, to provide shareholders with the best possible market for their securities.

To the masses of Americans, there is no more familiar aspect of the New York Stock Exchange than its trading floor.



The trading floor today.



Brokers gathering around a specialist near one of Exchange's 18 trading posts.

Yet what takes place there is, to many investors, more a mystery than anything else; it seems, really, to be a panorama of purposeless motion.

Actually, quite the opposite is the case, for each one of the approximately 2,400 persons on the trading floor has a very explicit role to play. About 600 of the "actors" in this spectacle are reporters and pages, all employees of the Exchange. In addition, there are about 900 clerks, employees of member concerns who work at the 18 trading posts as aides to the brokers on the floor. And lastly there are approximately 800 to 900 Exchange members actually buying and selling stocks. The Big Board's trading floor is open from 10 a.m. to 2 p.m. each weekday.

Of all the brokers doing business on the floor, about one quarter are "specialists," so-called because they specialize in certain issues assigned to them by the Exchange. The specialist stays at one post and his function is to give the market stability and continuity by keeping it "liquid." Essentially, the specialist performs his task in two major ways: he holds for eventual execution orders left with him by brokers, and he strives to maintain a fair and orderly market in the shares assigned to him. To do this, he will purchase stock at a higher price than anyone is willing to pay or by selling stock at a lower price than anyone else is willing to take.

The specialist system began in 1875 when a broker, restricted in his activities by a broken leg, decided to stay at one spot and trade in only one issue. This proved so efficient and popular with brokers on the floor that it was made permanent. Since then, every issue has been assigned to a specialist and he will execute most—though not all—buy or sell orders in the issues under his jurisdiction. Every specialist handles several issues, and he is forbidden from buying or selling for his own account until all orders left with him by other brokers have been executed.

There is no additional charge to the public for the services of the specialist because his fees are paid by the brokers out of their commissions (about 1% of the market value of stocks and  $\frac{1}{4}$  of 1% on bonds). It should be said, as well, that the specialist is not an Exchange employee. He is a member of the Big Board and is an employee of one of its member organizations.

However, since he is charged with the critical task of "making the market" in his assigned issues, the specialist's activities are closely regulated by the Exchange. He is required to maintain an overnight position of 2000 shares for each 100-share unit of his assigned stocks. What's more, he must give to the Exchange eight times a year a detailed outline of his dealings for one-week periods. The Exchange calls for these reports indiscriminately, and without prior notice to the specialist. One principal aim of this regulatory procedure is to make sure the specialist is maintaining proper stability and continuity in his issues.

This, incidentally, the specialists have been doing with unparalleled success. According to a recent study, the Exchange said, 92.3% of specialists' transactions in 1966 had a stabilizing effect on the market. Of all the transactions looked at in that study, 93.7% were unchanged from previous prices or no more than  $\frac{1}{4}$ -point away!

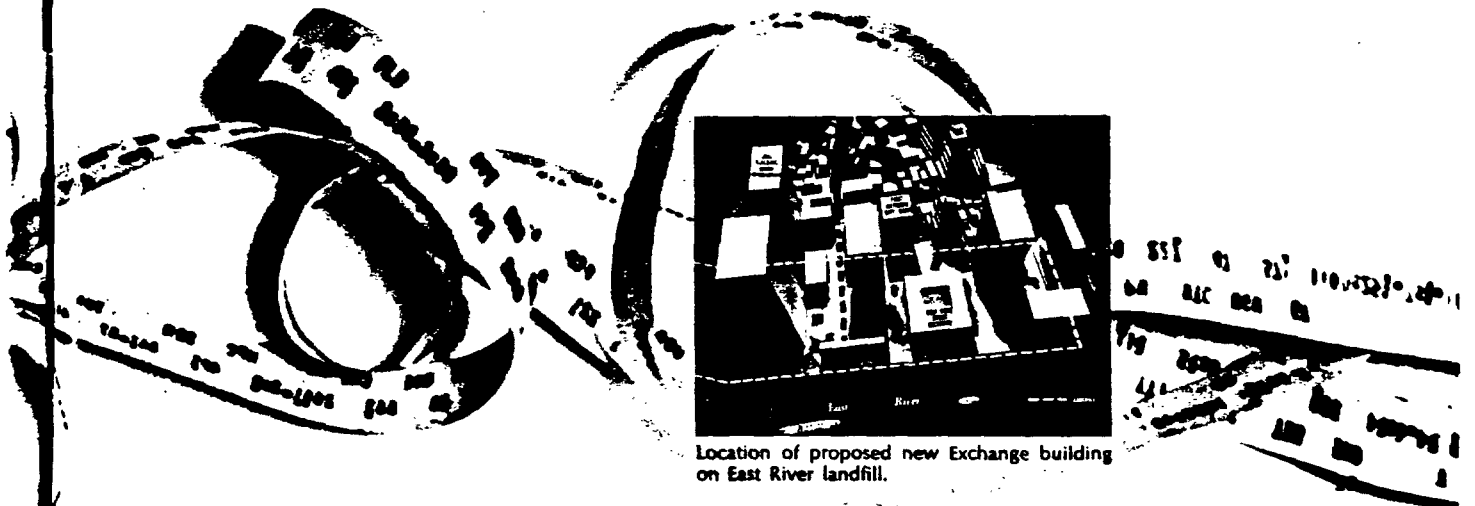
The phenomenal growth of America into the world's foremost industrial state has been reflected, almost step for step, in the development of the New York Stock Exchange. There, in Wall Street, a central marketplace was established for trading in the ownership of American enterprise. As the nation and its economy have expanded, so has the Big Board, and this forward trend will continue in the future.

By 1975, the Exchange estimates that the number of stockholders in the United States will increase from 24 million to about 30 million, and that the daily volume of trading on the Big Board will climb from 11 million to 20 million shares.

In order to accommodate the rapidly-expanding securities industry, the Board of Governors approved a plan last March to move the Exchange to a projected new facility on land-fill in the East River. Mr. Haack, the President, said the building program would have to be completed by 1975 in order for the Big Board to keep functioning properly.

The new Exchange, estimated to cost about \$155 million, will be situated at the extreme eastern end of Wall Street, approximately five blocks from its present historic location. Covering an area of about 150,000 square feet, the new edifice will contain a trading area of some 90,000 square feet—three times the size of the present trading floor!

One wonders what the buttonwood associates of 1792 would think of all this. ■

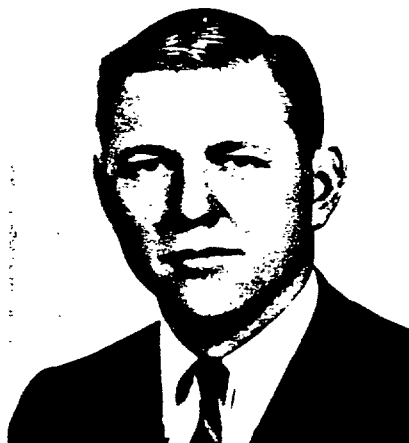


Location of proposed new Exchange building on East River landfill.

# DEVELOPMENTS



Alan C. Tully



Kenneth A. Freberg

## Tully Ends 40-Year Ethyl Career; Freberg To Head Ethyl Canada

Alan C. Tully, president of Ethyl Corporation of Canada Limited, will retire from the Company on July 1 after 40 years of service.

He will be succeeded as president of the Ethyl subsidiary by Kenneth A. Freberg, whose election has been announced by Dr. George F. Kirby, Jr., Ethyl's president.

Mr. Freberg was transferred to Ethyl Canada as vice president and general manager in 1968. He joined the parent company as a sales trainee in 1953, being assigned shortly thereafter as a field representative in the San Francisco office of the Western Region. In 1960, Mr. Freberg was named account representative. He was appointed regional sales manager in Los Angeles in 1965 and Western Regional manager a year later, serving in that position until his move to Ethyl Canada.

A native of Aberdeen, South Dakota, Mr. Freberg holds a BA degree

in economics and business administration from the University of Washington. He is a member of the Canadian Chemical Producers' Association and the American Petroleum Institute.

Mr. Tully began his career with Ethyl Corporation in 1929 and has been president of the Canadian subsidiary since its formation in 1955. Previously, he was engaged in both domestic and overseas sales for the company for some 25 years. During part of this time, he was in charge of Ethyl sales operations in Australia and the Far East.

Born in Levenshulme, England, Mr. Tully holds a BS degree in civil engineering from the Illinois Institute of Technology. He is married to the former Lady Kingsford-Smith of Sydney, Australia, and has two children and three grandchildren. He is a member of the Canadian Chemical Producers' Association, the Society of the Chemical Industry and the American Petroleum Institute.

## Two New Plastics Plants

Indicative of its expanding activities in plastics, Ethyl recently announced plans for the construction of two new plastics manufacturing facilities.

One will be a 115,000 sq. ft. plastic bottle plant in Vandalia, Illinois to be operated by Imco Container Company, an Ethyl subsidiary. The other plant, comprising 60,000 sq. ft., will be located in Richmond, Virginia, and will produce polyvinyl chloride (PVC) film.

The Vandalia facility is scheduled for completion in the third quarter of 1969 and will be Imco's 12th plastic bottle manufacturing plant in the United States. Plans call for the Richmond plant to be completed in the last quarter of this year.

## VOLRAC Unit Available

Ethyl Corporation recently announced the availability of the first commercial, on-line analyzer system for continuous monitoring and/or control of the vapor to liquid (V/L) ratio in gasoline blending operations.

The unit is called the VOLRAC (Vapor Over Liquid Ratio Controller). It is being manufactured by Ethyl's Refinery Systems group and is available initially only in the United States and Canada.

The VOLRAC offers refiners year around flexibility, economy and efficiency in blending light-end components. The analyzer provides the refiner with precise, on-the-spot, continuous analysis for control of front-end volatility. This is done by determining the volume of vapor formed by a unit quantity of gasoline at any selected temperature.

The unit responds quickly to vola-

tility changes with a precision of plus or minus 0.5 V/L. As a result, there is a reduction or elimination in the need for time consuming laboratory V/L tests used for interim or "after-the-fact" blend acceptance.

VOLRAC has been in refinery operation for more than one year and has proved its ability to provide meaningful and reliable information on gasoline front-end volatility. The data show excellent correlations with laboratory analyses and demonstrate effective volatility control through automatic on-line analysis.



G. Samuel Roberts

### Award Goes To Sam Roberts

G. Samuel Roberts, Ethyl's chief engineer, has been given the 1969 Missouri Honor Award for outstanding service as a professional engineer.

The award is sponsored jointly by the University of Missouri's engineering college—Roberts graduated from the school in 1941—and the Missouri

Engineering Society. One of five recipients, Roberts was cited for distinguished service in engineering education and professional engineering practice. He received the award during Engineers' Week observances at the University last March.

### Dr. Kirby Wins Coates Award

Dr. George F. Kirby, Jr., Ethyl's president, is the 1969 recipient of the Charles E. Coates Memorial Award for eminent accomplishments in chemistry and chemical engineering.

Given annually since 1957, the award is sponsored jointly by the Baton Rouge, La. sections of the American Chemical Society and the American Institute of Chemical Engineers. It is named in honor of the late Dr. Charles E. Coates, who was a leading figure in chemistry and chemical engineering.

Dr. Kirby received the award at a joint meeting of the two professional groups in Baton Rouge in May.

### "Silvereid" In Service



The Silvereid shortly after being launched

Like the Company itself, Ethyl's ocean-going tanker fleet is growing.

The latest addition to the line is the 2,300 ton vessel M/V Silvereid, which was placed in service last April.

The first ship to be built specifically for the shipment of antiknock compounds, the Silvereid will supply Ethyl's terminals in Europe and the Canary Islands in addition to servicing the Company's manufacturing plant in Thessaloniki, Greece.

With the new ship at sea, Ethyl's tankers now are three in number. The other two are the M/V Chemical Trader and the M/V EID.

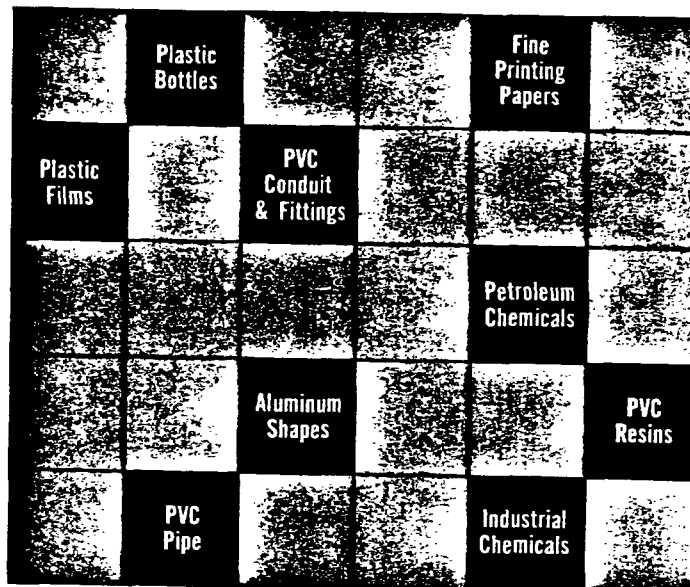
## PRODUCTION NOTES

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# THE ETHYL MATRIX

## A Pattern of Progress



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Corporation

*Changing... to Serve a Changing World*

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**Ethyl**  
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# Ethyl

MAGAZINE

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Ethyl Magazine is published by the Corporate Public Relations Department: Ethyl Corporation, 100 Park Avenue, New York, N. Y. 10017: (212) 679-2000. Bruce C. Gottwald, president; Frederick P. Warne, secretary; Frank J. McNally, treasurer.

**Acting Editor**

Stanton P. Nickerson

**Contributing Writers**

Richard M. Barr; Herman Kahn;

Christopher C. Vogel; Anthony J. Wiener;

Thom Yates

**Assistant**

Stella Sideris

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Cover illustration, EXPLORER. Elements mandatory in successful accomplishment—strength, determination and vigor—are reflected in the features, stance and weaponry of this Spanish conquistador interpreted in stained glass. Photographed by Irving J. Olson, the window represents the discovery of Monterey Bay, California, by Sebastian Viscaïno during his voyage of 1602-03. The stalwart figure has a broader and stronger meaning for observers alert to its symbolism: that in any era, achieving worthwhile objectives is inseparable from the preparedness, adventuresome spirit, vision, perseverance and related characteristics of pioneering explorers. See page 26.

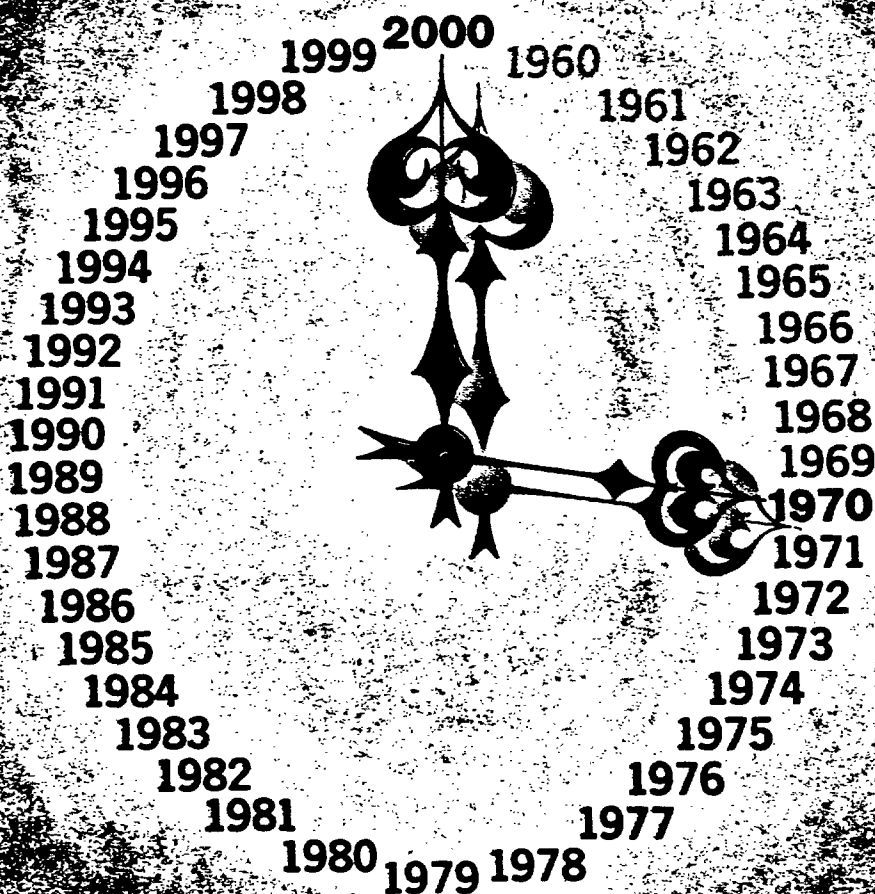
**MEETING THE CHALLENGES  
OF ITS "TOMORROWS"**

The beginning of a new decade this year gives fresh meaning to the familiar saying that time flies. We are reminded too how futile it is to expect a full measure of rewards from static sameness in an era where constant changes are inseparable from progress.

Such concepts are in alignment not only with Ethyl's business philosophy for the 1970's, as the company achieves stronger and more diversified capabilities than ever, but to the confidence with which it is moving toward the next century.

Even if mankind in all probability will never achieve 100 percent control over his destiny, it also is true that few of us appreciate how close we can come to doing so if we plan and act intelligently before rapidly-approaching "tomorrows" arrive.

With a team of highly qualified man-power a major asset in the continuous implementation of "Changing . . . to serve a changing world," Ethyl is preparing for its "tomorrows" by designed planning and action to assure the company's further growth and success.



**Ethyl**  
Corporation

*Changing... to Serve a Changing World*



# Tomorrow is here today

**HOUSTON IS FIRST . . .**  
in a series of articles to be published in future issues of the Ethyl Magazine about other distinctive cities in various parts of the United States.

Evidence continues to pile up in Houston that the future is arriving ahead of schedule for this burgeoning Texas metropolis. Community leaders point with excitement and pride to the way the city and its environs are already outdistancing projections for the mid-1970's—from increases in population and employment to the escalating number, size and achievements of area business, industrial, commercial and scientific enterprises.

A powerful combination of tangible and intangible assets is responsible for what Houston is today and where it confidently expects to be tomorrow. Having jumped from fourteenth place to the nation's sixth largest city during



## y ... in Houston

the 1960's, with economic indices surging upward commensurately, it has been said that its "pulse beats so fast that last month already is history and last year almost is antiquity."

It is impossible to understand what makes Houston tick without emphasizing the characteristics of its population. The casual visitor, as well as newcomers, is soon aware of the predominating youthfulness, enthusiasm, friendliness, high educational level, vibrancy, ambition, civic pride and enjoyment of life shared by most of the 1.9 million people who live and work in the city and surrounding counties.

Known collectively as the Houston-Gulf Coast, the region embraces some

6,000 square miles, including 450 square miles within Houston's city limits—the heart of Harris County. Among the thriving score of prospering communities nearby are Galveston, Texas City, Baytown and Pasadena, where one of Ethyl's largest chemical plants is located.

Over and above its hundreds of producing oil wells, the Houston-Gulf Coast has the nation's largest concentration of petroleum refining and petro-chemical manufacturing facilities. As a producer and distributor of equipment for the oil industry, Houston also leads.

Such factors are among the controlling reasons why Ethyl is moving the headquarters of its Petroleum Chemicals divi-

sion from New York to Houston by midsummer.

Most metropolitan Houstonians consider their region's pre-eminent prosperity both a cause and a result of population growth, currently topping some 50,000 annually. This is more than elsewhere in the southwest.

The area's principal seaport—of major economic importance—is in the city itself. Greater Houston also surpasses other regional localities in the number and diversity of industrial plants, investment in them, value of manufactured products, wholesale and retail sales, bank deposits, skilled manpower, industrial payroll, roster of professional scientists and even in the number of company and privately-owned aircraft.

Greater Houston has so much dynamism that there is little doubt it will be achieving more national and regional first places in record time. In so doing, the region also anticipates adding new dimensions to leaderships already acquired, as well as outdoing competitive parts of Texas and other states in additional categories.

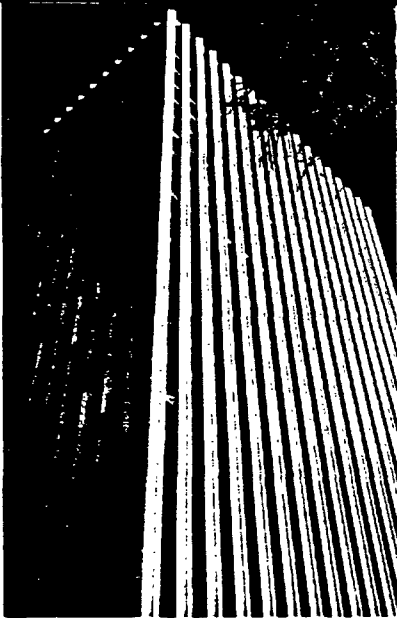
Over and above the built-in momentum of predominating enterprises, the Houston-Gulf Coast is gaining national and regional stature, for example, as a major source of food and allied products, non-petroleum chemicals, metals, lumber, furniture and fixtures, paper, printing and publishing, glass, ceramics, machinery, electronics and scientific equipment.

Of all visual evidence that Houston is booming in contemporary urban ways, the city's continuously changing skyline is particularly dramatic. In fact Houstonians complain proudly that photographs of its downtown heartland are obsolete before they can be developed.

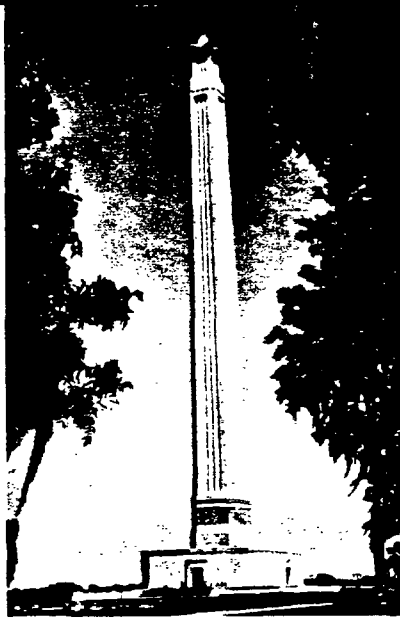
More realistically, it is recognized that the central complex of soaring office, commercial, hotel and company buildings bows to those of no other metropolis outside New York and Chicago—and unlike older cities, most of Houston's skyscrapers are ultra-modern. At times, ground is broken for more of them before the newest is occupied.

In 1970 the city will have the tallest office structure west of the Mississippi in its One Shell Plaza, a 50-story monolith currently in completion stages.

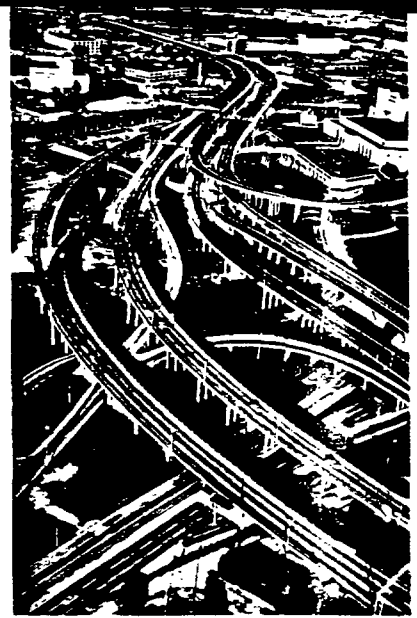
Recent newcomers sharing skyline glitter with neighboring high-rise con-



*This 27-story Houston Lighting & Power Company tower is among many recent additions to the city's skyline.*



*An obelisk taller than the Washington Monument marks the battlefield where Texans won freedom from Mexico.*



*A "spaghetti bowl" of interchanges expedites traffic entering and leaving Houston via freeway networks.*

struction humming with activity include the Houston Natural Gas Corporation Building and Houston Lighting and Power Company's lofty Electric Tower. Multiple-story business and residential structures are springing up frequently in other parts of the city and its surrounding communities too.

Prestige accruing to Houston for its key role in space exploration is growing internationally via the NASA Manned Spacecraft Center 22 miles southeast of the city's core. MSC conceives, designs, develops and operates manned spacecraft and trains astronauts—whether heading for the moon or on other pioneering ventures. Press, radio and television coverage of space breakthroughs originates at the center.

Representing an investment of \$200 million since operations began in 1962, the MSC—constantly being expanded on its 1,600-acre site—is contributing significantly to the Houston-Gulf Coast's changing characteristics allied with its boom.

The space complex employs some 5,000 civil service personnel, including professional scientists, engineers, medical specialists and skilled technicians, whose annual income exceeds \$60 million.

A magnet for space-oriented employment opportunities, the MSC is largely responsible for giving metropolitan Houston one of the largest concentrations of scientists in the nation.

There is ample evidence that still more prominence for Houston-in-space is just ahead. This prospect is contingent

not only on continuing space probes, but also on the growing size and complexity of research, development, testing and evaluations underway.

At the same time, such activities will continue to have a commensurate impact on the region's economy. Already there are 10,000 employees of 30 support contractors on and off the center who are earning \$250-million annually. Some 1,500 firms located or represented in Houston are being paid about \$63-million a year for MSC procurement needs.

Some of the most eye-opening changes brought about by the space center are in what used to be open countryside between the city of Houston and Galveston Bay. On acreage formerly occupied only by vacation cottages, ranches and farms are entirely new concentrations of comfortable suburban homes, schools, churches, shopping centers, businesses and space-related industries.

Houston is alive with the vigor of transactions both large and small. Multi-million-dollar industrial operations are announced almost weekly, but of equal significance are the many and diverse smaller establishments spawned by rapid growth. Innovation plays a key role in these new endeavors—and in the diversification efforts of other companies.

Typical of such developments are the two Houston firms with extensive experience and know-how in specialty metal fabrication—particularly in pressure-vessel design—who have turned their capabilities to the construction of personnel spheres for oceanographic

projects. As a result, with few exceptions every oceanographic deep-submersible vessel made in the United States so far has a basic hull manufactured in Houston.

Another new firm has been set up by University of Texas dental students to make oral hygiene products. Rice University engineers find themselves lending their capabilities in support of bio-medical research to develop an artificial human heart.

The list of innovations emanating from business, industry, medical and university environments explains why Houston so often is called "The Changingest City." Change has been steered to advantage and used as a catalyst for greater accomplishments.

Most generally, investment in new plants and equipment in the Houston-Gulf Coast area continues at a rate which assures it of a consistently high place among the nation's top four cities in volume of new construction. Total industrial development in the region during the most recent four-year period for which figures are available was more than \$2-billion.

Metropolitan Houston's professional dedication to and achievements in the fields of medicine, surgery and health is concentrated in its prestigious Texas Medical Center—internationally famous for pioneering in human heart surgery and organ transplantation, as well as for less publicized accomplishments.

With facilities valued at some \$150 million, the 175-acre complex contains 23 medical institutions and 10 supporting



Up to 45,000 people watch sports events in the area's roofed-over Astrodome.



With emphasis on the future, Houston opened its \$110-million Intercontinental Airport last June. It is designed to handle 10 million passengers annually by 1975.

organizations concerned with training, patient care, and research in such fields as cancer, open-heart surgery, childhood disorders and a variety of other illnesses which still defy medical ingenuity.

Intellectual and cultural ferment is an area-wide trend of accelerating momentum. Thousands of Houstonians and others living nearby are attending symphony concerts, operas, ballets, recitals and theatrical performances in the city's impressive Jesse H. Jones Hall for the Performing Arts.

Completed at a cost of \$7.4-million and dedicated in 1966, the air-conditioned auditorium's features include a movable ceiling which can be raised or lowered for acoustical purposes. Marble for its walls came from the same quarries from which the Colosseum in Rome was built centuries ago.

Typical of other cultural focal-points are the city's Alley Theatre, now in a new \$3-million complex downtown; the Houston Museum of Fine Arts, which houses a \$11-million permanent collection, the Contemporary Arts Museum nearby and popular Burke Planetarium at the Museum of Natural Science.

There are 11 institutions of higher education within Houston's city limits, as well as more than a dozen smaller colleges in neighboring communities. The state's second largest educational center, the University of Houston, has an enrollment topping 20,000, exceeded only by the University of Texas. Technically-oriented Rice University attracts undergraduate and graduate students from all parts of the country and from abroad.

Texas Southern's 4,500 co-educational attendance is predominately Negro.

Most people arriving at the newly opened Houston Intercontinental Airport, especially those coming for the first time, are fascinated by the far-sighted planning carried out in the \$110-million terminal's arrangements and facilities, as well as by its architectural distinction.

Built with passenger convenience as a primary objective, little walking is required to board or leave planes. An underground electronic train connects the airport's two wings. Houston Intercontinental maintains it has the fastest baggage-handling service anywhere, and the easiest access to ample parking. The entire airport has multiple connections with major highways.

Opened in June last year—at the same time designed for future expansion by adding more terminal wings—the airport is ready not only for today's jumbo jets but also for the supersonic air transports of tomorrow. The 10 national and international airlines serving Greater Houston expect to be carrying at least five million passengers during their first year of operations, increasing to an estimated 10 million by 1975. Future plans call for a large airport hotel.

Unlike cities permitting obsolescence to choke off the usefulness of their airports before new ones could be built, Houston acted in ample time to acquire the 7,300 acres needed for its new air terminal complex. It has replaced the city's William P. Hobby Airport, considered adequate only a decade ago, but

now being used exclusively by business executive and private aircraft.

Older but no less commanding in its own right is the 52-mile Houston Ship Channel, a dredged waterway from the Gulf of Mexico to the city's centrally-located docks, warehouses and truck, rail and barge distribution facilities.

Opened in 1915, the channel has undergone extensive improvements during intervening years. It now accommodates the largest ocean-going freighters, but plans are underway currently for deepening and widening the channel and its turning basin to handle the still larger super-tankers and bulkier cargo ships of tomorrow.

As the third busiest seaport in the country and the southwest's largest, Houston last year saw the arrival and sailing of some 4,250 vessels transporting more than 57-million tons of cargo. They shared the use of more than 150 ship channel docks, berths and piers. New ones are being added.

The value of Houston foreign trade alone (largely exports) exceeds \$2-billion annually, with customs revenue on imports amounting to some \$50-million a year. Intracoastal waterway barge lines with access to the 10,000-mile inland waterways system provide convenient and inexpensive transportation of cargoes from Houston to other parts of the United States.

On both sides of the ship channel there are huge and varied concentrations of industry—refineries, chemical plants (including Ethyl's), steel, pulp and paper mills and a diversity of heavy and light

industrial complexes continuously being enlarged. Manufacturing and production installations along the channel represent a total investment of more than \$3-billion.

Houstonians back their dreams with dollars for other purposes too. The metropolitan community takes special pride in its huge Astrodome, the world's first roofed-over, air-conditioned stadium and sports arena. Among contests drawing capacity crowds are the home football and baseball games of Houston's major league Oilers and Astros.

Completed in 1965 at a cost of \$35.5 million, the Astrodome is contributing an estimated \$80-million annually to the economy of Greater Houston. Exhibits and cattle-shows are accommodated in a spacious adjoining building.

Another feature which makes the Astrodome area a focal point for recreation is Astroworld, a family-oriented entertainment and educational park attracting more than a million people during the first three months after it opened in 1968.

The quality of life in the city of Houston and surrounding communities is conditioned largely by everyday familiarities and experiences, as well as by such focal points as the Astrodome, its adjuncts and the city's cultural attractions. No matter how residents spend their leisure time, most of them endorse enthusiastically the diversified and appealing character of the Houston-Gulf Coast.

One of the strongest appeals to newcomers is the spacious and attractive pattern of residential sections in the city and elsewhere. Modern ranch-type homes predominate in newer developments, most of them air-conditioned, with the greatest number sold in the \$15,000 to \$50,000 price range. Accelerating prosperity is a stimulant for increasing demand for larger houses costing more.

Rather than tolerating traditional urban and suburban sprawl, Greater Houston plans and builds with emphasis on the attractiveness of residential districts, coupled with spaciousness, conveniences of all kinds and ready access to such facilities as shopping centers, schools, parks, churches, other neighborhoods and points of interest.

In 1968 more than 21,000 homes were built in Harris County, of which Houston is the core. Some of the largest concentrations of new homes—including



*These Mission Control facilities at the NASA Manned Spacecraft Center in Houston are the heart of global stations for guiding astronauts.*



*As the nation's third busiest seaport, Houston accommodates more than 4,000 tankers, freighters and other cargo vessels annually via its Ship Channel.*

entirely new communities—did not exist as recently as the early 1960's.

Town house and apartment living in metropolitan Houston is largely a post-World War II trend, with demand for them increasing substantially.

A year ago close to 13,000 newly-completed apartments were available, compared with 7,000 in 1967. The city and environs are offering 14,000 more this January, including hundreds in high-rise towers with such extras as swimming pools, health clubs, recreation rooms, tennis courts and landscaped gardens. Two or three story townhouses are growing in popularity too, either for tenant ownership or as rented accommodations.

Unlike many other cities, Houston's downtown shopping area is experiencing more prosperity than ever, rather than shrinking. In addition to the opening of new stores and remodeling and enlarging others, forward-looking merchants are currently weighing an innovative

plan which calls for air-conditioned sidewalk corridors to help attract still more customers. In the area's outlying shopping centers, air-conditioned stores and malls are established realities.

A mild climate throughout the Houston-Gulf Coast region encourages a variety of outdoor living and recreational activities. Such watersports as boating, fishing, skiing and swimming in salt or fresh water are enjoyable in all but midwinter months. Hunters welcome opportunities for bagging game and birds within a few miles from their homes. Yacht, tennis, country and golf club memberships are climbing.

In addition to these attractions, strategically convenient to most Greater Houstonians, Galveston offers not only one of Texas' most famous resort beaches but its Sea-Arama of marine life. The city has outstanding seafood restaurants. It is a mecca for yachtsmen.

Further inland, there is a variety of



Residential sections of the Gulf Coast area are carefully planned and built to give families plenty of elbow room for fun outdoors.

goals for weekend drives or vacations. Among them are the state's rugged Big Thicket, the Alabama-Coushatta Indian Reservation, The Bluebonnet Trail and East Dogwood Trail. Lake Houston is within a short drive of the city limits. So are numerous other lakes, tracts of woodland and sizeable ranches which are of particular interest to Houston newcomers unfamiliar with cattle-raising.

Nature in the Texas outdoors is eye-opening during most seasons. The Houston-Gulf Coast is known far and wide for brilliant azaleas, camellias, oleanders, purple bougainvillea, fields of Texas bluebonnets and scarlet Indian Paintbrush.

The area's extensive network of freeways and connecting roads is a major factor in the widespread mobility of most people living and working in metropolitan Houston, and instrumental in making full enjoyment of the outdoors possible. A freeway system of 150 miles serves the city and adjoining parts of Harris County, with another 250 miles planned. Elaborate but easily-followed interchanges expedite traffic flows even at peak going-to-work or driving-home hours.

With the pace and dimensions of Greater Houston's economy surging forward with such momentum, it is logical to find the city prepared to accommodate proportionate numbers of businessmen, industrialists, scientists and others in a convention complex offering more than a million square feet of air-conditioned exhibit space.

Modern hotels and motels with a

total of 11,500 rooms are to be increased to a total of 14,500 rooms by the year's end. More than 300,000 convention delegates and a rising tide of tourists are bringing in an estimated \$90-million annually to the Houston-Gulf Coast area.

Old guard residents, including the few who cling to Houston's frontier image, sometimes deplore the city's swing toward more sophistication. They regret seeing fewer cowboys in levis, boots and western-style hats walking along downtown streets. Later generations are inclined to disagree—preferring to limit frontier ways to recreational horseback riding or attending cattle shows and rodeos.

Much of this look-ahead and go-ahead attitude stems from the youthful dynamism of the majority who live and work in Houston's metropolitan area. Their median age is 27.5 years, compared with 33.2 for the population of Los Angeles and 35.1 in New York.

This high quota of young men and women, as well as their number, also helps explain why industries, businesses, science-oriented companies and other commercial enterprises are zeroing in more and more on going places and doing things in Greater Houston. The high educational level of the area's youth tops the national average: five out of eight high school graduates go on to college, adding to the quality of Houston's available manpower.

At the same time, there is no conflict between dominant involvement in the upsurging progressiveness of modern Houston and the way in which local

people of all age brackets appreciate the region's colorful past. In fact current generations draw liberally on the motivating spirit of yesteryear.

The most meaningful reminder of their heritage of courage and daring is the San Jacinto Battlefield monument on the city's outskirts in suburban Pasadena.

Here the world's tallest stone and concrete obelisk overlooks rolling countryside where General Sam Houston and his 900 stalwarts routed 3,000 Mexican troops in a decisive battle on April 21, 1836, assuring the freedom of Texas from Mexico. As an independent republic, it voted to join the United States in 1845.

Adjoining the monument the retired Navy battleship Texas is moored in a ship channel slip. Attracting thousands of visitors annually, the massive dreadnaught memorializes the thousands of Lone Star State men who fought for their country around the world during both World Wars.

Respect for the city's past is reflected further in a downtown "Old Houston" project—a restoration of historical homes in the shadow of skyscrapers overlooking placid Sam Houston Park. Authentically furnished, they are open to streams of visitors daily. Soon they will be joined by a replica of the old capitol building of the Republic of Texas.

Named for the swashbuckling hero of San Jacinto, Houston's beginnings go back to 1836, when two brothers from New York bought 6,642 acres for \$1 each for development as a new town. The ambitious real estate entrepreneurs immediately launched a promotion campaign to attract settlers—no small undertaking when the land for sale was almost uninhabited nothingness—and outside the United States as well.

"When the rich lands of this country shall be settled," a New York newspaper advertisement read, "a trade will flow to Houston, making it the greatest . . . commercial emporium of Texas."

Bold but prophetic, these words are as valid today as they were merely speculative 134 years ago. Houston's growth and prosperity, at first centering around agriculture and cattle-raising, have been doubling and redoubling from the beginning.

An early mayor of the city is credited with saying, "Whatever Houston needs, Houston will get."

So far it has: and who can say Houston won't? □

### Comprehensive and Imaginative

This Ethyl Magazine feature is based on the authors' book, "The Year 2000: A Framework for Speculation," a Macmillan publication, © 1967, The Hudson Institute, Croton-on-Hudson, New York. The introduction is by Daniel Bell, chairman of the Commission on the Year 2000, American Academy of Arts and Sciences.

The book's jacket presents these comments:

"The study of the future, once the exclusive domain of science fiction writers and occasional prophets, has become a vital part of the conduct of public policy and the strategies of survival. 'The Year 2000' draws a comprehensive and imaginative picture of the shape of the probable, possible and nightmare worlds that will present new challenges in the dawn of the second millennium.

"Such forecasting demands the vision of both art and science. Economics, demography, history and political science, sociology and the physical sciences have all provided statistics, projections and information about massive changes anticipated in technology, science, population and international power balances—changes that will condition the quality of human existence and the nature of society in the United States and other parts of the world.

"The authors are concerned with making it possible to plan ahead; to achieve man's best possible worlds before events overtake us with all the bewildering speed of technological doubling.

"With America as a focal point, a number of possible future worlds are constructed. New probable power alignments and international challenges to American security are examined in detail. Large questions of world order and stability are debated in terms of 'scenarios' or imaginative simulations of what *might* happen—and how the United States and other countries would respond.

"Beyond the 'probable' and 'standard' worlds lies the worst of all possible worlds—the twenty-first century nightmare—that will take over in the event of the failure of men to decide and to act in their own best interests.

"'The Year 2000' ultimately defends the humanist position of man as an architect of his own destiny. Questions of process in technology and progress in planning and control of population growth, food supply, aggression, internal alienation and disruption in our own society, economic cooperation and the rise of new nationalism are all related to the larger design of building a world in which life is more than merely livable.

"This first volume of studies done under the Commission on the Year 2000 is sponsored by the American Academy of Arts and Sciences and is supported by the Coming Glass Foundation and the Carnegie Corporation. It is the product of a long-term project of the Hudson Institute, a non-profit, private research center devoted to the study of major problems affecting United States public policy, international development, defense and peace-keeping."

# A Glimpse of the Year 2000

by

Herman Kahn and Anthony J. Wiener

1995  
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1980 1975  
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1960

FOREWORD: All prospects and possibilities for the future presented here refer, in general, to industrialized nations of the world. In some respects, however, the so-called underdeveloped countries will be involved too. In this account we are assuming a "standard world" of "surprise-free" projections in which there will be no nuclear war or other major interruption in current trends.

Time's inexorable unfolding compels us to realize that the year 2000 is by no means in the distant future, but just around the corner—arriving in only 30 years. That it will dawn on a world vastly different from the one we now live in is generally recognized and accepted. A few prospects for what lies ahead are cited and discussed briefly in this presentation.



HERMAN KAHN      ANTHONY J. WIENER

#### ABOUT THE AUTHORS

Both are key men on the professional staff of the Hudson Institute at Croton-on-Hudson, N.Y., a private, non-profit research organization established in 1961 to study public policy issues, especially those relating to long-range planning for government and industry, to United States security and world order, and to social and economic development. The Institute's goal is to promote better communication and understanding among those at work on public policy problems, and where necessary to develop special techniques for doing so.

A physicist and specialist in public policy analyses, Mr. Kahn is the director and a trustee of the Institute, as well as one of its

principal founders. His major responsibilities are in directing and administering the organization's overall research program, including long-range (10 to 35 years) concern with political, economic, technological and cultural changes, as well as research into strategic warfare and national security policies.

Mr. Kahn has had extensive professional experience of breadth and penetration with problems in applied physics and mathematics, operations research and systems analysis, weapon design, particle and radiation diffusion, civil defense and strategic warfare. He is the author of six books and numerous articles on these and related subjects, and lectures internationally.

In addition to serving as a consultant to the Atomic Energy Commission, the Department of Defense and other government components, Mr. Kahn has been called upon in similar capacities by a variety of industrial and scientific enterprises. In 1959 he was a visiting research associate at the Princeton Center for International Studies.

Like Director Kahn, Mr. Wiener also is a leading analyst of public policy issues. He is chairman of the Institute's Research Management Council, the steering committee of project leaders. Mr. Wiener's studies and reports deal with such topics as the future of poverty in the United States, race relations and urban

problems, long-range problems of industry and education, economic development, international crises, arms control and issues involving European political and military policies.

In addition to his responsibilities at the Hudson Institute, Mr. Wiener is currently chairman of the White House Urban Affairs Research Committee, a member of the Research Advisory Committee of the U.S. Educational Policy Research Center at Syracuse University, and adjunct professor at Brooklyn Polytechnical Institute. He is a well-known lecturer at university and management training institutes.

Mr. Wiener joined the Institute when it was established—after employment in New York City as a consultant on political and economic aspects of science and technology. Earlier he was an instructor in political science at the Massachusetts Institute of Technology. He was co-author of a National Science Foundation study of science and technology in Russia during his affiliation with the Center for International Studies at M.I.T. Mr. Wiener's other professional associations and services have been with the Society for the Investigation of Human Ecology, the U.S. Joint Commission on Mental Illness and Health, and with a variety of government agencies, corporations and psychiatric and sociological research projects.

**Acknowledgments:** Ethyl appreciates cooperative authorizations received from the Hudson Institute and the MacMillan Company, publishers, for this Kahn-Wiener adaptation of parts of their book, "The Year 2000".

## A Glimpse of the Year 2000

Of all forces and factors which are shaping the new millennium, change predominates. There have been more changes in the life of mankind during the first two-thirds of the twentieth century than in the previous 500 years combined. It is largely because the rate of change itself is still accelerating that even more radically different developments can be expected from now on.

A generation ago—in 1940—supersonic aircraft and trips to the moon were taken seriously only in science fiction. Ninety percent of all prescriptions written by physicians today could not have been filled 30 years ago: their medical ingredients had yet to be discovered. Transplanting human organs successfully was still a surgical dream. It has been only during the past three decades that the world has seen such other examples of discovery, innovation and change as digital computers, nuclear reactor power plants, Polaris submarines, air-conditioned cars and color television.

A generation from now—in the year 2000—it is virtually axiomatic that even such achievements as these will be eclipsed by what the future has in store. The imminence of tomorrow's world can be appreciated best by people to whom World War II seems in the recent past: they realize that 2000 A.D. is only that far in the future.

With so little time left to get ready for the twenty-first century, there can be no question that it is imperative to think and plan more for the world of 30 years from now, as well as for dealing with it. When the year 2000 does arrive, certain inevitable developments will pose difficult and complex questions among those responsible for public policy.

Individuals will face comparable challenges.

It is not at all unlikely that by then, for example, everybody's life will be recorded in a central computer bank, beginning with his birth and covering his education, employment history, personal activities and other germane information. Parents may be able to select the gender and characteristics of their children through genetic controls.

The national environment probability will include at least three great metropolitan areas: (1) Boswash, stretching from Boston to Washington; (2) Chipitts, from Chicago to Pittsburgh, and (3) San-San on the Pacific coast, an urban belt extending from San Francisco southward to San Diego.

Such changes represent, of course, the results of progress (although many people may question whether progress is quite the word). Some other probabilities we can look for by or before the twentieth century's end—discussed more fully in the first chapter of our book, "The Year 2000"—are presented for consideration below:

In the health field, there will be extensive use of cyborg techniques, i.e., mechanical aids or substitutes for human organs, senses, limbs and other components of the body. We can expect a major reduction in hereditary and congenital defects. Physicians will be able to prescribe relatively effective weight and appetite control as well as controlled or supereffective relaxation and sleep. Also for medical purposes, we will witness "hibernation" for periods ranging from hours to days.

Farming and mining will be revolutionized. Developments will include an intensive and extensive expansion of tropical

agriculture and forestry, as well as the introduction in all climes of new and useful plant and animal species.

Certainly there will be new and improved ways to utilize the world's oceans more advantageously, including practical, lower-cost desalinization processing to provide fresh water in large quantities where it is most needed. Controlled "farming" of ocean products and extracting more diversified mineral wealth from sea-water by innovative ways and means are prospects for the future too. Harnessing tides as sources of energy is another possibility, in spite of yesterday's failure to do so at Passamaquoddy Bay in Maine.

In the rapidly evolving field of air transportation, there will be widespread use of such innovations as ground effect machines, hovercraft, STOL (short take-off or landing) and VTOL (vertical take-off or landing) aircraft, plus, of course, the giant supersonic jets already projected and still-to-come helicopter versions of them.

The world's continuously expanding need for more and better land transportation (perhaps it never will stop growing) is bound to affect commensurately major industries and enterprises concerned with it. Petroleum is likely to remain the principal source for tomorrow's fuels, including still better gasolines, but we can anticipate entirely new types of pollution-free hydrocarbon fuels too, as well as improved engines adapted to them.

There is general agreement that cars with nuclear engines are not likely to come off automobile assembly lines within the foreseeable future. At least some authorities, however, believe that such other sources of power as fuel cells, storage batteries, electro-magnetic propulsion or support, and jet and turbine engines will play increasingly important roles in satisfying tomorrow's transportation needs.

As for water transportation by or before the year 2000, it is valid to conclude that the stage is currently set for the most part. The special purpose container ships developed and introduced in recent years will find increasing acceptance and consequently are to be built in greater numbers. Fleets of mammoth submarines are to join surface vessels as international cargo transports. Automated single-purpose bulk carriers will become familiar.

With so much attention being directed toward environ-

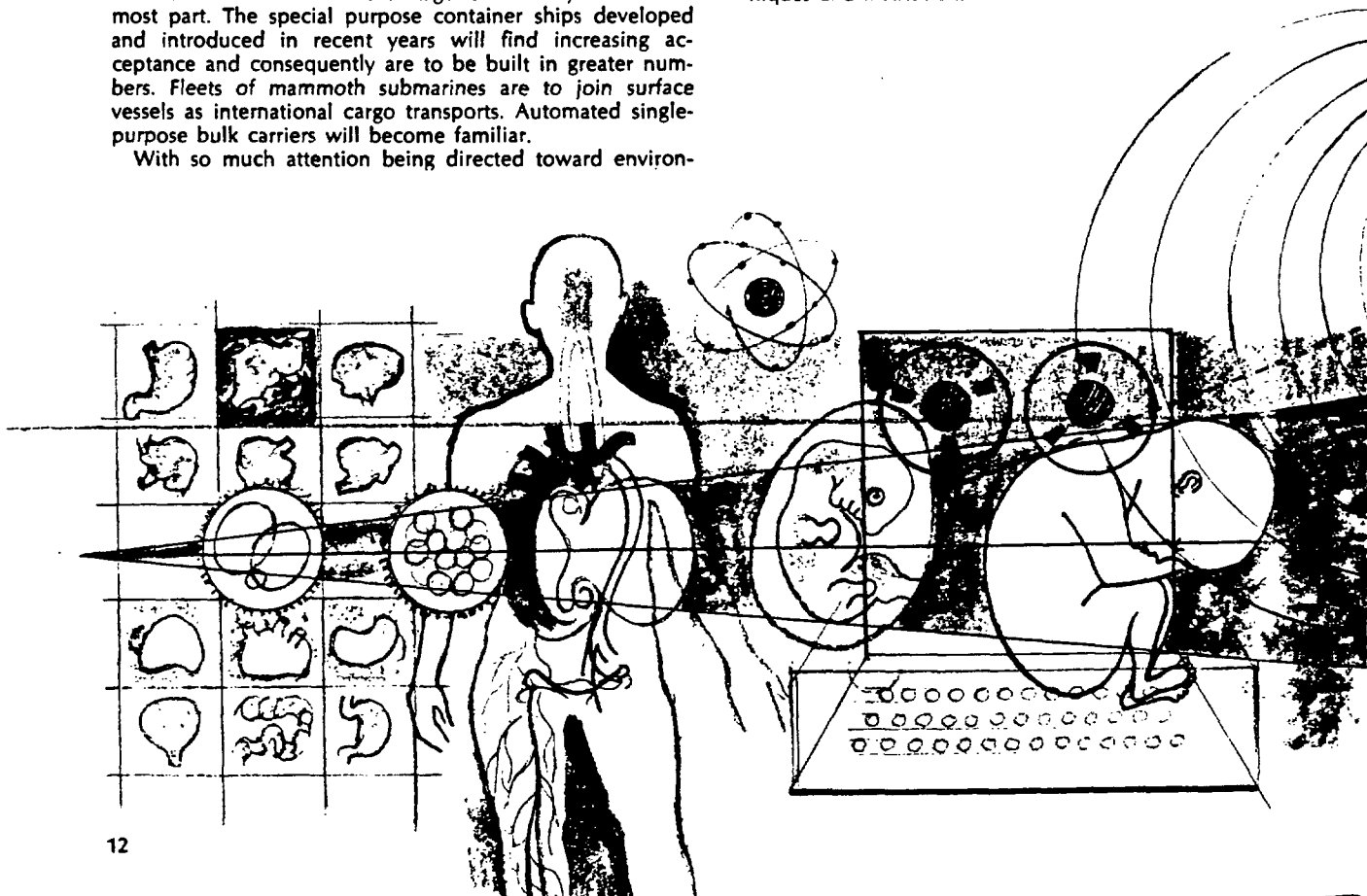
mental preservation and protection these days, by the year 2000 we will have achieved not only substantial progress toward current objectives but new techniques for much more effective control of pollution. There will be more reliable and longer-range weather forecasting as well as extensive and intensive worldwide use of high altitude cameras for mapping, prospecting, census, land use and geological investigations.

Business and industrial developments will include multiple applications of lasers and masers for sensing, measuring, cutting, communicating, heating, welding, power transmission, illumination and other purposes. There will be widespread commercial applications of shaped-charge explosives. Extreme high-strength and/or high-temperature structural materials are to be available.

Power plants and other fixed-power installations will be run not only by nuclear energy, but by such other new means as thermionic and thermoelectric, radioactive and magneto-hydrodynamic power. We can anticipate inexpensive design and procurement of "one-of-a-kind" items through the use of computerized analysis and automated production. And it's safe to expect more sophisticated architectural engineering through the use of geodesic domes, fancy stressed shells, pressurized skins and esoteric materials.

Both our business and personal lives will be affected by new or improved superperformance fabrics (papers, fibers, plastics) as well as by new or improved materials for equipment and appliances (plastics, glasses, alloys, ceramics, inter-metallics and cermets). And, of course, there will be three-dimensional photography, television, movies and illustrations, all in color.

Automated or more mechanized housekeeping and home maintenance will affect our personal lives. So will new techniques and institutions for adult education.



In all of these projections, it is safe to offer two-to-one odds that each will occur by or before the year 2000. But if a twenty-first century Pandora's box is to be avoided, more thinking and planning are required and appropriate action must be taken before innovations already born or in gestations stages mature into demons difficult or impossible to control.

Could the military applications of lasers and masers to ballistic missile defense systems accelerate a Soviet-United States arms race? Such questions already are prompting serious concerns in some quarters. Would the expansion and development of tropical agriculture and forestry mean an undesirable shift in economic and/or military strength as well as dislocation for competitive enterprises?

In fact adjustment difficulties of significant and often potentially hazardous proportions are virtually inescapable adjuncts of nearly all areas of innovation, although there probably is a consensus that all such changes represent world "progress." (For a fuller discussion of twenty-first century nightmare possibilities, see Chapter VIII of our book).

Other innovations, well within view, are so controversial that one school of thought recommends broadside government action to restrict or discourage them. These controversial areas raise a labyrinth of issues. Here are some of them:

Accelerated nuclear proliferation; loss of privacy; excessive government and/or private power over individuals; decisions becoming necessary that are too large, important, complex, uncertain or comprehensive to be left safely to mere mortals; new capabilities so inherently dangerous that they are likely to be disastrously abused; too rapid or cataclysmic change for smooth adjustment, and so on. Only a few of these will be considered here.

There undoubtedly will be general use of automation and

cybernation in management and production. This will lead, in turn, to extensive and intensive centralization of current and past personal and business information in high-speed data processors. The obvious outcome would be the creation of new and possibly pervasive techniques for the surveillance, monitoring and control of individuals and organizations.

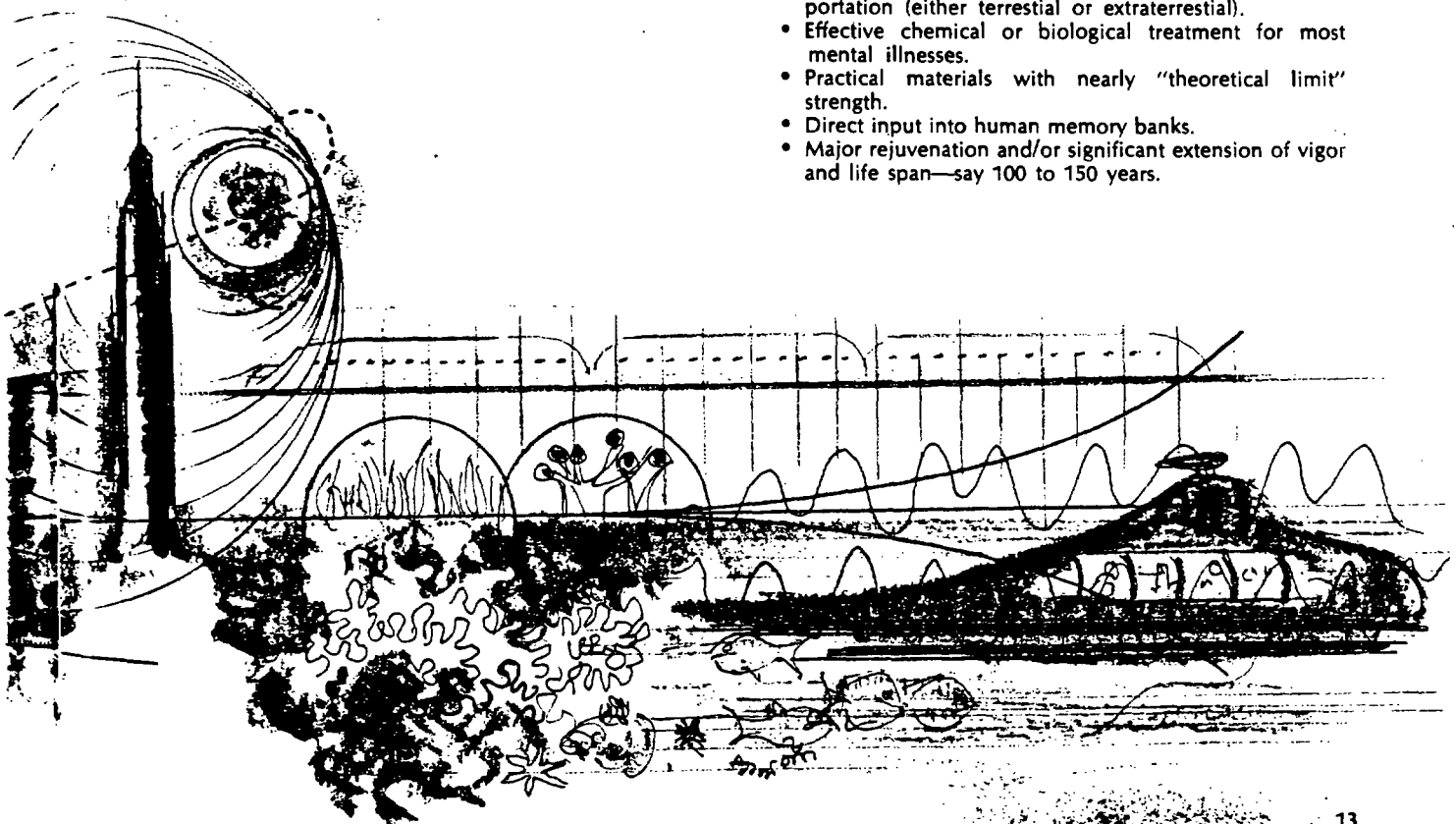
In medicine, look for new developments in inexpensive, reliable and convenient birth control. There will be new, more varied and more reliable drugs to control fatigue, tension, alertness, mood, personality, perception, fantasies and other psychobiological states. Certainly we can expect more extensive transplantation of human organs, for science will have discovered effective techniques for suppressing or controlling the body's natural rejection mechanism. And, by 2000, in addition to being able to select the sex of unborn children, we also may have the capability to change the sex of either children or adults.

A general and substantial increase in life expectancy can be anticipated, as well as ability to postpone the aging process. Through drugs or surgical operations, mankind will achieve ability to attain limited rejuvenation.

There will be extensive use of robots and machines "slaved" to humans. Individual flying platforms and/or enclosed "two-seaters" will be common. Inexpensive and rapid transmission and reception of facsimiles, already in limited use, will be common in the future to make possible almost instantaneous delivery of mail, news, library information, commercial announcements and other printouts, both in homes and offices.

All of the above are likely by the year 2000. Somewhat less probable (even money bets, give or take a factor of five) are certain other technological developments such as the following:

- Major use of rockets for commercial or private transportation (either terrestrial or extraterrestrial).
- Effective chemical or biological treatment for most mental illnesses.
- Practical materials with nearly "theoretical limit" strength.
- Direct input into human memory banks.
- Major rejuvenation and/or significant extension of vigor and life span—say 100 to 150 years.



- Automated highways.
- Extensive use of moving sidewalks for local transportation.
- Substantial manned lunar or planetary installations.
- Verification of some extrasensory phenomena.
- A technological equivalent of telepathy.
- Some direct control of individual thought processes.

There are serious thinkers today who also believe likely the development of more radical possibilities, some of which hardly make sense. The authors do not believe that any of these will occur by 2000 A.D., or perhaps ever. But since they are being discussed in serious terms, and since they do emphasize the fact that some dramatic and radical innovations may be expected, we mention a few of them, if only to suggest how surprising and exciting (or outrageous) they might prove.

Interstellar travel is one such possibility, though if it does occur it probably will be limited for the first few decades to planets in our own solar system. Unmanned probes of planets in other solar systems are, however, a possibility.

Antigravity, or the practical use of gravity waves, is also being discussed. As usually envisaged, this would make possible a practical perpetual motion machine, and therefore the creation of energy out of nothing. Your authors do not foresee this as even a far-out possibility, but we include antigravity—even though it annoys some physicist friends—as an example of some totally new use of a basic phenomena or the seeming violation of a basic law.

Lifetime immunization against practically all diseases is being mentioned in some circles today, though whether such an all-embracing prophylactic will ever be available is, to our minds, doubtful.

Electric power available for less than .03 mill per kw hour also is being spoken of, and there are some engineers who believe that it eventually will become reality. The source of this cheap energy is generally left unspecified.

And finally there is the possibility—more far-fetched than popular science fiction has it but impossible to rule out—of the discovery of extra-terrestrial life and the much more imaginative extreme of communication with extraterrestrial intelligence.

The developments and innovations mentioned so far make only the obvious point that, as the result of long-term

trends toward the accumulation of knowledge and the institutionalization of change, many important new things will happen in the next few decades. It is worthwhile asking specifically what the consequences of each item—and their interactions—might be.

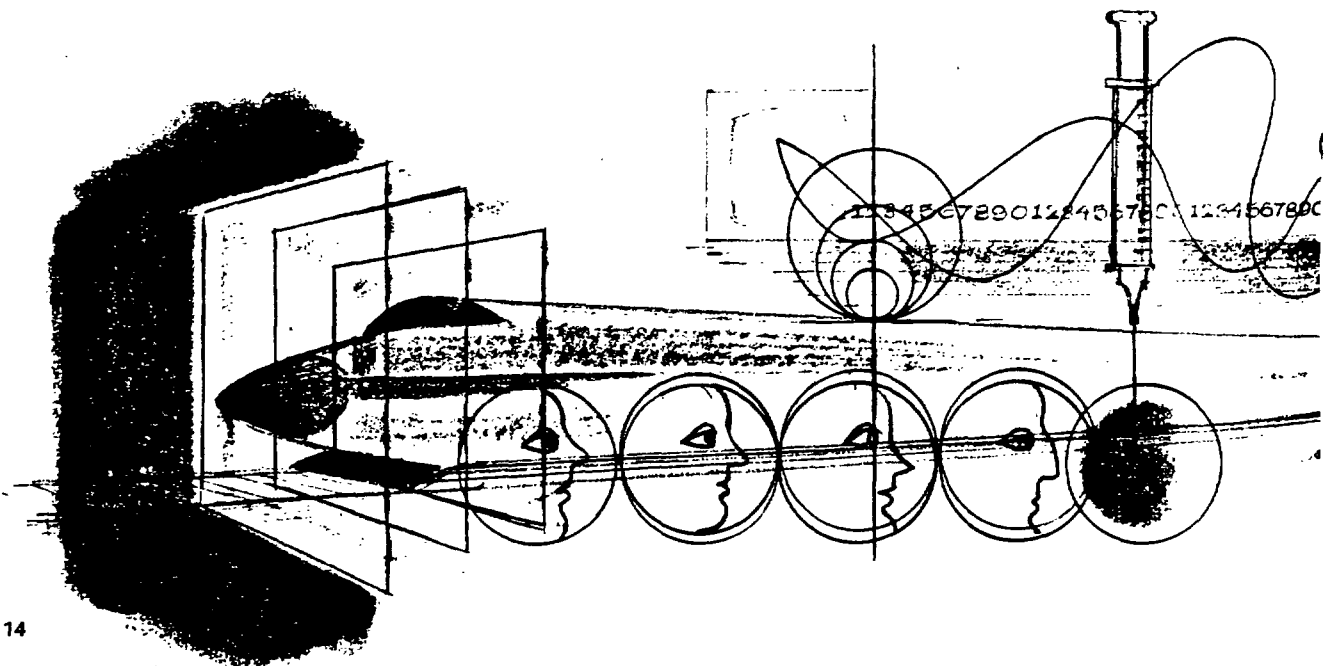
Let us turn, for one example, to a topic that should be of the utmost importance to us: the biological manipulation of man. Briefly, this is what may be done by medical, chemical and biological means to affect not only our psychology, vigor, health and longevity, but the genetic constitution of future human beings, including whether or not they should ever be born.

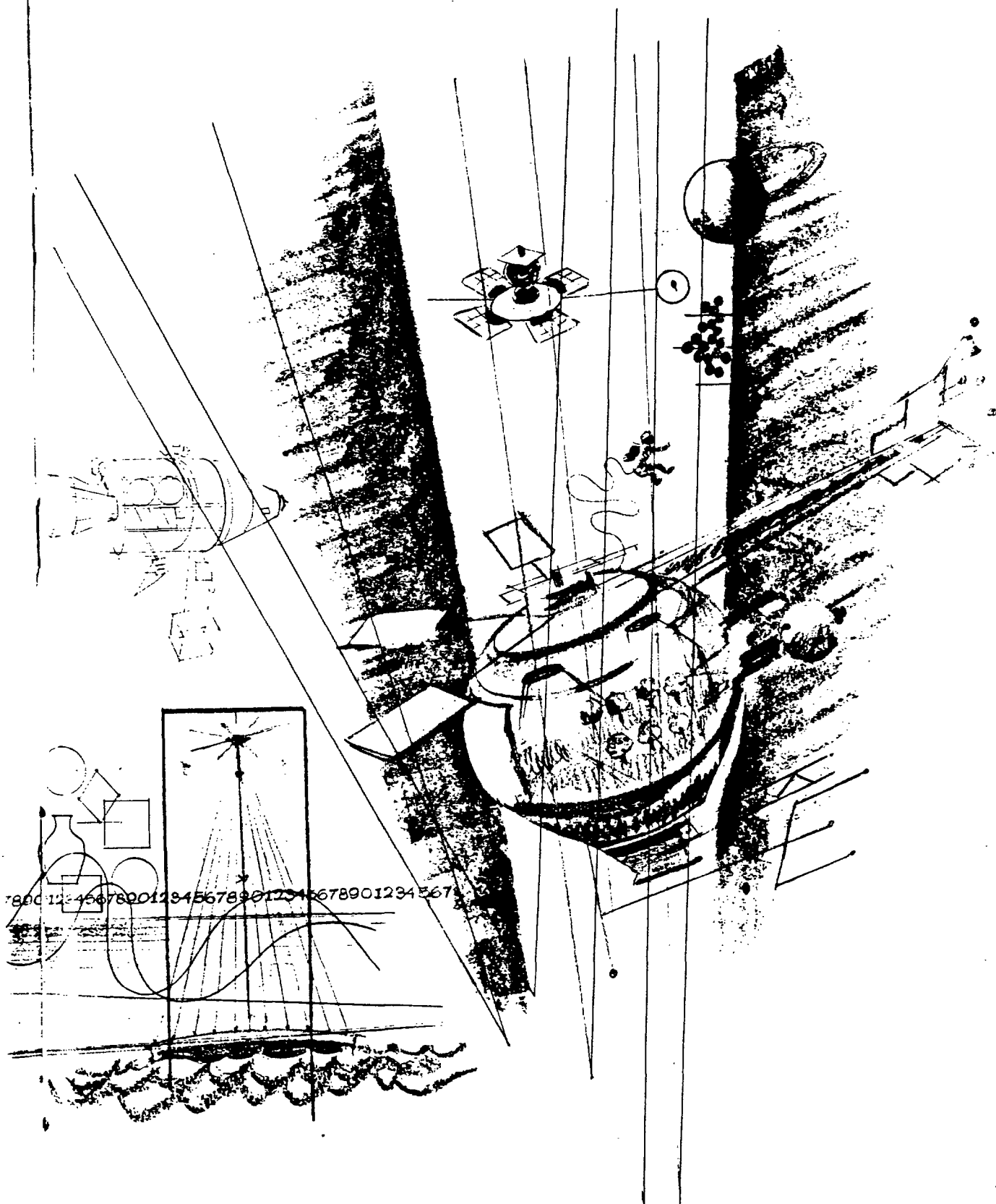
The prospects in medicine and birth control are exciting—and in genetics and other areas both attractive and a little frightening. We can begin by considering heart disease, now the Number One killer in the United States. Future efforts in fighting it will emphasize diagnosis, alleviation and cure, and it is not at all unlikely that by or before the end of this century the death rate from heart ailments will have been reduced drastically. The first results will be seen in a sharp decline in "premature" deaths in the 50-60 age bracket.

Cancer research probably will depend on advances in molecular biology and perhaps virology. The cure rate, currently about 33 percent, may double by the close of the century—and this forecast does not take into account the many cases that might be prevented entirely by early examination and diagnosis.

Dramatic advances can be looked for in surgical techniques. Lasers already are used successfully to "weld" small tears and defects in the eye's retina, and probably will be used widely to treat such disorders as malignant melanoma and others requiring the selective creation of lesions within the body. Cryosurgery (freezing), now being used on brain cells to reduce the tremors of Parkinson's disease, undoubtedly will be expanded to treat successfully deep brain tumors, bone tumors, the prostate gland, tonsils, abnormal uterine bleeding, and other disorders.

Progress certainly will be made in rejoining severed limbs, transplanting tissues and organs and applying microelectronics and new materials to artificial organs and limbs. We can look for new techniques to staple or glue artificial membranes to hold blood vessels together and, eventually, we will be able to transplant limbs, as well as organs, from





dead people to live ones.

We also can look for artificial corneas, lungs, and "mechanized artificial limbs as versatile as natural arms, legs and hands," as well as "electronic substitutes for all the senses, including sight and touch." It seems reasonable, in fact, to look for these developments to be realized before the year 2000, particularly after 1975-80—when new materials and anticipated success with some artificial organs will stimulate doctors and engineers to become even bolder.

Such medical progress will result in people living longer and, as the life span lengthens, the science of geriatrics—care of the aging—will claim more attention. The authors think senility will be reduced and arthritis eliminated before 2000, and that a major extension of life expectancy is quite possible by then.

At the other end of human life, "artificial wombs" may save the lives of countless premature babies. Meanwhile, fetology—medical care of unborn babies in the womb—is expanding rapidly, including such measures as blood transfusions to fetuses with haemolytic disease involving the Rh factor. As we learn more about fetal development, we'll be able to perfect nanosurgery, which is about 10,000 times finer than the microsurgery now used in pediatrics.

All of these advances will lead inevitably to "genetic engineering"—a combination of surgical, engineering, biochemical and perhaps viral processes to bring about genetic modifications and manipulation. (Greatly improved drugs also will be involved.) The implications of such developments obviously are enormous.

More extensive use of computers, assured during the years ahead, will have an impact on medicine. Already in use in some hospitals, future computer applications will include storage of medical knowledge, enabling doctors to consult such records for alternative diagnoses and prescriptions. It is probable that computer-kept data will be a major source of new knowledge as well as promoting better applications of existing information.

Computers, in fact, will become almost as familiar in business and other areas as typewriters are today. They are likely to match, simulate, or surpass some of our most specialized intellectual abilities, perhaps including some of our aesthetic and creative capacities.

Inasmuch as it remains an open question what inherent

limitations computers have, there are proponents who maintain that new electronic mechanisms may be built with some abilities which humans do not have. If, on the other hand, it turns out that computers cannot duplicate or exceed certain characteristically human capabilities, that too would be one of the century's most important discoveries.

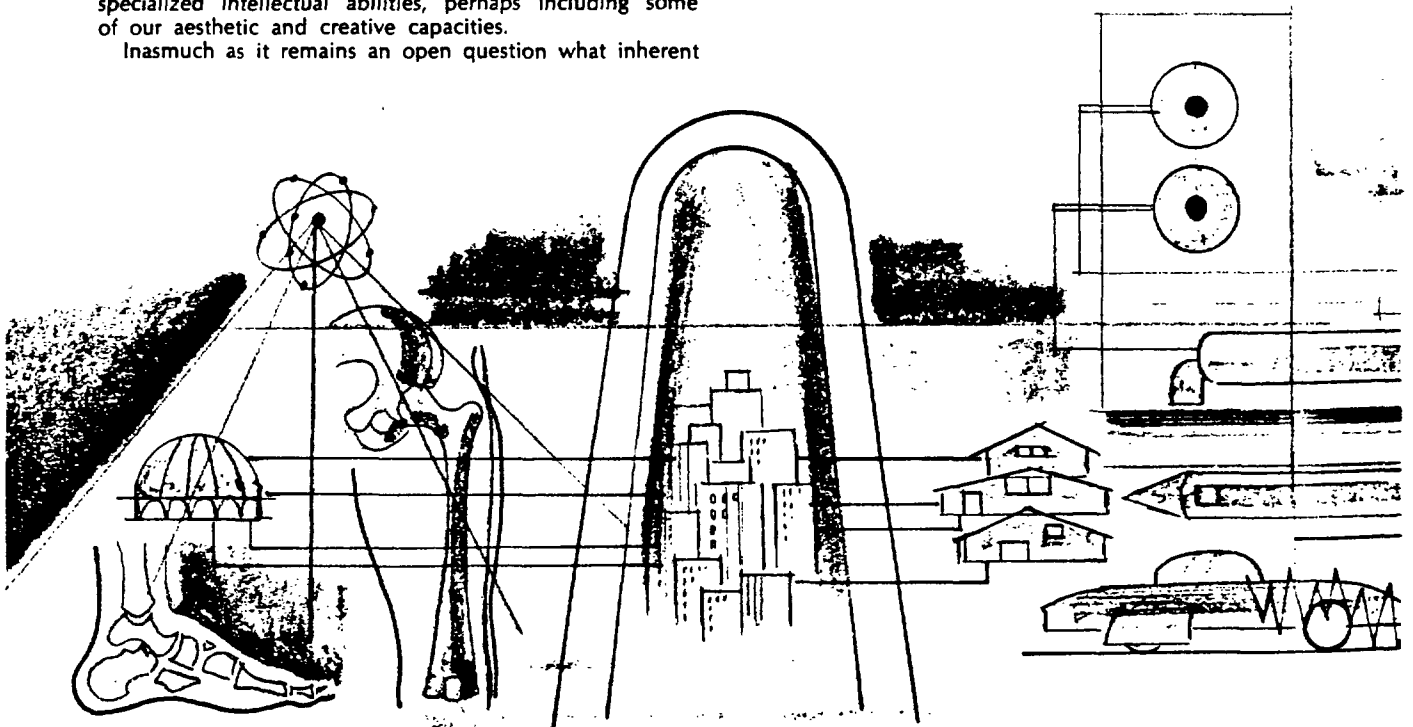
It is a virtual certainty that any report written in the year 2000 about technological developments of the last third of our present century will focus attention on the results of serendipity—unexpected discoveries made by accident.

In some cases, the degree of surprise may be so great as to seem to oppose a law of physics. For example, many applications of lasers apparently contradict the second law of thermodynamics as described in old textbooks on optics. These books did not consider what could be done with coherent light. The laser, which makes practical the generation and use of coherent light, appears to be one of the fundamental technologies of the future with fascinating potentials for usefulness. Its discovery was an unexpected breakthrough.

We know today that man is developing enormous power to change his environment—not only the outside world, but also his internal physiological and intrapsychic situation. The prevailing secular humanist view is that this is "progress"—and your authors agree that it would be no more desirable than feasible to attempt to halt the process permanently, or to reverse it.

Yet this very power over nature threatens to become a force of nature that is itself out of control, as the social framework of action obscures and thwarts not only the human objectives of all the striving for "achievement" and "advancement," but also the various inarticulate or ideological reactions against such changes.

In the final decades of this century, we shall have the technological and economic power to alter the world radically, but it is doubtful that we can develop ability to restrain our strivings, let alone understand or control the results of all the complex changes we will be making.



If we cannot learn to take full advantage of our increasing technological successes, and to cope with resulting (often potentially dangerous) responsibilities, we may only have thrown off one set of chains—nature-imposed—for another, ostensibly man-made, but in a deeper sense, as Faust learned, also imposed by nature.

If there is any single lesson that emerges from the above, it is this: while it would certainly be desirable, and might even be helpful, to have a better grasp of how social action may lead to unanticipated or unwanted results, understanding alone is not likely to be sufficient.

Given man's vastly increased power over his internal and external environment, and, in particular, given the unprecedented opportunities for centralization of social control that follow from the economic and technological changes that have taken place and are likely to occur, the effects of social policies—planned or haphazard—are likely to increase drastically. At the same time, the disastrous consequences of mistakes are likely to grow correspondingly. While all decisions are in a sense irrevocable, this existential fact must be appreciated increasingly as it becomes an ever more important aspect of all policy decisions.

Of course it will be worthwhile to try to improve our understanding of future possibilities and long-term consequences of alternative policies. But the achievement of such understanding is too difficult to be entirely successful. Consequently almost the only course that remains is to attempt, in general, to moderate impulses to overpower our environment.

We must try to decrease both excessive centralization and too much reliance on accumulating political, economic and technological power. An alternative is to arrange safeguards—somehow—so that the centralization of such power is placed in the hands of people who will respect its disastrous potentials and will not centralize it further.

In approaching the year 2000, what is necessary is an unflagging respect for the world as we find it. Dissent and diversity merit full recognition—even ornery individual stubbornness—in spite of the mounting impressiveness of the

technical-rational structure our society is building today.

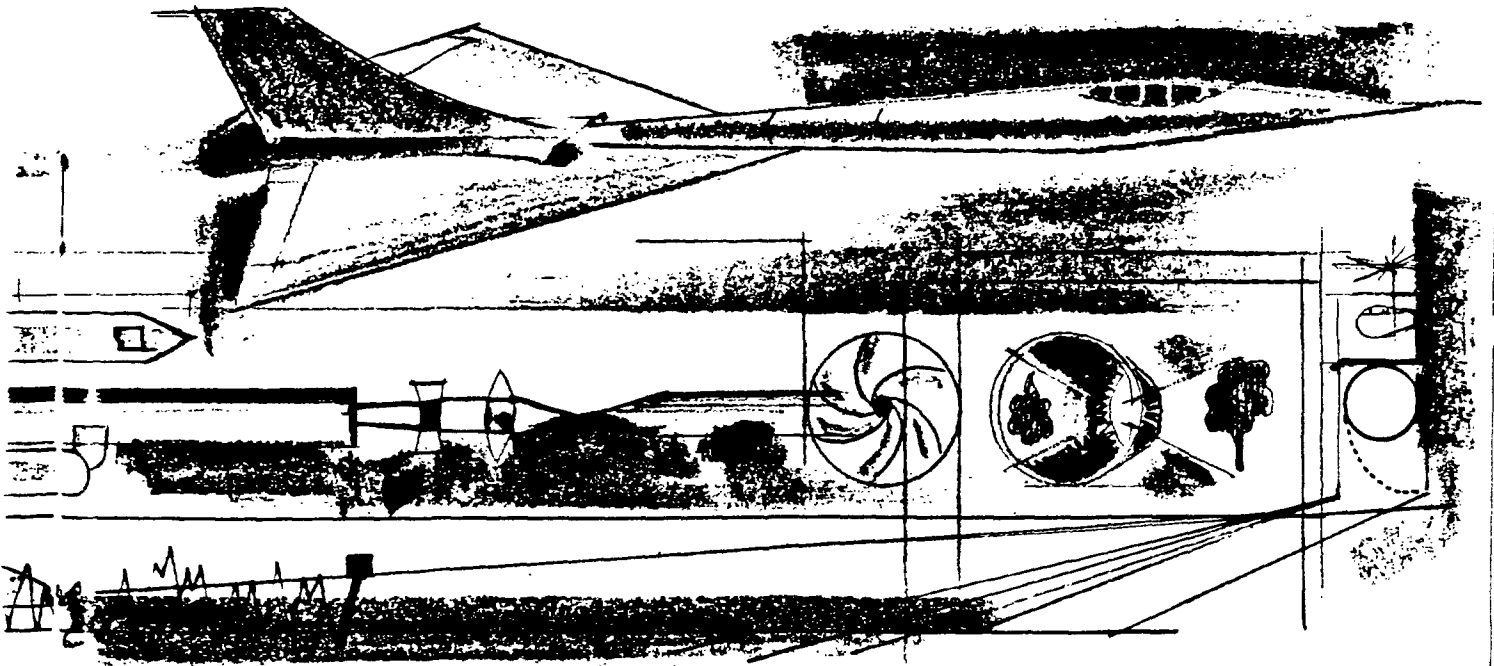
Above all, there must be active concern with perpetuating those institutions that protect freedom of human choice—not only for today's individuals and the pluralistic social groups that would want their views represented, but more important, for those who will follow us—those who in the future may experience their problems differently, and would not want to find that we have already—unnecessarily and unwisely—foreclosed their choices and altered their natural and social world irretrievably. □

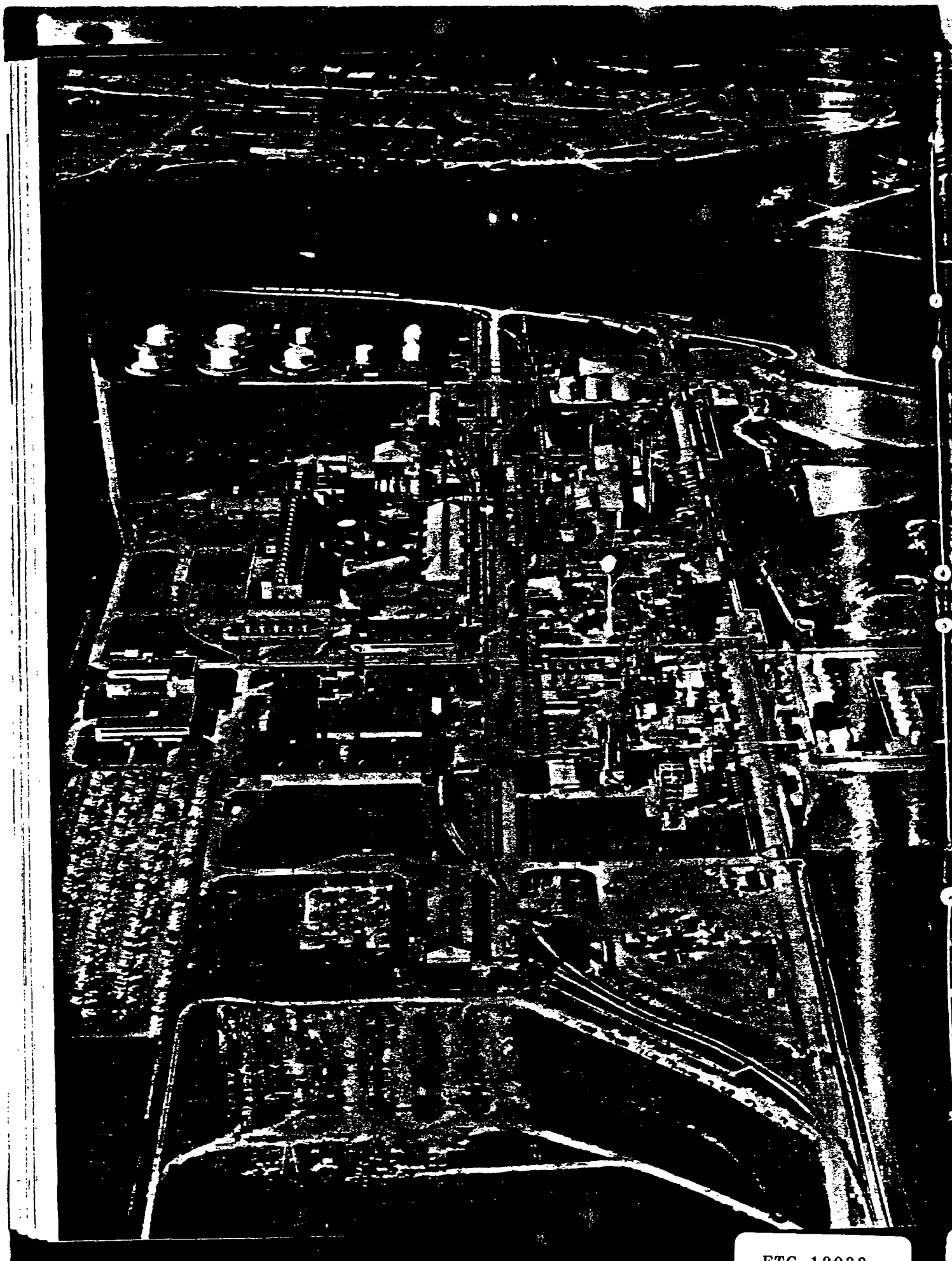
#### MORE ON THE YEAR 2000

Ethyl Magazine readers interested in additional prospects for the year 2000 and more about some of the future's problems and challenges are referred to the authors' book, "THE YEAR 2000: A Framework for Speculation."

Chapters likely to be of particular interest include the following:

- Change and Continuity
- Comments on Science and Technology
- Some Surprise-Free Economic Projections
- Postindustrial Society in a Standard World
- International Society in a Standard World
- International Politics in the Standard World
- Some Possibilities for Nuclear Wars
- Other Twenty-first Century Nightmares
- The International System in the Very Long Range
- Policy Research and Social Change





ETC 18032



*Ethyl product additions to include versatile family of industrial chemicals for detergent and other manufacturers—coming from a new \$10-million*

## **PLANT TO MAKE ALPHA OLEFINS**

Capitalizing on unique capabilities in a growing segment of the industrial chemicals field, Ethyl is investing more than \$10-million in a new plant for the production of alpha olefins—chemical intermediates with important roles in manufacturing detergents, shampoos, soaps and plasticizers. Other end-products made advantageously with olefins include plastics, resins and coatings.

The new plant, currently under construction at the company's 400-acre chemical manufacturing complex in Pasadena, Texas (suburban Houston), is scheduled to go on stream early in 1971. It will adjoin existing installations where aluminum alkyl industrial catalysts and primary alcohols used as detergent and plasticizer intermediates are being made.

*The new alpha olefins plant will adjoin facilities for aluminum alkyl and alcohol production at Ethyl's manufacturing complex in Pasadena, Texas.*

Part and parcel of Ethyl's continuing extension of its operations and product lines, the alpha olefins plant represents the latest application of specialized technology developed by the company in ethylene and related chemistry.

This in-depth familiarity and know-how are largely responsible for the strong position Ethyl already has as a leading source for primary alcohols and aluminum alkyl catalysts. In fact the company has the world's largest facilities for making long chain alcohols. Completed in 1965, they are producing at a rate of more than 100 million pounds annually.

Higher quality end-products as well as improved efficiencies and economies in manufacturing them are among major advantages shared by industries using alpha olefins. Such dividends accrue not only to present consumers but are also anticipated for the projected application of olefins as intermediates in numerous other chemical processes.

As determined by national market analyses, Ethyl expects that heavy demands for its alpha olefins will be coming from the detergent industry, especially from companies manufacturing the newer biodegradable household detergents now in widespread and increasing use.

Already representing annual production of some five billion pounds in 1969 and with the year's sales estimated at more than \$1.2-billion, the detergent industry—after an increase of better than nine percent over 1968—is anticipating a future with still further growth of substantial dimensions.

Other prospective consumers of the new Ethyl intermediates in bulk quantities include manufacturers of shampoos and soaps, which are being produced in hundreds of millions of pounds-per-year quantities with commensurately high income from sales and bright prospects for the years ahead. The properties of alpha olefins are such that they can be used to make the finest shampoo and soap specialties as effectively as detergents—at the same time insuring high quality output.

A third principal application of alpha olefins is in making the industrial alcohols required for manufacturing plasticizer ingredients going into polyvinyl chloride (PVC). It is from this modern synthetic that such products as waterproof coats, automobile upholstery, fabrics for furniture, other coverings and a variety of additional goods originate.

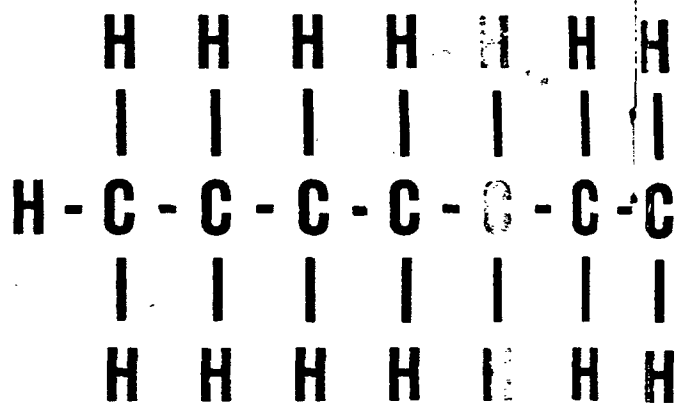
These alcohols, by reacting with other chemicals, contribute desirable properties to PVC-based materials not obtainable economically by other means. As a major PVC and plasticizer-alcohol manufacturer, Ethyl will be a still more versatile source of supply for fabricators of PVC when the alpha olefins plant goes on stream.

In addition to basing demands for the new Ethyl intermediates on markets currently available, the company's commercial development and industrial chemical staffs are exploring aggressively other process and product areas inviting the application of alpha olefins. One of these is alpha olefin sulphonate, of interest to the detergent industry in

connection with manufacturing milder products as well as those designed for heavy duty work.

Prospects for related uses of olefins include the production of fatty acids now made from such natural raw materials as tallow and vegetable oils. These acids, in turn, are required in manufacturing high quality soaps, creams, lotions and similar toiletries. The synthetic rubber industry is potentially a major alpha olefins consumer too.

Although yet to be determined entirely, the diversity and



range of promising applications for industrial processing with alpha olefins are so extensive that Ethyl has designed its new plant for expansion and adaptations as future demands may require.

The company has ample evidence that in a world increasingly dependent on the proceeds of industrial chemistry, the development of new applications for alpha olefins is inevitable. Completion of Ethyl's new plant next year, coupled with company investigations into a variety of potential new

uses for the intermediates, are expected not only to eliminate the short supply of olefins currently available from only a handful of producers, but in so doing to promote new and larger markets difficult to open up under present circumstances.

Among the brightest prospects for market extensions are in the manufacture of such products as synthetic lubricants, food supplements, polymer modifiers, bromides, glycols, epoxides, sulphates, ketones, mercaptans and numerous

hydrogen atoms. Alpha olefins are distinctive for having a so-called "double bond" at one end of each molecular chain. It is this double bond which gives exceptional versatility to the intermediates when used in the manufacture of such a wide variety of modern products for which demands are accelerating so substantially.

Ethyl's interest in alpha olefins has roots in company research during the early 1950's on new ways to produce tetraethyl lead for antiknock compounds. Experiments included making TEL by employing tri-ethyl aluminum and similar compounds.

Coincidentally with this work, innovative technology in the use of aluminum alkyls to produce new polymers like polypropylene, polyisoprene, and polybutadiene was being developed by Professor Karl Ziegler in Germany.

When new plants based on Ziegler technology were built in the United States, Ethyl directed emphasis on the manufacture of aluminum alkyls and alkyl aluminum halides which could be used to produce these polymers. In achieving stature as a major source for tri-ethyl aluminum, tri-isobutyl aluminum and related aluminum alkyl halides, the company became and continues to be a leading producer of catalysts required by the new and important family of polymerization industries.

Experience and know-how in orbits closely akin to those of Prof. Ziegler have been accumulated by Ethyl in its research, development and manufacturing of aluminum alkyls—resulting in the creation of a unique and strong technology which supplements the company's other capabilities. Distinctive in flexibility and pivotal in connection with optimum production of alpha olefins, this technology is directly responsible for Ethyl's preliminary consideration of manufacturing them some 10 years ago—but at a time when there was no sizable market for the intermediates.

Consequently the company shifted the direction of emphasis on new product development via its new technology to manufacturing linear alcohols for household detergents and plasticizer intermediates.

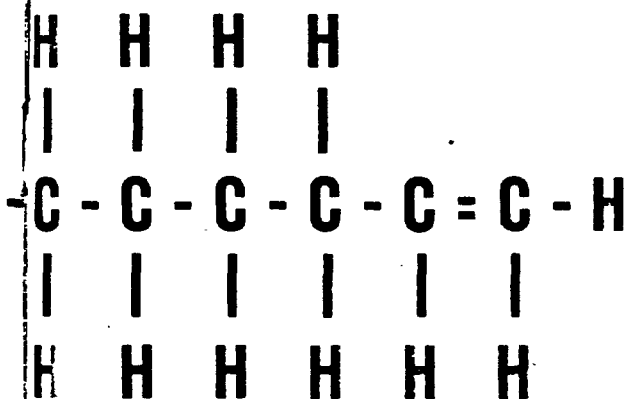
In meeting successfully a variety of challenges relating to plant design, operations and product uses apropos its burgeoning alcohol and plasticizer intermediate ventures, Ethyl has added materially to the caliber, dimensions and applications of the company's latest technology. Such refinements are being utilized fully in connection with alpha olefin horizons.

There will be noteworthy advantages in locating the new olefins plant next to comparable but entirely separate primary alcohol and aluminum alkyl facilities at Ethyl's Pasadena complex. Company-made aluminum alkyls, for example, will be used as catalysts in olefin production. More broadly, operating relationships between the alcohol and olefins plants will enhance Ethyl's capabilities in tailoring chain growth products to meet a variety of customer requirements. □

others dependent on processing to which the properties of olefins could contribute advantageously.

As clear and colorless as water, the versatile new Ethyl intermediates are to be manufactured from ethylene supplied largely by refineries near the company's Pasadena complex. The use of ethylene, in which Ethyl is pioneering, offers a number of advantages over traditional paraffin feedstocks.

Chemists know olefins as straight chain hydrocarbons—a term based on linear arrangement of their carbon and



# TO THE NATION'S CREDIT

*How the Federal Reserve System Operates*



*Transactions between people wanting to borrow money and banks providing it are affected by Federal Reserve policies.*

As signs of the times in recent months, a man and wife buying a new home found they must pay a much higher rate of interest than only a few years ago in order to get a mortgage from a bank . . .

A breadwinner seeking a "consumer loan" from a bank discovered he first had to satisfy the bank that he needed the money for an essential purpose . . .

A company planning to borrow money to finance a new project learned it had to shop around among banks to find both a willing lender and an interest

rate the company itself was willing to pay. . .

All of these instances, diverse as they may seem, have a common denominator in the monetary policies of the Federal Reserve System. The people and organizations involved had no contact at all with the Federal Reserve, but each one was indirectly affected by the way the Federal Reserve regulates the flow of money and credit to all sectors of the United States' economy as a whole.

For the past year the Federal Reserve

has been following a "tight money" policy, which accounts in part for the difficulties various people and enterprises have experienced in obtaining credit. At the same time, however, the Federal Reserve, in pursuing its objective, has been our country's strongest ally in the fight against inflation.

As the nation's central banking system, the Federal Reserve exerts a very great influence on the flow of money and credit available throughout the country at any given time. By so doing,

it not only affects current business conditions but also the likely future course of our nation's economy.

The Federal Reserve does this through a number of powers which indirectly control the volume of credit that commercial banks can make available to individuals and companies. These powers had their origin in the creation of the Federal Reserve System in 1913.

When the System was first established (under the Federal Reserve Act of 1913), it was designed to prevent a repetition of the money panics which had periodically beset the country, and at the same time to foster economic growth and stability. As the preamble of the enabling Act stated, the Federal Reserve Banks were to be established "to furnish an elastic currency, to afford means of rediscounting commercial paper, to establish a more effective supervision of banking in the United States, and for other purposes."

Section 4 of the new statute charged the Federal Reserve Bank with making "such discounts, advancements and accommodations as may be safely and reasonably made with due regard for . . .

the maintenance of sound credit conditions, and the accommodation of commerce, industry and agriculture."

As presently organized, the Federal Reserve System is supervised by its Board of Governors, with headquarters in Washington. There are 12 Federal Reserve banks and 24 branches strategically located throughout the country. Forming the base of the structure are some 6,000 member banks (privately owned and operated under national or state charters), and which account for over 80% of total commercial bank deposits in the country.

All national banks are required by law to be members of the System, while state banks may join at their discretion if they meet certain requirements. The member banks assume certain obligations as members of the System, but at the same time enjoy numerous advantages.

The Federal Reserve is an independent agency within the framework of the Federal government. As William McChesney Martin, retired chairman of the Board of Governors of the System once expressed it, the System's place is "not



Top, the Federal Reserve Board's new chairman, Arthur F. Burns, took office Feb. 1.



Above, the retired Board chairman, William McC. Martin, has just completed 18 years' service.



When the 25th anniversary of the Federal Reserve was observed in 1938, this bas-relief was unveiled to honor Sen. Carter Glass (Va.) left, known as "father of the System."

independent of government, but independent within the structure of government." The Federal Reserve, by means of the Federal Reserve Notes it issues, is also responsible for most of the United States currency in circulation.

The Federal Reserve System, it has been pointed out, "is self-sustaining and is not dependent upon appropriations by the Federal Government. While not operated for profit, the Federal Reserve Banks not only pay their own way but at the present time turn over to the Treasury of the United States, after payment of expenses and dividends, all earnings over and above that amount required to maintain a surplus equal to their paid-in capital." In 1968, the Banks paid the Treasury more than \$2,463 million out of their total earnings.

The Federal Reserve System, under the direction of the Board of Governors, has sweeping powers over the nation's supply of money and credit. One of the most potent consists of its open market

operations, by which is meant its purchases and sales of securities, primarily government securities.

When the Federal Reserve, through its Open Market Committee, buys securities, the net effect is to increase the reserves (and hence the lending ability) of its member banks. Conversely, when the Federal Reserve sells securities, the effect is to contract the available supply of credit.

Most of the Federal Reserve's open market transactions are in government securities, but they also include a limited amount of bankers' acceptances and, from time to time, foreign currencies.

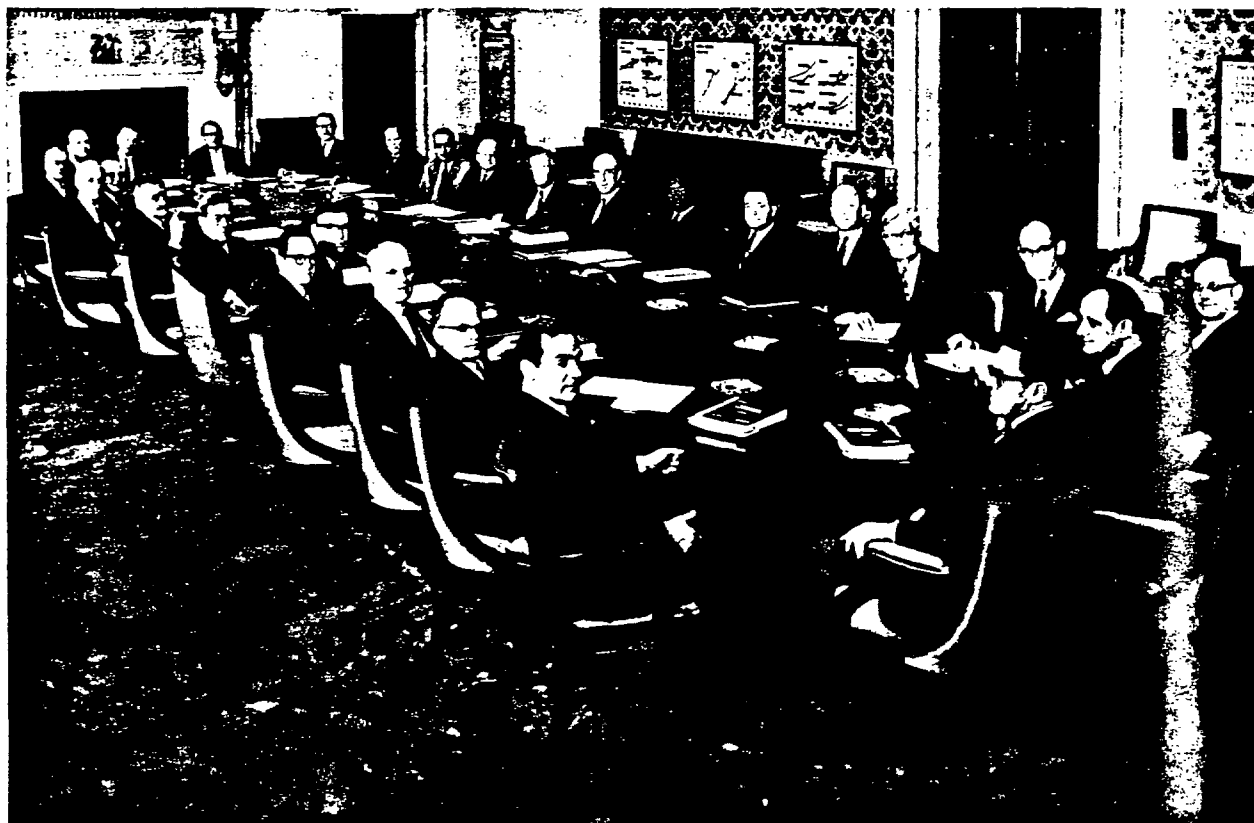
A second weapon in the Federal Reserve's financial arsenal consists of the reserves its member banks are required to keep as cash in their vaults or on deposit with a Federal Reserve Bank. As the total for these required reserves is raised or lowered by the Federal Reserve Board, member banks increase or

decrease their loans and investments. Consequently reserve requirements have a very direct effect on a member bank's ability to lend or invest its funds.

A third and related power is the Reserve's discount rate. This is the interest it charges member banks for loans.

Member banks have the privilege of borrowing from Federal Reserve banks to meet unusual demands for funds. The discount rate is raised or lowered as money market conditions may require. In addition to its direct effect on member bank loans, the Federal Reserve's discount rate frequently sets the pattern for all other short-term interest rates.

Among its other powers, the Federal Reserve regulates the flow of stock market credit, to prevent excessive speculation. Reflecting this, stock market margin requirements have been at the high level of 80 percent since June, 1968. The Federal Reserve also establishes the maximum rate of interest that its member



*The Federal Reserve's Open Market Committee controls the lending ability of System member banks.*

banks may pay on time and savings deposits.

Besides its basic function of regulating money and credit, the Federal Reserve also collects and publishes numerous economic and business statistics. For example, the Federal Reserve Board Index of Industrial Production is considered a key indicator of business conditions, and monthly changes in the index are followed closely by economists and businessmen.

Overseeing the operations of the Federal Reserve System is its Board of Governors, which meets in Washington. Each of its seven members is appointed to a 14-year term by the President of the United States. The President also selects one Board member to serve as chairman for a term of four years.

For the past 18 years, William McChesney Martin has been chairman of the Board of Governors, and in so doing has played a key role in the nation's economy.

After a distinguished career in the financial community, including a term as the first paid president of the New York Stock Exchange, Mr. Martin was appointed to the Federal Reserve Board by President Truman in 1951, and has since served under Presidents Eisenhower, Kennedy, Johnson, and Nixon.

With the January expiration of his incumbency as chairman of the Federal Reserve's Board of Governors, Mr. Martin has been succeeded by Arthur F. Burns, appointed to Board membership by President Nixon with senate approval late last year.

Mr. Burns, like Mr. Martin, has an economic background of distinction. He has served as Chairman of the Council of Economic Advisers in the Eisenhower administration as well as an economic adviser to President Nixon.

Paying tribute to Mr. Martin—and to the critical nature of his role in economic affairs over the years—President Nixon recently said of him, "It is diffi-

cult to think of any economic policymaker in this country, since the time of Alexander Hamilton, whose influence has been as considerable as Chairman Martin's over such an extended period of time. As Chairman Martin's term of office comes to an end, a grateful nation can salute him for the energy, dedication and the skill with which he has performed his important work. His tenure has coincided with an era of unsurpassed prosperity and economic growth."

More than ordinary importance attaches to the appointment of a new head of the Federal Reserve System, because of the widespread effects of Federal Reserve policy upon the nation's economy.

Federal Reserve actions not only influence current business conditions but also set the stage for what lies ahead. The future course of business activity will be determined to a large extent by Reserve Board decisions as to the best course of monetary policy to pursue. □



Index of Industrial Production charts are prepared regularly at the Federal Reserve's headquarters (background) in Washington.



Thomas Midgley, Jr.  
1889-1944

*He has made science a liberator, and we rejoice with him in the satisfaction that must be his in seeing the fruits of his labor. Posterity will acknowledge their permanent value.*

Dr. William Lloyd Evans  
Professor Emeritus, Ohio State University

As a future-oriented enterprise moving ahead with still more products and services for the needs of a changing world, Ethyl is continuing to capitalize not only on its noteworthy material assets and know-how in the field of industrial chemistry, but on the company's heritage of achievement and inspiration from key men of the past.

Ethyl's debt to the late Dr. Thomas Midgley, Jr. has exceptional dimensions when measured by any yardstick. Of all his major contributions to scientific knowledge, the most important is unquestionably his discovery of the anti-knock properties of tetraethyl lead. A breakthrough still assuring continuous progress in motorized transportation, it led to the founding of the original Ethyl (Gasoline) Corporation in 1924.

Annual tribute to this distinguished pioneer was paid again by the Detroit Section of the American Chemical Society, in cooperation with Ethyl, when its Thomas Midgley award for 1970 was presented on January 20 to Dr. Waldo L.

## THOMAS MIDGLEY, Jr.

Semon, the B. F. Goodrich Company's retired director of corporate forward technology planning.

Chosen for his outstanding achievements in chemistry "connected with products or processes used . . . by the automotive industry," Dr. Semon is the creator of plasticized polyvinyl chloride (PVC) and holds basic patents on it. The industry consumes some 200 million pounds of this versatile plastic material annually for car roofs, seat covers, trim, instrument panels and other automobile components.

As a footnote to the changing Ethyl of today, this occasion invariably brings out that a change in the direction of Dr. Midgley's professional interests and capabilities paved the way for distinctions he achieved and the honors he won. Although a mechanical engineer by education, all of his accomplishments and recognitions were in the field of chemistry.

Honors for the 1970 Midgley Award recipient followed Ethyl's quiet earnestness last fall when the company recalled respectfully the twenty-five anniversary of Dr. Midgley's death on November 2, 1944. Commenting at that time, Earl W. Webb, then president of Ethyl, described his colleague as "a man of genius, faith and courage. For Tom Midgley was more than an inventor, more than a scientist, more than one of the most creative chemists in the world. He was, as Dr. William Lloyd Evans of Ohio State University has said, 'a master of philosophical living,' and as such he remains a source of inspiration to us all."

Vice president of the company at the time of his death, he was the first man to hold simultaneously the offices of board chairman and president of the American Chemical Society. Dr. Midgley also was the first recipient of all of chemistry's "big four" awards—the Nichols, Perkin, Priestly and Willard Gibbs medals.

Senior men at Ethyl and others now retired are familiar at first hand with the way in which polio crippled their indomitable executive in 1940, when he was 52 years old.

But not even confinement to a wheel-chair prevented him from working continuously for the rest of his life, with the same enthusiasm, determination and drive characteristic of his entire career.

It is not easy to step back today and recapture the measure of the man. There were many brilliant and distinctive facets to his character, over and above his stature as a scientist, inventor, a breaker of precedents and an optimistic scholar ceaselessly pursuing the elusive.

Before opportunities for still more accomplishments were cut short by his death, the proceeds of Dr. Midgley's labor in the discovery and development of antiknocks were called the most important boon to automotive progress since the invention of the self-starter in 1912.

Tetraethyl lead or its companion, tetramethyl lead, are in such widespread use today that they improve about 97 out of every 100 gallons of gasoline consumed throughout the free world. These two additives, or combinations of

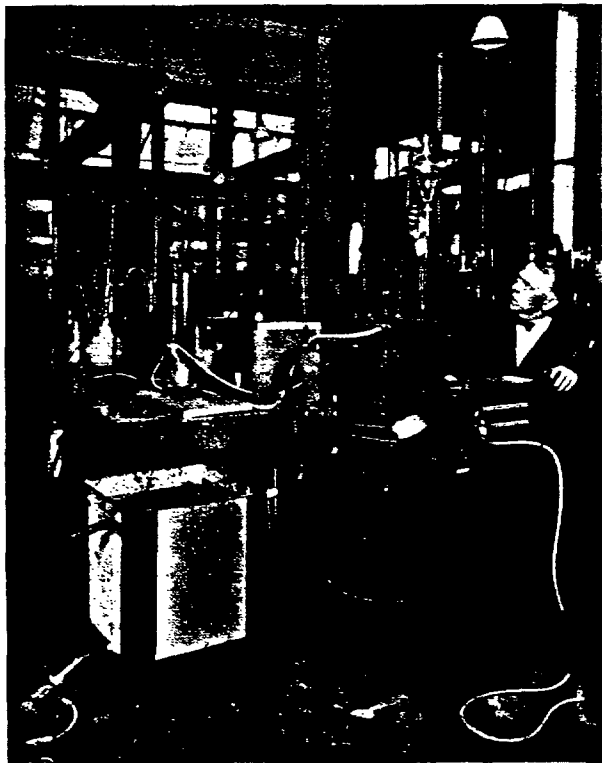
them, contribute significantly to the power, efficiency and economy of gasoline engines. Without the use of antiknocks, it would take at least 11 gallons of gasoline to do the work of 10 gallons of leaded fuel.

In economic terms, antiknock compounds save American motorists about \$2 billion annually on what they spend for gasoline.

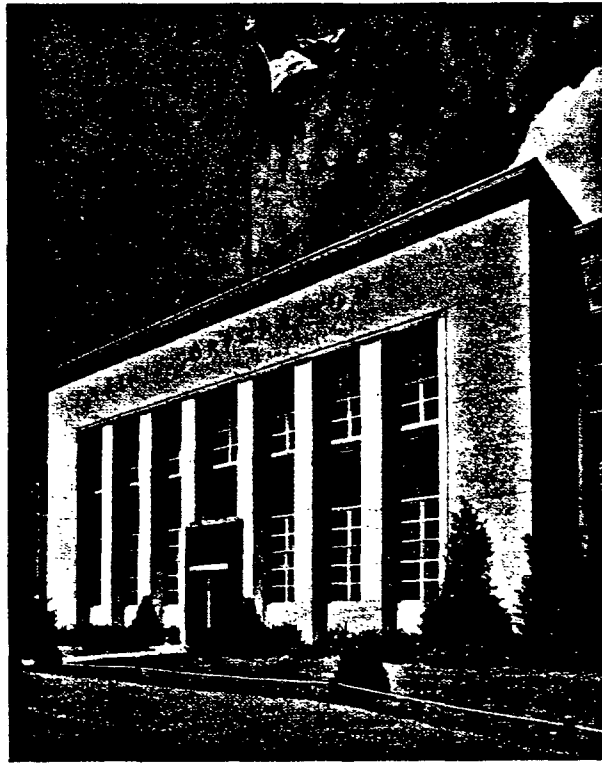
As the petroleum industry is aware, it takes only about a teaspoon of "Ethyl" antiknock compound to increase a gallon of gasoline's octane number (ability to produce power) to an optimum level. If refining processes alone were used to achieve the same results, less gasoline could be obtained from a barrel of crude oil. In other words, the general use of antiknocks is saving almost 200 million barrels of crude annually in the United States alone.

Another example of the long-range usefulness of Dr. Midgley's ingenuity is the way he collaborated with others on determining the feasibility of extracting bromine from

## **... "A source of inspiration to us all"**



*This makeshift apparatus was the first source of experimental and commercial TEL when Dr. Midgley's pioneering efforts for General Motors were underway early in the 1920's.*



*In addition to continuous studies of antiknocks today, Ethyl also is investigating broader inter-related engine, fuel and lubricant problems at its modern Research Laboratories.*

sea-water. By inventing Freon, the non-toxic, non-inflammable refrigerant, he was instrumental in making possible modern refrigeration and air-conditioning systems. Dr. Midgley's researches into the chemistry of rubber were years ahead of their time.

Coming from a family of inventors probably contributed to his fascination with new ideas. A demountable rim for automobile tires was one of his father's creations, as well as improved tire cord. Dr. Midgley's maternal grandfather invented the inverted-tooth saw. Family lore had it that an English ancestor worked closely with James Watt, inventor of the steam engine.

A native of Beaver Falls, Pa., the potential chemist spent most of his boyhood in Trenton, N. J. before entering Betts Academy in Stamford, Conn. Enthusiasm for sports brought about what in all likelihood was the juvenile Midgley's first invention—coating a baseball with slippery elm extract so that pitchers could throw spit-ball curves more effectively.

Young Tom was following his father's wishes when he graduated from Cornell in 1911 with a degree in mechanical engineering. His formal education in chemistry had been limited to high school studies supplemented by university courses in quantitative analysis and general chemistry. There was no indication that a brilliant future as a chemist lay ahead.

Engineer Midgley's first position immediately after graduating was as a draftsman and designer with the National Cash Register Company in Dayton, Ohio. Then his father's request for help at the Midgley Tire and Rubber Company prompted a move to the family enterprise. Not long afterward, however, financial problems forced the firm's liquidation in 1916—and Thomas Jr. found himself jobless.

A decision pivotal to the course of his career was reached at that time. The unemployed Midgley made up his mind to abandon mechanical engineering in favor of the challenges

of broader experimentation. In doing so, he accepted placement as a research laboratory assistant with the Dayton Engineering Laboratories Company—an enterprising manufacturer of electrical equipment for automobiles, including the self-starter. The company also had a burgeoning business in making engine-driven electric generators for use on farms.

Founded by the distinguished scientist and inventor, Dr. Charles F. Kettering, Delco provided its 27-year-old neophyte with the kind of stimulating environment he had been looking for. Even more meaningful was the beginning of long, productive and rewarding Midgley-Kettering association, cemented by mutual respect and close ties of "Boss Ket" and "Midge" friendship.

With Dr. Kettering as mentor and constant source of encouragement and inspiration, "Midge" immersed himself in new projects, at first comparatively minor ones. Then a challenge without precedent at Delco or elsewhere added new dimensions to the new research assistant's responsibilities.

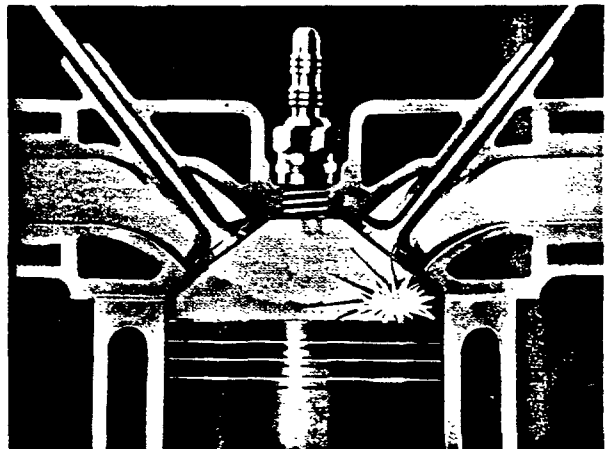
"Boss Ket" asked young Midgley one June day in 1916 to try his hand at finding out what was causing knock in the company's farm lighting plant engines, and how to stop it. As well as cracking cylinder heads and pistons in Delco equipment operating on kerosene, the troublesome phenomena was beginning to occur in the gasoline engines of automobiles too.

Knock was a complete mystery in those days. There was no certainty that its effects had mechanical, electrical or fuel origins, although the astute Dr. Kettering, inventor of the automobile self-starter, had some evidence pointing to fuel. The only indisputable knowledge was that internal combustion engines were subject to knock's hammering and damage.

Neither was it understood at first that what seemed like a problem relating only to the operation of a single kind of low compression farm unit was in reality a formidable barrier to progress in motorized transportation. By preventing the development of more powerful, efficient and economical engines, knock was braking much too effectively the



Dr. Midgley, left, and "Boss Ket" reminiscing in 1943 at an informal 20th anniversary observance of "Ethyl" gasoline's first public sale in Dayton, Ohio.



As this diagram shows, knock is a sudden detonation of unburned fuel in an engine's cylinder—causing loss of power and at times severe damage.

automobile industry's efforts to improve its gasoline powered cars for a world demanding more and more of them.

From the beginning, Dr. Midgley was intrigued by his new assignment, particularly its opportunity to explore and master the unknown. So were colleagues joining him in due course, the first of whom were T. A. ("Tab") Boyd, destined for future distinction in General Motors research, and Carroll A. Hochwalt, in later years a key executive with Monsanto Chemical Company and Chemstrand Corporation.

What lay ahead of them was seemingly endless futility. There were to be hundreds of dead ends as more and more ways and means were tried to suppress knock. Weeks were to run into months and months into years of more tests, more money spent and more failures. It is estimated that the discovery of tetraethyl lead's usefulness cost some \$3-million.

In the course of confirming Dr. Kettering's suspicion that fuel behavior caused knock, and for a better understanding of the phenomena, Dr. Midgley developed early in his investigations the optical indicator which bears his name. A high-speed recording device, the indicator magnified and showed visibly the course of increasing pressure within an operating engine's cylinder. A sharp upward spurt in pressure always coincided with every knock. A rise in temperature occurred too.

Another innovation let the researchers see what was happening inside a test engine. Dr. Midgley bored a hole in a cylinder's side and plugged it with transparent quartz. Through this window a blue flame was noted when fuel burned as the engine ran normally. At times, however, this quick but smooth burning would stop before all vaporized fuel and air in the cylinder had been ignited. Then there would be a white hot spontaneous flash of the remaining fuel-and-air mixture—an explosion which was knock in visible form.

It was logical to theorize at this time that to prevent detonation, a dark fuel might absorb enough of the intense heat generated by knock. This train of thought was touched off by "Boss Ket" in recalling how the reddish underside of arbutus leaves draws enough warmth from spring sunshine for the plant to flower before snow melts. Although the theory proved invalid, investigating it determined for the first time that the problem of knock control was indisputably a chemical one.

It was entirely by happenstance that Dr. Midgley used iodine crystals to color his test fuel a rich purplish-red. After starting the laboratory engine and running it with ordinary fuel until knock began, the iodine-mix was added. Immediately the hammering detonations stopped.

Excitement was short-lived, however. Regardless of its knock-suppressing properties, iodine was too expensive for general use as a kerosene or gasoline additive. Another serious drawback was the way impetive deposits built up. All hope of finding a way to prevent knock by a color route was abandoned when Dr. Midgley and his colleagues found that the use of standard oil-soluble dyes made no difference whatever.

Before the antiknock research group could begin probing into the chemistry of iodine's ability to overcome knock, America's entry into World War I compelled shelving such

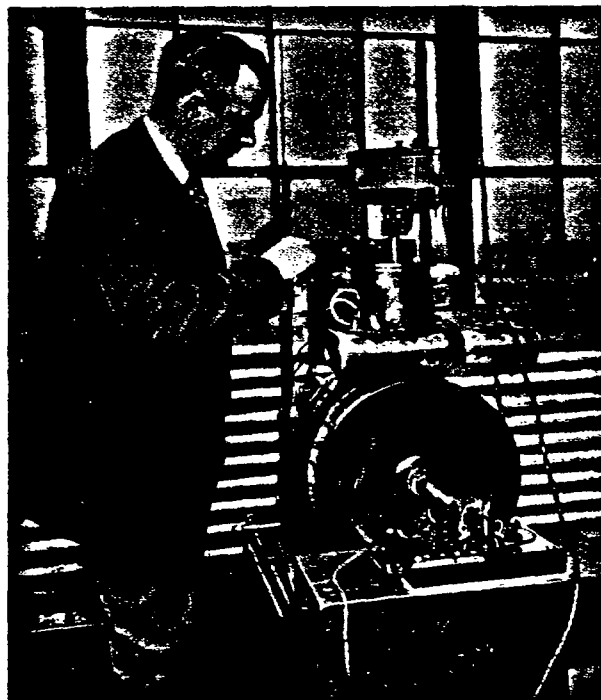
efforts in favor of more urgent projects related to the nation's military requirements.

The Kettering laboratories' first assignment from Washington was to develop an aviation fuel much less subject to knock than the 55 octane gasoline (estimated) then in use. Dr. Midgley and his colleagues achieved another breakthrough by discovering that the molecular structure of a fuel is closely related to its ability to withstand knock. When it was concluded that improved aviation gasoline of the necessary composition could not be obtained from natural sources, the wartime project evolved into laboratory creation of the world's first synthetic fuel.

Consisting of 70 percent cyclohexane and 30 percent benzene, this man-made gasoline—through greatly increased antiknock quality—proved to be not only comparatively free from knock, but at the same time it permitted an increase in the compression ratio of airplane engines from the then usual 5.5 to 1 to what was considered an incredible high of about 8 to 1. Government plans to produce the synthetic fuel were dropped, however, when the war ended.

The armistice of 1918 also grounded another successful aerially-oriented project which "Boss Ket," Dr. Midgley and others had just completed—the first unmanned flying torpedo steered gyroscopically and armed with 300 pounds of explosive. It was the predecessor of Germany's "buzz-bomb" of World War II and antecedent of today's more sophisticated missile weaponry.

Inasmuch as there was little likelihood that its synthetic aviation fuel would be taking the place of orthodox gasoline



It was with this laboratory engine that Dr. Midgley and his colleagues discovered the antiknock properties of tetraethyl lead in 1921.

in peacetime ground transportation, the Midgley group resumed research on knock within a few weeks after the end of hostilities abroad. No progress of any consequence was made, however, until January of 1919, when aniline was found to be a better knock-suppressor than iodine.

This discovery, although without lasting usefulness, literally saved the day for all those dedicated to overcoming knock. Laboratory instructions had just been issued to abandon the search if there were no satisfactory results within the next two weeks. Then a further boost to morale followed an army plane's new altitude record achieved on gasoline containing xylidine—another experimental antiknock additive.

These rewards of early 1920 were accompanied by General Motors' acquisition of the Kettering properties and interests in Dayton, and the appointment of "Boss Ket" as director of the General Motors Research Corporation, where Dr. Midgley and crew continued their work on overcoming knock.

Extensive testing of aniline followed, including its use in a device which Chemist Midgley invented to inject aniline into an engine's fuel supply at high throttle. A discouraging side-effect was the disagreeable odor which the chemical added to exhaust gases. As other chemical additives were tested, some of them were even more offensive: diethyl telluride, for example, generated an overpowering garlic-like aroma which proved almost unendurable, although the tellurium compound was an excellent knock suppressor.

More experiments continued after "Midge" and "Tab" Boyd perfected their bouncing-pin indicator during the summer of 1921. This instrument, used with the already developed Midgley Optical Indicator, made possible extremely accurate measurement of knock intensity—which in turn increased chances for finding an acceptable antiknock additive.

By fall, without realizing that they were closing in rapidly



One of many professional distinctions won by Dr. Midgley, right, was the coveted Perkin Medal, presented in 1937 by Prof. M. T. Bogert for the Society of the Chemical Industry.

on a quarry which had been eluding them for five years, Dr. Midgley and his assistants began a uniquely logistical approach to their investigations. Based on chemistry's Periodic Table of the Elements, it was a new method of tracking down specific agents most likely to affect knock.

Their first attempt with this untried-before approach was successful in pinpointing the antiknock properties of tetraethyl tin, although the metallic compound was apt to induce pre-ignition in the laboratory's test engine.

Then, as planned, tetraethyl lead was the next trial additive—in those days a laboratory curiosity without known uses. Results were immediate. TEL was vastly superior to any other chemical in assuring smooth, quiet engine operation. Jubilant over their achievement that memorable day of December 9, 1921, Dr. Midgley and his men, as he often said in retrospect, "danced a non-scientific jig around the laboratory."

Paving the way as it did for continuing progress in motorized transportation, the discovery of tetraethyl lead as a commercially successful antiknock agent established a secure place for Dr. Midgley in the top ranks of America's chemists. His stature grew as his achievements multiplied in such ways as developing non-flammable and non-toxic Freon refrigerants from normally hazardous chlorine and fluorine.

In addition to receiving the American Chemical Society's "big four" awards between 1922 and 1942, Dr. Midgley was honored by the Franklin Institute of Philadelphia when he was presented with its Longstreth Medal. The National Academy of Sciences invited his membership. Honorary degrees were conferred on Dr. Midgley by the College of Wooster, Ohio and Ohio State University.

In addition to being Ethyl (Gasoline) Corporation's vice president, Dr. Midgley also was a director of the Ethyl-Dow Chemical Company and vice president of the Ohio State University Research Foundation. The author of numerous scientific papers, he was still better known for many patents in his name.

Dr. Midgley believed strongly in the value of professional societies. He belonged to the American Association for the Advancement of Science, the American Institute of Chemical Engineers and the American Society for Testing Materials. He was instrumental in founding the National Inventors' Council in 1940 and had a major part in organizing the Centennial Celebration of the American Patent System in 1936, as well as the celebration of the United States Patent Law Sesquicentennial in 1940.

Of all those who worked long and closely with Dr. Midgley, "Boss Ket," Ethyl's first president, was the one who saw the full measure of the mechanical-engineer-turned-chemist the most clearly.

"Midge," Dr. Kettering once observed, "was not only an inventor—he also had the ability to give an invention practical usefulness, and sell and educate the public as to its advantages. The combination of these three things in an individual seldom occurs."

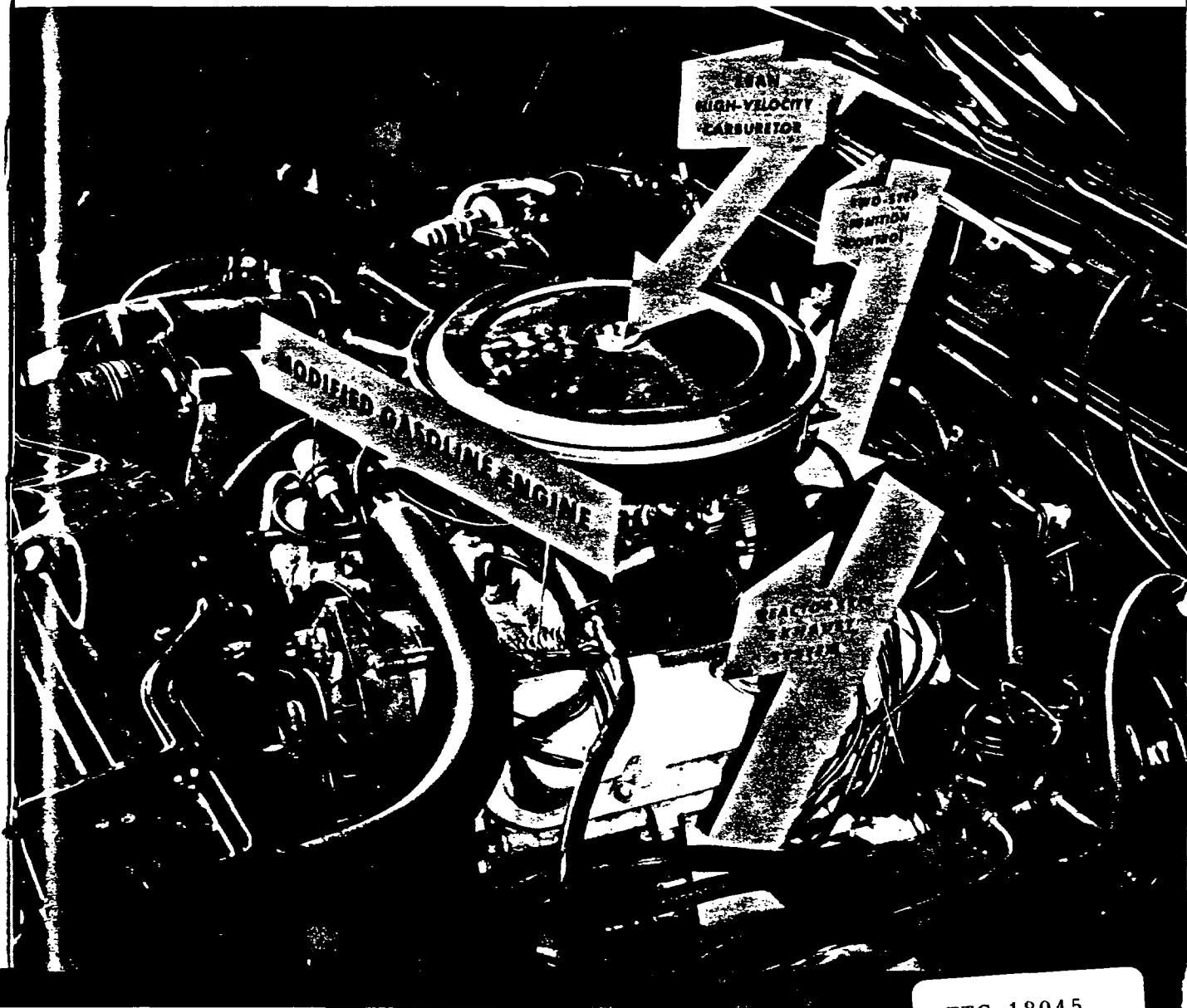
"He was a great crusader as well as a great scientist . . . His work and inventions have added greatly to the industrial and economic status of the world in which we live today, and these same ideas will undoubtedly influence progress and scientific thinking in the new world of tomorrow." □

# LEAN REACTOR CAR CUTS EXHAUST EMISSIONS

Ethyl offers  
experimental engine changes  
as contribution  
to air pollution control

An engine modified to produce very low exhaust emissions while operating on conventional leaded gasoline stands as the latest success in Ethyl Corporation's long-range program of research aimed at minimizing automotive exhaust emis-

sions without impairing the high level of on-the-road performance that motorists insist upon. The experimental engine has been installed in a standard late-model automobile—the unit as a whole known as the Ethyl Lean Reactor Car.





Company-developed engine improvements in the Ethyl Lean Reactor Car achieve extremely low levels of hydrocarbon and carbon monoxide emissions and substantially lower nitrogen oxide emissions. These results come from significant modifications of the vehicle's induction, ignition, and exhaust systems.

Emissions have been reduced to less than 50 parts per million (ppm) unburned hydrocarbons, 0.4 percent carbon monoxide, and 600 ppm nitrogen oxides—all in line with air cleanliness standards established for the years ahead. Each improvement has been achieved without sacrificing the car's performance and driveability.

Ethyl's major modifications are (1) an experimental high-velocity carburetor,

including deceleration control and improved choke; (2) a two-step control of vacuum ignitions advance; and (3) an exhaust system that includes stainless steel port liners, insulated stainless steel exhaust reactors, and a large insulated exhaust pipe. In addition, adaptations of systems developed by the automotive industry are used to control crankcase emissions and evaporative losses.

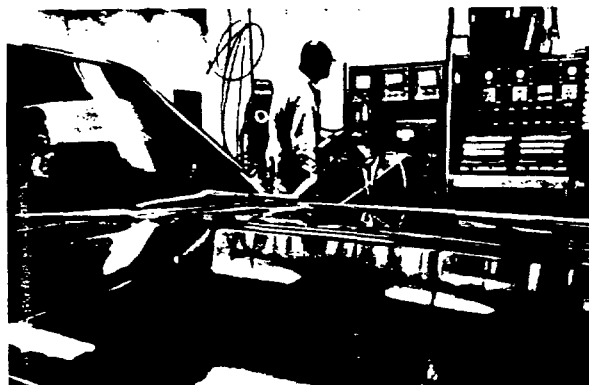
The high-velocity carburetor feeds thoroughly mixed fuel and air to the engine's cylinders, permitting satisfactory car operation on extremely lean air-fuel mixtures. Low emissions levels of carbon monoxide, unburned hydrocarbons, and nitrogen oxides are assured by these lean mixtures. They also provide substantial oxygen in engine exhaust.

This hot and intimately mixed oxygen is then available to combine with unburned fuel constituents in the heat-conserving exhaust reactor system. Since the amount of unburned materials left to be consumed in the reactor is small, problems of high temperatures in the exhaust reactor system are minimized.

The Ethyl Lean Reactor Car was demonstrated at Newport Beach, California, in late August for and at the request of President Nixon's Cabinet-level Environmental Quality Council. Other government officials and key state legislators and local authorities were among those attending. Chrysler, Ford, General Motors, and several other leading companies and organizations active in the field of vehicle emissions control also



A table display of Lean Reactor Car components (above, left) attracting the attention of George Romney, former governor of Michigan and now Secretary of Housing and Urban Development, right. Explaining them is Frederick J. Marsee, Ethyl Automotive Research.



Among prominent federal and state officials scrutinizing the Ethyl car thoroughly were George Murphy, above, California state senator.

Ethyl developed its experimental car (left) at the company's Detroit Research Laboratories, where various changes were tried to achieve optimum results.

participated in the demonstration-exhibit, displaying not only gasoline-powered vehicles but also a gas turbine car and trucks, steam cars, fuel-cell and electric cars, and natural-gas vehicles.

The purpose of the exhibit was to give Environmental Quality Council members an opportunity to observe at first hand and en masse the substantial progress that industry has scored in reducing automobile exhaust emissions.

Among those on hand were the Secretaries of Agriculture (Clifford Hardin), Interior (Walter Hickel), Commerce (Maurice Stans), Housing and Urban Development (George Romney), and Transportation (John Volpe). Also attending were Dr. Lee A. DuBridge, science advisor to President Nixon and executive

secretary of the Environmental Quality Council; U. S. Senator George Murphy of California; Laurance S. Rockefeller, chairman of the Environmental Quality Council's citizens advisory committee; Dr. A. J. Haagen-Smith, chairman of the California Air Resources Board; and Mayor Sam Yorty of Los Angeles.

As Ethyl Corporation pointed out in a statement prepared for members of the President's Environmental Quality Council:

"Ethyl's research has identified a number of approaches to reduction of vehicle emissions. These approaches combine uniform lean mixtures with burning in the exhaust system to produce very low emissions. To date, these modification concepts have been applied to a

limited number of experimental vehicles. However, the trends should apply broadly.

"We recognize that these low emission levels have been attained in a research study. Application of these principles to production vehicles and production of automotive components in large volume involves many additional problems.

"Nevertheless, this work demonstrates that approaches do exist for reducing vehicle exhaust emissions to low levels. We are confident that the problems can be solved and that vehicles powered by conventional piston engines can have acceptably low emissions while running on the gasoline in use today." □

# DEVELOPMENTS



Floyd D. Gottwald, Jr.



Bruce C. Gottwald



M. F. Gautreaux



James M. Gill



C. Raymond Hailey



Robert Herzog

## COMPANY ELECTS NEW EXECUTIVES

Ethyl is beginning the 1970's with a new chief executive officer, a new president, additions to its board of directors, and new corporate management positions for other key executives.

The company's newly-elected chief executive officer is Floyd D. Gottwald, Jr., since 1968 chairman of the board of directors, a position in which he will continue. Chosen for his new post in January, Mr. Gottwald succeeds his father, who is remaining chairman of the executive committee.

Ethyl's new president, who was elected in December, is the chief executive officer's brother, Bruce C. Gottwald, a director and executive committee member. Formerly executive vice president and corporate secretary, he is filling the vacancy left by Dr. George F. Kirby, who has resigned as president to accept another position elsewhere. Dr. Kirby remains a director and also will serve Ethyl in advisory capacities.

Other board action in December includes promotion to executive vice president for Robert Herzog, who had been vice president of Planning. At the same time, he was elected a director and an executive committee member too. Another newly elected director is James M. Gill, formerly Chemical Group vice president. He also has been promoted to senior vice president of the company.

Clarence M. Neher, until the December board meeting vice president and general manager of the Plastics division, is the other new senior vice president. He is to be nominated as a director at the next annual stock-



A. B. Horn



Clarence M. Neher



Richard K. Scales



Frederick P. Warne

holders' meeting in April or earlier if any vacancy occurs.

Four new corporate vice presidents have been elected. They are M. F. Gautreaux, general manager of Research and Development; C. Raymond Hailey, executive vice president of the Oxford Paper Company division; A. B. Horn, vice president and general manager of Ethyl International division; and Richard K. Scales, assistant to the president.

Mr. Gautreaux is succeeding Kenneth Swartwood, who is retiring later this year as R & D vice president.

In addition to continuing as general counsel for the company, Frederick P. Warne is now the newly-designated corporate secretary as well. Arthur W. Helwig, director of Long-Range Planning and Profit Improvement, is being assigned further responsibilities as executive committee secretary.

Ethyl's new chief executive officer, as well as its newly-elected president, have been key executives of the company since the 1962 merger of the original Ethyl Corporation (Delaware) and the Albemarle Paper Manufacturing Company of Richmond into the

present Ethyl Corporation (Virginia).

Both brothers are Virginia Military Institute graduates with degrees in chemistry. Each has held positions of increasing responsibility with Albemarle Paper and Ethyl.

**New chemical building-blocks.** As intermediates for use in the manufacture of pesticides, pharmaceuticals, flame retardants and other products, Ethyl is introducing two additions to its growing family of alkyl phosphorous chemicals.

These compounds, available in developmental quantities, are methylphosphonous dichloride (MPD) and methylphosphonothioic dichloride (MPTD). Clear liquids soluble in paraffin hydrocarbons, ethers, and aromatic solvents, they react with amines, mercaptans, alcohols, phenols, water and certain salts.

The new phosphorous alkyls are available from the Commercial Development division, Ethyl Corporation Research Laboratories, 1600 West Eight Mile Road, Detroit, Michigan 48220.

**Guide to modern waste treatment.** An illustrated brochure is being offered by Ethyl to highlight features of the company's newly-improved "Floco" system for the scientific treatment and purification of municipal sewage and water containing industrial wastes.

A honeycomb-structured filter media made with the company's polyvinyl chloride (PVC), "Floco" is engineered to increase the unit efficiency and loading capacity of sewage and waste treatment units. As the brochure points out, the Ethyl plastic filter material is light, durable, inert, stable and immune to attack by chemicals or bacteria.

The publication explains how the patented PVC modules avoid the shortcomings of such conventional packings as stone and gravel. It also notes that the use of "Floco" permits engineers to introduce new thinking in the design of waste treatment facilities—whether operating for complete or supplementary purposes.

Copies of the brochure are available from the Commercial Development division, Ethyl Corporation, Ethyl Tower, 451 Florida Boulevard, Baton Rouge, La. 70821.



Lewis F. Powell, Jr.



Melvin C. Hudgins

Richmond, Va. law firm of Hunton, Williams, Gay, Powell and Gibson, has been honored for public service by the Old Dominion Chapter of the Public Relations Society of America, which presented him recently with its Thomas Jefferson Award for 1969. Mr. Powell is prominent in efforts to reduce crime . . .

**MELVIN C. HUDGINS**, resident manager of the Ethyl plant in Pasadena, Texas since 1956, has been elected president of the Texas Chemical Council for 1970-71.

**In keeping with plans for continuous growth**, Ethyl acquired controlling stock interest in an aluminum fabricating company in December: The Capitol Products Corporation of Me-

chanicsburg, Pa. The transaction involved purchasing at \$17 a share 986,422 shares or approximately 56 percent of Capitol Products' outstanding stock.

Newly elected officers of Capitol Products include Thomas M. Smylie, vice president of Ethyl, who is to be chairman of the board and chief executive officer. The new president is Joseph T. Colliflower, former executive vice president of Capitol.



Thomas M. Smylie

Other new members of the Board of Directors from Ethyl are Bruce C. Gottwald, president, and Frederick P. Warne, corporate secretary and general counsel. Four Capitol Products directors are continuing in office among them George S. Thumler, treasurer.

With annual sales of some \$28-million, Capitol Products specializes in fabricating aluminum frame doors, windows and additional aluminum products. It also supplies aluminum billets to other manufacturers.

## Other News About People...



James J. Bergin



William C. Strader

**JAMES J. BERGIN**, resident manager of Ethyl's chemical plant at Baton Rouge, La. since 1966, has been appointed to the newly-created position of control manager-operations for the company's Manufacturing department. He has been succeeded by **WILLIAM C. STRADER**, formerly the plant's assistant resident manager . . .

**LEWIS F. POWELL, JR.**, a director of the company and partner in the

## PRODUCTION NOTES

**PRINTING/** This issue of the Ethyl Magazine has been printed by offset lithography on a #61 Miehle, four-color 43x60 press at 5,500 impressions per hour. Color sequence was yellow, blue, black and red. **TYPOGRAPHY/** Body copy set 9/10 Optima with semi-bold and italic. Supplementary copy, pages 10-11, set 8/9 Optima italic. Pages 34-35 set 9/10 Melior. **PAPER STOCK/** The paper is 80 lb. Solitaire Gloss, produced by the Oxford Paper Company, an Ethyl Corporation division, at the Oxford mill in Lawrence, Mass. Suitable for both offset and letterpress printing. Solitaire is a medium-priced coated stock with high brightness and gloss usually found only in more expensive papers. Solitaire also is available in dull and embossed finishes—in matching text and cover weights. Additional information about Solitaire and other fine printing papers is available from Oxford Paper representatives.

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Alum  
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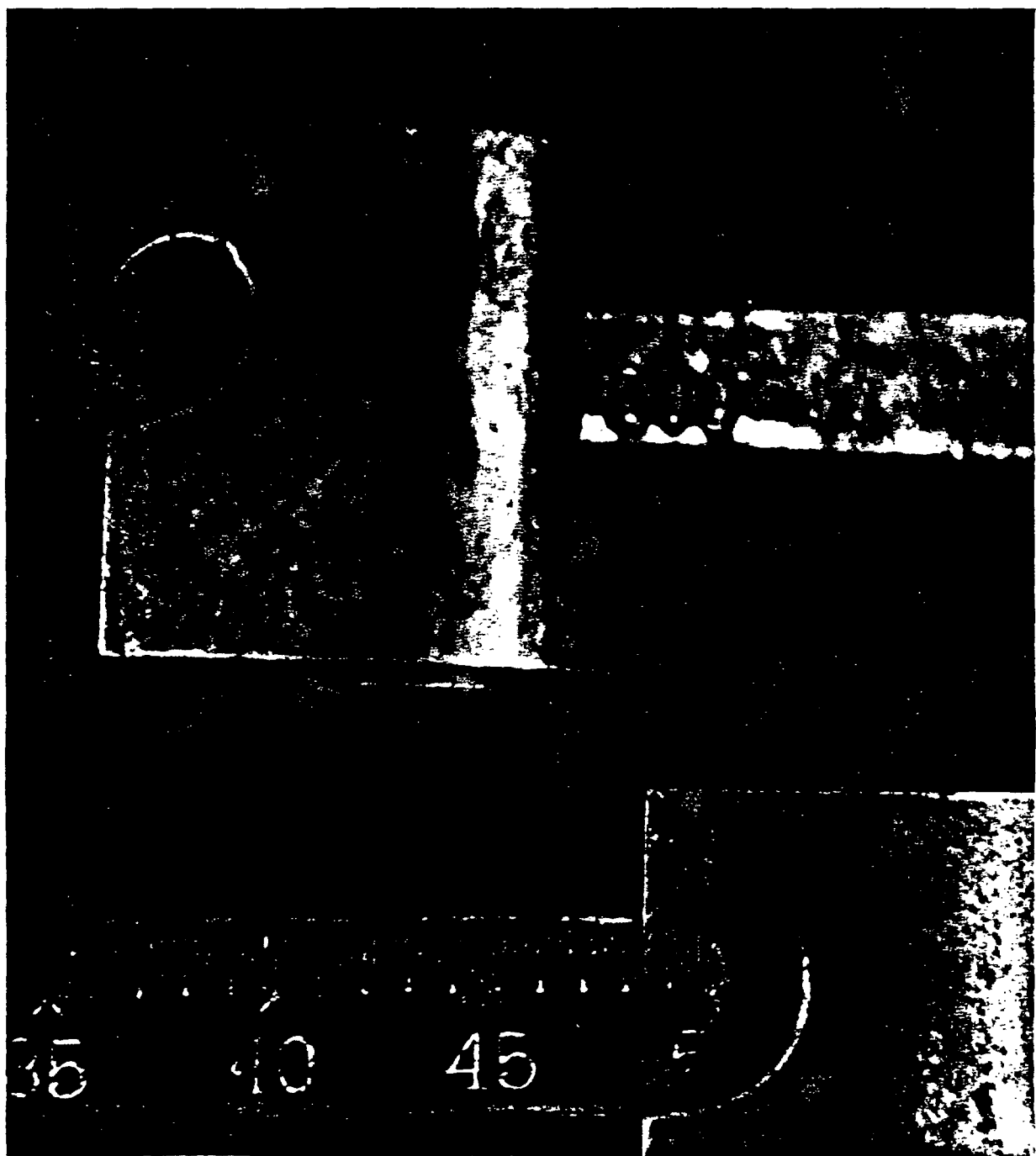
#### **ALUMINUM PRODUCTS**

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TWO/1970

**Ethyl**  
MAGAZINE



ETC 18051

TWO/1970

# Ethyl MAGAZINE

## LEADED OR NON-LEADED GASOLINE . . . WHAT ARE THE FACTS?

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This comprehensive survey focuses attention on the positives of continuing to use lead and the negatives of its elimination.

## CLEAN AIR CAR RACE

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A novel coast-to-coast summer race, with a set of complex rules, was staged by college students in vehicles with different kinds of engines, which may help solve automobile emission problems.

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14

Industrial and commercial growth, a boom in construction and rising per capita incomes are among developments affecting Virginia's capital.

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## ALUMINUM: FROM TERRA FIRMA TO FIRMAMENT

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### Acting Editor

Stanton P. Nickerson

### Contributing writers

James E. Donahue, 3rd.

Burr J. French

S.A. Gendernalik

A. Prescott Rowe

Christopher C. Vogel

Thom Yates

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**Cover illustration, SCALES:** Although largely supplanted by modern devices of greater sophistication, this familiar beamscale—photographed by Irving J. Olson—can be said to symbolize man's never-changing need to make just and reliable evaluations, whether in physically weighing various materials or in mentally weighing both sides of a subject, such as the current controversy about leaded gasoline (see Page 4).

## MORE GROWTH AHEAD

Extending the dimensions of its stature as a source for more and better products which a changing world is bound to need is part and parcel of Ethyl Corporation's growth and prosperity objectives during the 1970's and beyond.

Back in the early 1960's, Ethyl was basically a one-product company with annual sales of less than a quarter billion, of which close to 70 percent came from the manufacture and marketing of lead antiknocks. Annual sales today are exceeding half a billion.

By far the largest part of this total represents income from scores of different products. They include intermediate and finished plastic output, fine printing papers, aluminum products for building, transportation and marine markets, and a variety of industrial chemicals.

Growth through planned diversification is a way of life at Ethyl—a growth we plan to continue. Ahead are more prospects for significant achievements, not only in the United States and Canada, but on world-wide fronts as well.

ETC 18052



ETC 18053

# LEADED OR NONLEADED GASOLINE? WHAT ARE THE FACTS?

One of the most perplexing developments in national efforts to reduce air pollution from automobile exhaust is the current proposal to restrict and eventually eliminate lead antiknocks from gasoline.

After acquiring a wealth of expertise in the field of engine/fuel relationships for almost 50 years, Ethyl Corporation has ample data to show that such a course of action would not only fail to achieve its objectives, but generate new problems as well.

At the same time, there is substantial evidence that support for "Get the Lead Out" comes more from misunderstanding, uncertainty and distortion than from enlightened awareness of the realities described and discussed here.

## EFFECTS OF LEAD REMOVAL

Although the reasons given for using nonleaded fuel have been cited repeatedly in the press, the effects of lead removal have not been given equal coverage.

- Instead of reducing air pollution, lead removal will actually increase smog-forming constituents in car exhaust.
- In contrast, investigations at an independent research laboratory have established that the combustion products

## Sequence of Events

The present furor over nonleaded gasoline was triggered on January 14 when GM President Edward Cole, in a speech to the Society of Automotive Engineers, recommended removal of lead from gasoline by 1975. His main reason was that lead would interfere with the operation of emission-control devices proposed to meet the 1975 emission standards. The following events followed in quick order.

- Ford President Henry Ford II sent a letter to 19 oil companies stating that Ford would modify its engines for lower-octane nonleaded gasoline whenever such fuel became available and asking the companies to "explore the possibility" of marketing nonleaded gasoline.
- Led by Atlantic Richfield, a number of oil companies stated that they would supply nonleaded gasoline if the automobile companies build engines to use it.
- GM announced that its 1971 and later cars will be designed to operate on nonleaded fuels of about 91 Research octane number. Ford and Chrysler subsequently stated that most of their 1971 models will be able to operate on this fuel.
- Following day-before hearings of the California Air Resources Board (CARB), GM altered its position on nonleaded gasoline and suggested a 2-grade system consisting of a 91-octane fuel containing a maximum of 0.5 g lead/gallon and a 97-octane fuel containing up to 4 g lead/gallon.
- Ford stated that it believes the auto and oil industries will compromise for the short range on a 91-octane gasoline containing 0.5 g lead/gallon. Starting with the March hearings of the CARB, Ethyl, DuPont, automobile manufacturers and petroleum companies have testified at formal and informal hearings before state and federal bodies.

The following article, prepared by fuel/engine specialists at the Ethyl Research Laboratories in Detroit, is based on Ethyl's statements at these hearings and at other times. Ground covered includes projections often unrecognized or overlooked, especially some of the adverse effects of lead removal.

of lead antiknocks do not contribute to photochemical smog reaction.

- Lead removal will increase the eye-irritating effect of car exhaust by increasing its aldehyde content.
- Lead removal will expose the millions of cars on the road to excessive exhaust valve seat wear, with resulting several-fold increases in exhaust emissions.
- The use of emission-control systems requiring nonleaded fuels would impose a tremendous cost burden on the motoring public amounting to billions of dollars per year, starting in 1975.

**Costs of lead removal:** The cost of nonleaded gasoline to the motorist will largely depend on the route taken—two gasoline grades or three—91 octane or gasolines of present octane quality (94-RON regular and 100-RON premium), mixes of nonleaded and leaded fuels, etc.

Regardless of the approach, the motorist will have to pay more for nonleaded fuel. Some indication of how much is provided by the prices of 91-octane nonleaded fuel recently introduced on the market.

Texaco, the first to provide a 91-octane unleaded fuel, is marketing its fuel on a limited basis in the Los Angeles area at a pump price about 5-6 cents above that of its higher-octane leaded regular. And American Oil, until recently the only vendor of lead-free gasoline (Amoco Super Premium), started marketing a 91-octane unleaded fuel in the Detroit and Chicago areas at a pump price about 3 cents above its higher-octane leaded regular. Subsequently, Atlantic-Richfield and Standard Oil (California) introduced 91-octane unleaded gasolines at retail prices of 3 cents above leaded regular.

Subsequent to its introduction of unleaded gasoline, Texaco stated: "We will continue to supply whatever fuels the markets require—and this includes unleaded gasoline. But the company is concerned that decisions which affect the market be made with full knowledge of all the parameters involved and with reasonable assurance that emission goals are attained at a minimum total cost to the consuming public. . . . A refiner may be able to produce for a limited market one grade of gasoline having no lead by selecting the highest octane components for this specific product.

"On a nationwide basis, however, he would be unable to produce an unleaded gasoline in substantial volumes, meeting 91-octane requirements, without substantial investment in processing equipment."

In discussing the costs of producing unleaded gasolines, Texaco cited the American Petroleum Institute's Bonner and Moore study, which concluded that based on 1965 refining costs, \$4.235 billion in expanded and new facilities would be necessary to raise the industry pool 7.8 octanes (from 88.6 to 96.4). Texaco also stated, "Updating this figure to allow for today's inflation, rate of return and increased volumes of gasoline, the added refining costs would be 5.17 cents a gallon (a \$10.8 billion investment)."

**Meeting 1975 standards with catalysts:** The possible use of exhaust catalysts to meet 1975 standards has been widely cited as a primary reason for unleaded fuels. The impression is given that this approach is essentially worked out and that it would be practical to adopt such catalytic converters without a great deal of further development if unleaded fuels were available.

However, there are still a great many problems that face the catalytic converter. Unless these problems can be solved, there is considerable question as to whether the catalytic converter could be a practical solution with either leaded or unleaded fuels.

One of the persistent problems is catalyst attrition and loss. The catalyst is exposed in road service to many factors that tend to break it up—repeated heating and cooling, vibration, abrasion and rubbing, exposure to water and condensates, and freezing.

This is a difficult problem to solve because catalysts are inherently quite porous materials in order to provide a large surface area and thus achieve a high level of activity in a reasonably small space. Consequently there are limitations as to how hard a catalyst can be made and still have the desired activity. Thus, there are substantial mechanical problems with the catalyst itself, particularly in terms of long-service mileage under adverse conditions.

In a 1969 Society of Automotive Engineers' paper reporting the results of studies of catalysts using leaded and unleaded fuels, Ford Motor stated, "Catalyst loss by attrition is a serious problem and can be attributed to degradation of the catalyst support due to cumulative heat effect and/or problems related to design and construction of the converter can." In the Ford work, two catalyst cars were run on

unleaded fuel. Results showed not only hardware failures but extensive loss of catalyst by attrition in 18,000 miles and less.

Most of the catalysts used in development work have incorporated noble metals, such as platinum or palladium (a member of the platinum family). In reporting the performance of a catalytic converter using unleaded fuel in a 1969 SAE paper, General Motors stated, "The catalyst used in this evaluation contained a noble metal. This is not practical for large volume usage because of the high cost and limited availability of noble metals. A catalyst is needed that does not use precious metals."

Rough calculations indicate that, if catalytic devices were to be used on all U. S. cars, even extremely small concentrations of noble metal would result in a usage at least as great as the present total annual consumption of these metals. In addition, the Bonner and Moore study for the American Petroleum Institute showed that the production of unleaded gasoline would require about seven times the present annual consumption of platinum in refinery processing.

Since the world market in platinum and palladium is already very tight, it appears that there wouldn't be enough of these materials to go around. Also, the majority of world reserves are behind the Iron Curtain, notably in Russia.

Another problem with catalytic converters is quick warm-up. This was one of the major problems of earlier catalyst development work. Furthermore, the catalyst is really a bootstrapping type of device, getting part of the heat that it needs to operate effectively from the combustion of carbon monoxide and hydrocarbons passing through it.

Therefore, when a catalyst is applied to a low-emitting vehicle to further reduce emissions, quick warm-up becomes even more of a problem than it was in the days when catalytic converters were being widely tested several years ago on the higher-emitting cars of that period.

Another difficult problem is high-temperature protection. Most catalysts can be deactivated if they are heated much above the range of 1500 to 1800°F, and there are instances in which cars may malfunction or be subjected to severe driving conditions that can produce temperatures damaging to catalysts. Providing high-temperature protection with simple, inexpensive, and reliable devices is one of the most difficult problems in the development of catalytic converters.

These are the primary reasons that make us think that the use of a catalytic converter with either leaded or unleaded fuels for long-mileage periods will require a great deal more development work and may well be found to be impractical in the end. We believe that the approach of reducing emissions through mechanical modifications rather than by catalysts offers a good deal more practical promise.

**Exhaust recycle systems:** Some exhaust recycle systems to control nitrogen oxides have been reported to lose effectiveness because of lead deposit problems. However, recycle systems are in relatively early stages of development. Based on Ethyl research to date, we believe that recycle systems can be made to operate completely satisfactorily on leaded gasoline.

**Reduced hydrocarbon emissions:** Some claims have been made that restricting the use of lead antiknocks would reduce hydrocarbon emissions in automobile exhaust. The overwhelming evidence, however, indicates that little would be gained by such restrictions.

It is well known that, as car mileage accumulates, the build-up of deposits within the combustion chambers of the engine causes hydrocarbon emissions to increase, regardless

of whether the fuel does or does not contain lead antiknocks.

It is also well known that the extent of the increase in hydrocarbon emissions is a complex function of many factors including engine design, the manner in which the vehicle is operated during mileage accumulation, and the composition of the fuels used.

Accelerated test conditions involving rapid mileage accumulations, such as carried out on proving grounds where operation of the vehicle is relatively continuous with very few shutdown periods, generally cause larger increases in hydrocarbon emissions with a lead-containing fuel than with a unleaded fuel.

However, the differences are considerably less when cars are operated in typical car owner service. In very extensive surveys conducted by Ethyl and DuPont, which involved a total of 278 paired vehicles representing many engine models in typical owner service, the differences in hydrocarbon emissions between leaded and unleaded fuels were small, from one percent to seven percent.

These and other studies have shown that, while individual vehicles might show considerable hydrocarbon emission increases from the use of leaded fuels, the vehicle population as a whole is very little influenced by the presence of lead antiknocks. Thus, essentially no benefit would accrue from the operation of vehicles on low-lead or unleaded fuels.

Claims also have been made that hydrocarbon emissions would decrease if vehicles already on the road, which have been operated on leaded fuels, were switched to operation on unleaded fuels. Information developed in an extensive road test program involving 21 cars in normal owner service demonstrates that no significant benefit could be expected. They were 1961-1965 models of 11 makes with initial mileages ranging from 5,000 to 75,000 miles and averaging 25,000 miles.

After going on the program, these cars were operated for an additional 3,000 miles on a typical leaded fuel with emissions being measured each 1,000 miles. They were then operated for 10,000 miles on a prototype unleaded fuel, and finally an additional 5,000 miles on typical leaded fuel.

In each period of operation, average hydrocarbon emissions were essentially identical. Therefore, in normal owner service, no reduction in hydrocarbon emissions resulted from a change from leaded to unleaded fuels.

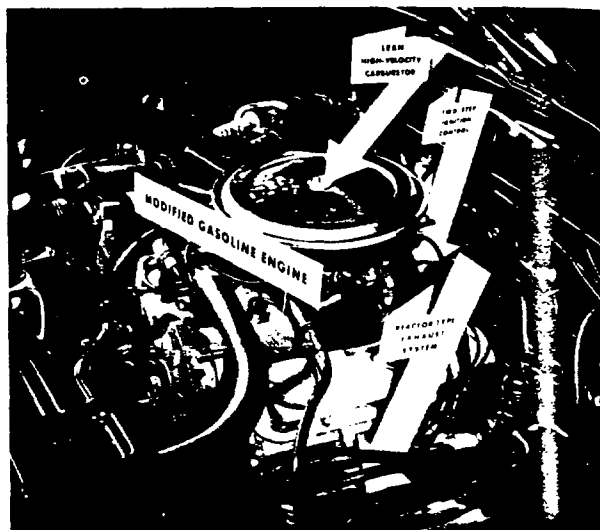
**Particulates:** The proposed 1975 Federal standards include a particulate level of 0.1 gram per mile. This has raised questions about:

- The level of particulate emissions from automobiles.
- The portion of these emissions that are lead compounds.

A Federal study made in Boston's Sumner Tunnel reported that particulates from vehicles were 0.36 gram per mile travelled. Lead emissions were reported to be 0.031 gram per mile, or 8.6 percent of the total exhaust particulates.

The Morse Report, issued by the Department of Commerce, states that vehicles produce a million tons of particulates per year. This report also indicates that lead accounts for 19 percent of these particulates. By assuming a total vehicle mileage, these numbers convert to approximately 0.7 gram per mile of exhaust particulates and 0.13 gram per mile of lead.

Finally, "Air Quality Criteria for Particulate Matter," issued by the Department of Health, Education and Welfare in 1969, reports that automobiles produce 12 pounds of particulates per 1000 gallons of gasoline. By assuming a fuel



Modifications in Ethyl Lean Reactor Car induction, ignition and exhaust systems make possible its extremely low emissions.

economy of 15 miles/gallon, this converts to approximately 0.36 gram of particulates per mile.

Recent data from as-yet-unpublished studies at Ethyl show that, on the present Federal Test Cycle, a group of 26 recent-model cars exhausted, on the average, 0.07 gram of lead per mile. If this value is combined with the 0.3 to 0.7 gram per mile of total particulates reported in the literature, lead is 10 to 23 percent of the exhaust particulates. This is in good agreement with the published data.

Earlier Ethyl studies showed that lead particulates in the exhaust are in the form of compounds that contain about  $\frac{2}{3}$  lead. Using a lead content of 20 percent and multiplying by 1.5 to convert to lead compounds, lead compounds represent about one-third of automotive particulates.

It seems appropriate to place the contribution of vehicle particulates in the proper perspective with regard both to total automotive emissions and to total atmospheric particulates. To comply with 1971 emission standards for hydrocarbons, carbon monoxide, and nitrogen oxides, a vehicle would emit approximately 31 grams of these compounds per mile. Thus, particulate emissions of 0.36 gram per mile would represent just over one percent of the controlled emissions of the vehicle. Lead would contribute only a minor portion of this one percent.

A recent report by HEW estimates that motor vehicles contribute four percent of the total man-made particulates entering the atmosphere. If lead contributes  $\frac{1}{3}$  of these, the contribution of lead to the total man-made particulates in the atmosphere is about one percent. The National Air Sampling Network has reported the results of studies in 27 cities for which data were given for suspended particulates and lead. These data showed that the average lead concentration in atmospheric particulates in these cities was 0.5 percent. Even in areas where the contribution of gasoline motor vehicles is estimated to be much higher, the lead concentration in atmospheric particulates averages only about one to two percent.

Thus, restricting the use of lead antiknocks would not significantly improve particulate loading of the atmosphere.

However, if it appeared desirable to control exhausted lead particulates, Ethyl has developed devices for trapping

these particulates. One type of particulate trap in an advanced state of development has about the same size, complexity, life, and cost as the standard muffler it would replace. Testing of this device, now in progress, has shown it to be capable of reducing exhausted lead compounds by almost two-thirds for 30,000 miles. Other types of traps, more complex and less fully developed, have reduced exhausted lead by 70 to 90 percent.

**Exhaust reactivity:** Reactivity is a measure of the smog-forming potential of hydrocarbons. Aromatics, olefins, and higher paraffins are the exhaust hydrocarbons that react most readily with nitrogen oxide in the atmosphere in the presence of sunlight to form nitrogen dioxide, a key initiator in the formation of ozone, oxidants, and eye irritants.

Ethyl's investigations, as well as those of others, have shown a direct relationship between the aromatic content of the fuel and the photochemical reactivity of the exhaust. Therefore, any increase in aromatic content to compensate for the loss of octane quality by lead removal will increase the smog-forming potential of exhaust gas.

The most-extensive and well-designed studies of these effects have been made by the U. S. Bureau of Mines. They found, in actual smog chamber tests, that the exhaust gas from high aromatic nonleaded fuels is as much as 38 percent more smog-forming than the exhaust gas from conventional leaded fuels. The studies involved prototype nonleaded fuels with hydrocarbon composition modified to provide octane quality equivalent to that of current leaded fuels.

**Polynuclear aromatic hydrocarbons:** The higher aromatic content of nonleaded gasoline required to achieve antiknock quality equivalent to that of current leaded gasolines would cause significant increases in the content of polynuclear aromatic (PNA) hydrocarbons in automotive exhaust gas and in the air.

The exact role of these compounds in causing cancer is not known. However, some are known to induce tumor formation in experimental animals and this certainly points a finger of suspicion at these compounds as hazards to public health.

Our studies and those of General Motors have shown that the presence of lead antiknocks in fuels of constant hydrocarbon composition has no effect on the PNA content of exhaust gas.

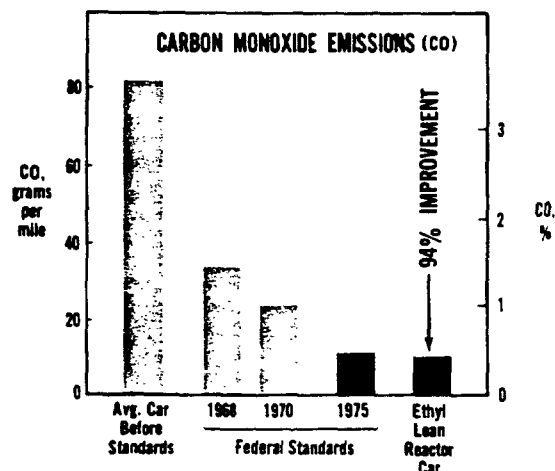
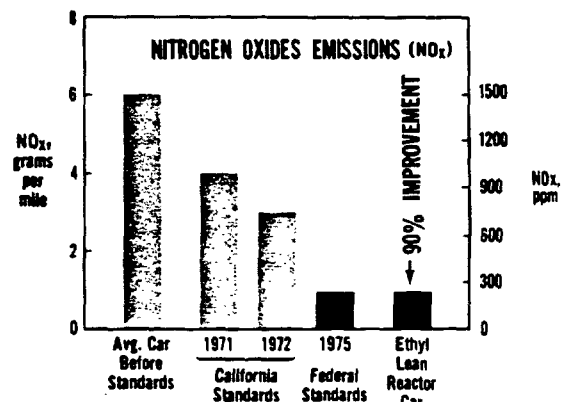
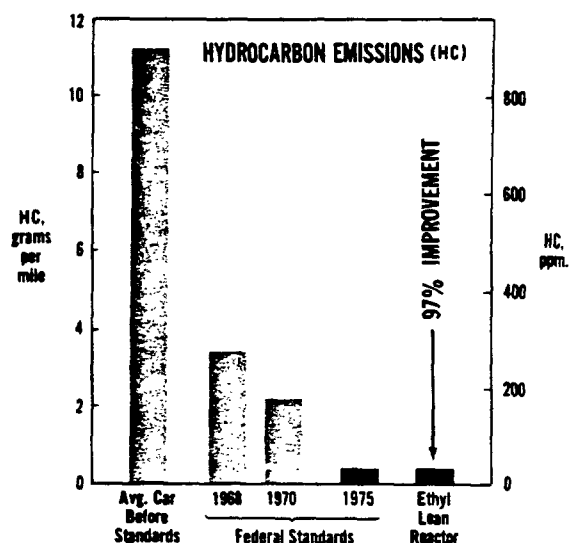
Increasing the aromatic content of gasoline also will increase the phenolic content of the exhaust gas. Phenols are known to be promoting agents that accelerate tumor formation, even for weak carcinogens.

**Aldehydes:** Both aliphatic and aromatic aldehydes are powerful air pollutants. They are present in exhaust gas and are also formed from exhaust gas in smog-forming reactions in the air. They have been reported to be eye irritants, irritants to mucous membranes, plant toxicants, participants in photochemical smog reactions, and carcinogen promoters.

Aldehydes are present in significant quantities in exhaust gas as it leaves the tailpipe. In fact, in cars equipped with some of the more-advanced emission-control systems, aldehyde content of the exhaust can be over one-third as much as the hydrocarbon content on a molar basis.

Removal of lead antiknocks from gasoline without changing base-fuel composition results in 10-16 percent more aldehydes in the exhaust gas, the increase depending on the particular fuels and engine conditions used. Thus, nonleaded fuels would be expected to produce more aldehydes.

Increasing the aromatic content of gasoline, while not affecting the total aldehyde content of the exhaust gas,



**ETHYL'S TEST RESULTS  
USING LEADED GASOLINE.**  
(1970 Federal Test Procedure)

increases the aromatic aldehyde content as much as 70 percent. General Motors reports that benzaldehyde, the major aromatic aldehyde in exhaust gas, is a necessary intermediate in photochemical reactions leading to the formation of peroxybenzoyl nitrate (PBzN). It appears that a major portion of eye irritation manifested in Los Angeles smog is contributed by PBzN, which is about 200 times as potent an irritant as formaldehyde, long recognized as an eye irritant.

**Exhaust valve seat recession:** Severe wear of exhaust valve seats is often encountered when cars are operated solely on unleaded fuels. This problem occurs due to the lack of a protective lead-deposit film on the valve face and seat. Although valve seat wear using unleaded fuels occurs during various operating conditions, the rate of seat wear increases most rapidly during high-speed driving (e.g., turnpike operation) or during high-load operation (e.g., pulling a trailer). When valve seat wear occurs, the valve progressively recesses into the cylinder head. This leads to rough engine operation, increased fuel consumption, poor performance, and higher exhaust emissions.

To illustrate the effects of valve recession, two cases can be cited. One is a 1970 6-cylinder sedan in turnpike operation using a commercial unleaded premium gasoline. At 10,000 miles, valve recession had used up the hydraulic lifter travel. The results—fuel economy had dropped from 25.1 mpg to 18.9 mpg and hydrocarbon emissions had increased from 83 ppm to 1201 ppm. With the recessed valves, high-speed performance using the National Highway Safety Bureau test was extremely poor.

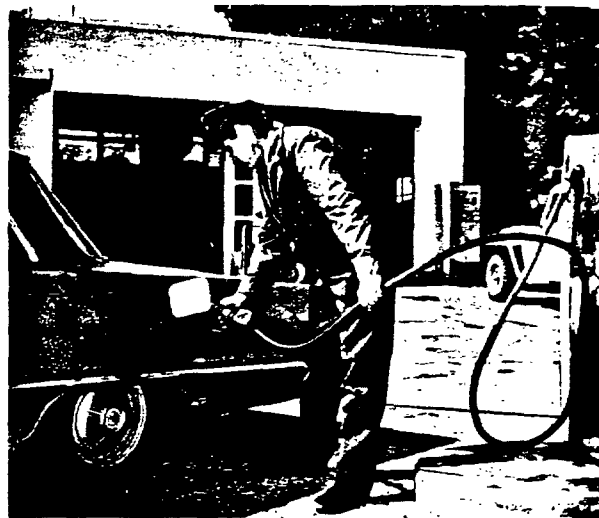
The other car was powered by a 1969 V-8 using the same premium gasoline in suburban private-owner operation. At 33,000 miles, valve recession had increased hydrocarbon emissions from 124 ppm to 1876 ppm. Fuel economy of this car was improved by 20 percent when new cylinder heads were installed in place of the recessed heads.

To overcome exhaust valve seat recession, valve seat inserts have been suggested. If proper-sized inserts were installed in existing cylinder heads, interference would result with the cooling water passages. If smaller inserts were installed that did not interfere, choking of the engine exhaust would result and the exhaust valve and insert would run hotter. Identical cylinder heads for certain engines can cost up to \$100 more with inserts than without.

**Public health:** There has been a vast amount of research carried out on the public health effects related to the discharge of lead compounds from motor vehicles as a result of the use of lead antiknock compounds in gasoline. Research conducted by the government, by universities, and by industry investigators has been under way since the commercial introduction of lead antiknocks in 1923, and is still continuing.

This research has been referred to as one of the most-extensive investigations of this nature on any single class of generally used chemical compounds. As a result of this extensive body of information covering almost 50 years of study, there have been numerous reviews of the situation and many investigations and conferences.

In the mid-1920's, after considerable scare propaganda relating to the possible effects of widespread dissemination of lead in motor vehicle exhaust, the entire situation was investigated with the best available technology. At that time, the Public Health Service concluded that there was no reason to prohibit the use of lead antiknocks. Government and industry studies since that time have repeatedly substantiated these initial medical findings.



Motorists are having to pay considerably more per gallon for unleaded gasoline of lower octane number.

In 1959, an ad hoc expert medical advisory committee of the Surgeon General of the U. S. Public Health Service again reviewed all available information pertaining to all aspects of the use of lead antiknocks. This committee concluded that raising the maximum allowable concentrations of lead antiknocks in motor gasolines from 3 to 4 milliliters per gallon would not significantly increase the hazard to public health. The average usage of lead in motor gasoline in the United States has always been substantially under the agreed-upon maximum values, and present usage averages about 2.5 milliliters per gallon.

The Surgeon General's committee did feel there was a need for additional information relating to the contribution of lead antiknocks to the atmosphere and the body burden of the population. As a result, an extensive industry-government investigation was initiated in 1961.

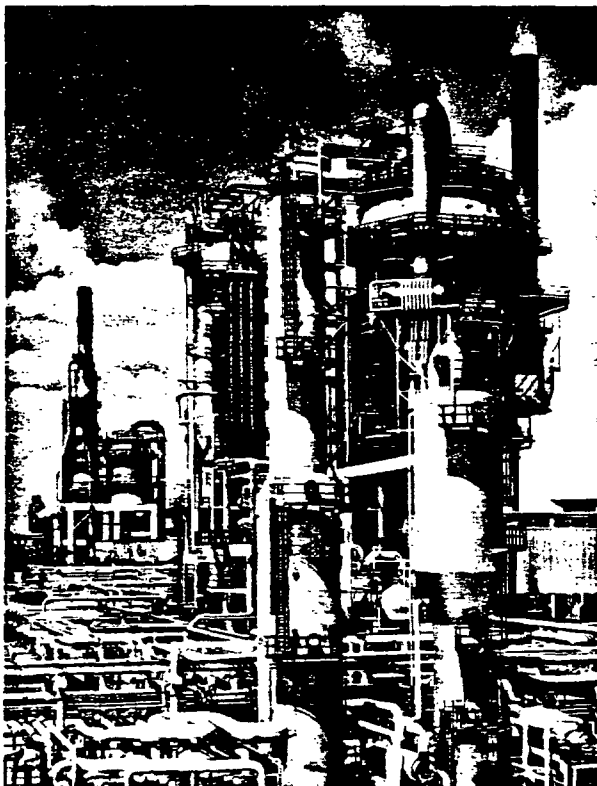
This one-year study assessed the concentration of lead-in-air of three major cities—Philadelphia, Cincinnati, and Los Angeles—and also lead body burdens as indicated by the lead content of the blood and urine of some 2,400 men and women residing in these areas.

These studies showed that atmospheric lead levels were, on the average, generally low and that the lead body burden of the population—including traffic policemen, downtown postmen, taxicab drivers, etc.—was within the levels generally considered normal.

To assess possible changes that may have occurred over the intervening period, an extended survey of similar nature is now under way, again supported jointly by the U. S. Public Health Service and industry. The original three cities are being reassayed, both aerometrically and biologically. In addition, four major cities—Washington, D. C., New York, Chicago, and Houston—have been added to the study. The results of this comprehensive program are anticipated upon completion of the sampling and analytical work in mid-1971.

The World Health Organization has reviewed the general lead situation as indicated by blood and urine analyses of individuals in some 16 different nations. Two statements from the report are felt to be significant:

"There has been no increase in lead contamination in the



To produce unleaded gasoline of adequate quality, refinery changes costing more than \$10 billion would be required.

last two decades. If there has been any change it would appear that at present man is exposed on the whole to less lead in his environment than he was twenty years ago."

"The lead levels reported in the blood of New Guinea aborigines are of particular interest in that they demonstrate that these natives living in the hills of New Guinea away from industrialization and motorization showed blood lead levels higher in range than urban and rural Californians."

The report did caution against complacency and indicated the situation should continue to be evaluated, and this is being done.

In response to the allegations of Professor Clair C. Patterson, a geochemist from California Institute of Technology, relating to the hazards of the continued usage of lead antiknocks, the American Medical Association commented in the February 1966 issue of Archives of Environmental Health as follows:

"The Committee on Occupational Toxicology of the Council on Occupational Health of the American Medical Association has reviewed with interest the article by Clair C. Patterson, Ph.D., in the September 1965 issue of the Archives. Whereas it feels it has no basis on which to judge Dr. Patterson's ability as a geochemist, it does at the same time feel obligated to point out that some of Dr. Patterson's conclusions in the biological field are open to serious question as to their validity.

"The Committee feels obliged to point out that as a result of years of careful clinical study in workers in the lead industry significant, subtle, and unrecognized or 'unrecognizable' changes are not occurring in the general population

as a result of its exposure to environmental lead. In fact, this vast clinical evidence, evaluated by a great number of clinically trained scientists, suggests that the general public is not now, nor in the immediate future, facing a lead hazard."

Further commenting on the Patterson allegation, Professor Thomas J. Haley, then of the University of California School of Medicine, Los Angeles, made the following comment, "The supposed chronic lead intoxication from environmental contamination is a myth not a fact."

To summarize Ethyl's position, we do not believe that there is at present or in the foreseeable future a public health problem related to the use of lead antiknock compounds. Our position has been and remains that there should be firm evidence indicating that such a problem exists before the use of lead antiknocks is curtailed.

### SOLUTIONS ARE AVAILABLE

Two basic systems of emission control have been developed to meet future emission standards while operating on leaded fuels. These are the lean-reactor approach originated by Ethyl Corporation and other reactor systems (operating at richer fuel-air mixtures) that are being engineered by DuPont, the Inter-Industry Emission Control Group, and other automobile and petroleum companies.

Very low emission levels are achieved by the Ethyl Lean Reactor Car through significant improvements in the induction, ignition, and exhaust systems. The Lean Reactor Car employs lean carburetion combined with exhaust gas recycle and an exhaust reactor. A high-velocity carburetor ensures a uniform fuel-air mixture in the engine cylinders, thereby permitting very lean operation. The exhaust gases leaving the cylinders contain very little carbon monoxide and unburned hydrocarbons but do contain 3-5 percent oxygen. These gases are fed to a relatively low-temperature exhaust reactor that provides environment conducive to further reaction between the small amounts of pollutants left and the leftover oxygen.

The emission levels achieved some time ago with the Lean Reactor Car were equal to or lower than the 1974 California standards. Since then, recent work has shown that it is possible to reach even lower emission values and meet gaseous emission levels that have been proposed for 1975.

### Some Press Comments

#### NATIONAL PETROLEUM NEWS

"The oil industry has just had a jolting scare over leaded gasoline, but it may be able to turn a tricky situation into a good solution.

"The storm over unleaded gasoline, seeded in a high political pressure area, broke on the industry before it had made any contingency plans. . . . Consequently, as an industry, it panicked and then froze. . . . No matter that a case against lead had not been established. . . . No matter that a segment of the economy (petroleum) could be put to great expense, another (TEL industry) could be harmed, and that the public simply might find itself stuck with higher-priced gasoline.

"Irony at this point is that the air probably won't be any cleaner. . . . Restraint by several leaders forestalled a lemming-like rush to no-lead as an instantaneous response to anti-lead pressures. . . . Meanwhile, work toward better exhaust systems should continue because that's where the real need is. Lead is a diversionary tactic.

"Both DuPont and Ethyl have brought out reactor systems

which show that emissions can be curbed significantly. . . . A sense of urgency should take hold. . . . What petroleum has is not really a breathing spell . . . but rather it has a respite in which to maneuver toward the best possible solution for companies, for the industry—and most important—for the public."

### CHEMICAL ENGINEERING

"We question the haste in which many government officials, automakers and, especially, petroleum companies have responded to each other's pronouncements. Many of these responses have been born of confusion, and in turn have added to that confusion.

"Such haste, however, merely reflects a deeper weakness. Far too many people in the lead-in-gasoline controversy are at best paying only occasional lip-service to the really basic goal: an acceptably clean automobile exhaust at a minimum overall cost to society. Is that goal served or is it harmed by starting promptly to withhold lead additives from gasoline? . . . This is a complicated question, and we don't presume to answer it.

"But we do insist that complex problems such as automobile pollution call for carefully reasoned systems-analysis solutions, and that the ban-the-lead advocates haven't rested their case on such a solution. Instead it rests mainly on one shaky, long-range assumption: that automobile pollution can best be prevented by exhaust-cleanup devices (still only in developmental stages today) equipped with catalysts that happen to be vulnerable to poisoning by lead.

"We commend Sun Oil Co. and Continental Oil Co. for standing out in stressing the need for careful thought and a systems approach. Similarly, we commend Mobil Oil Co. for saying most clearly that the emphasis should be on what comes out of the exhaust, not on what goes in with the fuel."

### OIL & GAS JOURNAL

"Oilmen oppose lead rush—but does Washington know it? Hard-nosed operators in the refining and marketing branches of the oil industry are almost in open revolt against the headlong rush to get the lead out of gasoline. And thank goodness for the opposition. Someone certainly needed to blow the whistle on the gamesmanship of automakers, some refiners, and federal authorities.

"Initial thrust of automakers was to shift the onus of pollution control from their hardware to fuels. Some refiners quickly accepted the unleaded bait with an eye to gaining an edge on competition. Federal authorities welcomed the action as evidence they could use in claiming gains in the battle to diminish air pollution.

"Sentiment expressed at recent conventions of refiners and marketers leaves no doubt that they oppose the headlong rush to eliminate lead additives as a useless waste of financial resources. . . . The feeling is strong within the industry that the Government has an obligation to take the necessary time to consider all approaches to cleaning up auto exhausts.

"The standards should be set for results, not on the hardware, fuels, or car modifications needed to achieve them."

### AUTOMOTIVE INDUSTRIES

"One thing is certain: the major gains in engine development such as high output per cu. in. of displacement, and high thermal efficiencies will be downgraded. In fact, the art is forced to retrogress some 15 years to the days when top compression ratio was around 8 to 1 or less.

"The disturbing fact is that there is now a top ceiling on

compression ratio for all engines, large or small. . . . All engines will experience some loss in top Bhp and performance, plus some loss in fuel economy. . . . So here we are.

"To achieve cleaner air, engine performance has to be downgraded. It is hoped that this is only a temporary setback in a period of sudden change. Any improvement in the octane rating of gasolines will have welcome results."

### OIL DAILY

An Oil Daily survey of "authoritative automotive engineers and expert auto repair technicians" showed "general agreement that the cost of adapting a high-compression automobile engine to handle a 97-octane gasoline could be anywhere between \$50 and \$300—and that even then there'd be no assurance that the vehicle's performance would not be seriously impaired. De-tuning would also, of course, increase the car's gasoline consumption."

### MOTOR TREND

"Sifting out undistorted facts on a subject such as this is tedious at best. It's a gut issue in some aspects, with lead being associated with 'poison' second only to arsenic among metals. Despite all the natural and man-made obstacles, we hadn't delved into the subject too far before uncovering lots that could have—and should have—been said, but hasn't, that would make just about anyone wonder if 'gettin' the lead out' is such a good idea, after all. . . .

"For starters, there's an overwhelming mass of evidence that unleaded gasoline will ruin most car engines. . . . It turns out that, in the absence of lead, exhaust valve seat wear becomes a problem and can result in failure in a few thousand miles. . . . Exhaust valve seat wear remains an unsolved problem when trying to run any existing car on unleaded gasoline. One thing for sure, unleaded gasoline would give the coup de grace to many a car now cluttering up roads and would probably do wonders for all the sagging new car sales. . . .

"The cost of lead removal—all, or nearly all, of which will be passed on to the car owner—will run into billions of dollars annually. The changeover to unleaded gasoline will cost the oil industry between \$3 billion and \$7 billion, depending on whose estimate you take, for additional refinery equipment which is from one-third to two-thirds of the total now invested. . . .

"The petroleum industry's consumption of platinum, which costs about \$135 an ounce and comes mostly from the Soviet Union and South Africa, would double to 1/4 million ounces annually if the switch to unleaded fuel is made. To this add another 1/2 million ounces for the initial charge to the new catalytic equipment and figure out what this does to our balance of payments and the market price of the metal, not to mention the added drain on our platinum reserves during a national emergency. . . .

"Every indication is that exhaust particulates, including lead compounds, are a non-problem when it comes to having any direct effect on our environment or endangering life or health. Not one person we contacted, including those who would like to see lead taken out of gasoline for health reasons, offered one shred of evidence to show that it presents any present or future danger.

"Before we take the giant—and expensive—leap forward with unleaded gasoline, which no one can say for certain will accomplish intended results, we ought to re-examine the whole auto emissions spectrum. By carefully separating gut issues from real problems, we might find lead unnecessary, or that we want to leap in some other direction." □



The 1970 intercollegiate Clean Air Car Race (CACR)—a three-week performance test to survey ways of reducing automotive emissions—attracted nationwide attention in late August and early September.

Despite the name, the event was not a race in the usual sense of the word. Instead of a track or a speedway, participating cars ran on public highways under more normal driving conditions than would be found in most races. Miles per hour was a relatively unimportant part of the competition.

The 3,600-mile transcontinental contest involved some 40 teams of college students travelling through 11 states and one Canadian province in an unusual collection of vehicles. Among the entries was Ethyl Corporation's Lean Reactor Car, which was piloted by a team from Louisiana State University.

Although the Lean Reactor Car did not win the competition, it really didn't lose either. Its performance in the contest achieved two important objectives. It validated Ethyl's firm belief that the low emission standards of the future can be met successfully and satisfactorily without sacrificing the efficiency and fuel

economy made possible by leaded gasoline. Furthermore, the engine's performance, on the basis of preliminary data, also provided valuable new information that will enable Ethyl to make further significant improvements in the Lean Reactor Car.

Top honors in the competition were taken by a 1971 Capri. The Capri was declared the winner under a complex set of rules as cited in a September 7 report in the Oil & Gas Journal:

"Selection of the Capri by five-judge panel was admittedly arbitrary since the winner failed to match most of the other cars in the point scoring system devised for the race.

"However, the panel said the car, entered by Wayne State University, met such subjective tests as the degree of innovation, student participation, practicality, cost, mass-production capability, safety, durability, and contribution to solving the overall problem of pollution."

Ethyl President Bruce C. Gottwald, in a statement issued following the CACR, congratulated the LSU student team "for

the gains they have scored on behalf of the public in the interest of continued automotive progress and a cleaner environment."

"The Race results aside," Mr. Gottwald said, "it must be agreed that the real winners of this competition are the motoring public and the general public. For, in spite of all the recent clamoring that leaded gasoline and even the internal combustion engine must go the way of the horse and carriage, our Lean Reactor Car has demonstrated that the nation's traditional means of automotive transportation is still the wave of the future."

The cars participating in the competition got underway at noon on August 24 from the Massachusetts Institute of Technology's Student Center in Cambridge, Mass.

Their geographic goal: the campus of California Institute of Technology in Pasadena, Cal. Their achievement goal: to demonstrate which type(s) of vehicle, operating on which type(s) of fuel, offer the most promise for attaining the low-emission levels prescribed by the Federal government for automobiles to be produced in this decade.



Louisiana State's 3-man team of students chosen to race the Ethyl Lean Reactor Car—Harry D. Coffee, Jr., Michel Wall and Thomas A. Greene.

The CACR was an outgrowth of a contest staged in 1968 by two student groups at MIT and Caltech. They built electrically-powered cars and raced them against each other in opposite directions across the country.

Then Prof. Richard Thornton and Prof. Jerome Shapiro, who were respective advisors to the MIT and Caltech rivals, decided to enlarge the idea and institute a competition open to vehicles of all descriptions and design specifications. They had in mind making practical contributions to ways and means of reducing automotive emissions.

Consequently the 1970 CACR brought together what was perhaps the most unorthodox collection of self-propelled vehicles ever assembled.

Among them were, of course, cars powered with conventional internal combustion engines operating on high-performance leaded gasolines, as well as on such unorthodox fuels as unleaded gasoline, propane, compressed natural gas and cryogenic (extremely cold) gases.

There were electric cars too, the so-called gasoline hybrid powered by electricity produced with an on-board generator driven by a gasoline engine; steamers, and turbines. In fact, as one Race committee member put it, "about the only thing we don't have is a car powered by a rubber band."

Despite their wide disparity and dissimilarity, all vehicles entered in the CACR had—as required under the rules of the event—two things in common. All were experimental, and all either already met or bettered the emission standards set by the Department of Health, Education and Welfare for 1975 production automobiles.

One of the entries was a further-improved version of Ethyl's famed Lean Reactor Car, which embodies a forward-

looking approach to solving the automotive emissions problem. It does not penalize the motorist in terms of smooth power, fuel economy and engine efficiency made possible by leaded gasoline. At the same time it permits retaining the extra luxury and comfort accessories that Americans enjoy in their automobiles.

The Lean Reactor Car was the official entry of Louisiana State University, with a three-student team of drivers and an observer carefully selected by LSU professors from among scores of applicants after intensive interviews. Dr. Bernard S. Pressburg, associate dean of engineering at the university, was the group's faculty advisor.

Race rules permitted the student teams to receive all the technical and material help they could get from industry, business and other non-university sources. Some of the collegians, for instance, constructed vehicles of their own design, using parts, money and technical advice provided by outside backers. Other groups, such as the LSU team driving the Ethyl Lean Reactor Car operated experimental vehicles built or modified by industrial firms.

But once the Race was underway, the students were entirely on their own. The only persons allowed to ride in rival vehicles during the actual competition were two registered and qualified students, a driver and assistant driver, plus a neutral observer.

The students had to be able to make all necessary roadside repairs themselves without any assistance by personnel of their sponsoring organization. In no case were repairs or adjustments of any emission control equipment allowed until the final emission measurements were completed at the end of the Race.

Let no one look upon the Clean Air

Car Race as a lark or a late-summer joyride across the country by madcap college students. These were all young men—there were no distaff entrants—deadly serious and earnest in their purpose.

Most of them spent all of their summer vacation readying their vehicles, with each team learning all of the technicalities and intricacies of its vehicle and propulsion source. Contestants studied and restudied the Massachusetts-to-California Race course too, becoming familiar with the driving and traffic laws of each of the states through which they were to go, and, finally, preparing the paper they had to present at a series of technical meetings on the MIT campus during the week of Aug. 17 before the start of the Race.

A case in point were the three students who comprised the team representing Louisiana State University in the CACR, operating the Ethyl Lean Reactor Car. They were Michel Wall, who received his B.S. in chemical engineering



John S. Wintringham, coordinator of the group of Ethyl automotive engineers in charge of May-to-August preparation for the LSU racers.

in 1969 and who had just finished his first year as a graduate student at LSU; seniors Thomas A. Greene, studying electrical engineering, and Harry D. Coffee, Jr., majoring in mechanical and aerospace engineering. Both Wall and Coffee are residents of Baton Rouge, La., where Wall's father, Henry, has been a long-time employee of Ethyl Corporation's Research and Development department. Greene's home is in Lake Charles, La.

Between the end of the 1969-70 academic year in May and Race preliminaries in Cambridge, all three young men were busy at the Ethyl Research

Laboratories in suburban Detroit, engaged as student engineers in connection with the Lean Reactor Car. They worked under the guidance of a special team of veteran Ethyl Corporation automotive research engineers consisting of John S. Wintringham, as coordinator; Denis L. Lenane, Frederick J. Marsee and A. Joel Warren.

The special Lean Reactor Car that the Wall-Coffee-Greene student team drove in the CACR was not a laboratory curiosity or Rube Goldberg-type creation. It was a standard 330 horsepower, 10:1 compression ratio 1970 Pontiac Catalina designed to operate on leaded gasoline.

It was, in one manner of speaking, a blend of the old and the new. While purchased and equipped specifically for the CACR competition, it relied heavily upon Ethyl's long and extensive engine/fuel research background to achieve its amazingly low emission levels.

All during their working summer at the Detroit Laboratories, the LSU students, under their Ethyl supervisors, were busily engaged in modifying the engine of the 1970 Pontiac so that it would, like Ethyl's other Lean Reactor Cars, meet 1975 emission standards.

Four significant engine modifications, stemming from Ethyl's near-half century of experience with engine/fuel relationships, account for the success of the Lean Reactor Car in reducing automotive emissions to low levels.

These modifications are: (1) an Ethyl-designed high velocity carburetor for better fuel distribution of very lean mixtures; (2) a two-step control of vacuum ignition advance for the best ignition timing under various speed and

load conditions; (3) an exhaust recycle system to supply the proper amount of exhaust gas and mix it with the incoming fuel-air mixture; and (4) exhaust reactors to conserve heat and provide time for further burning of combustible emissions.

In addition, the CACR entry had been equipped with a special device to trap the small particles of matter called particulates, before they can escape into the atmosphere through the automotive tailpipe. The U. S. Public Health Service estimates that, nationwide, only four percent of total particulates in the air comes from motor vehicles. Furthermore, it has been established that particulates make up less than one percent of total automotive emissions.

Nevertheless, Ethyl research is continuously seeking methods to further reduce automotive emissions by trapping particulates, and so the device for doing so on the Clean Air Car Race entry was subjected to rigid over-the-road testing accordingly.

All that the LSU student team had been working on this summer came to a head in mid-August when the Ethyl Lean Reactor Car arrived at the MIT campus assembly point to complete the first of the three parts into which the CACR was divided.

Along with all other entrants in the competition, Messrs. Wall, Coffee and Greene then began a week-long series of events to measure vehicle performance, safety, road handling, energy consumption and emission levels. The results of these tests were major factors in determining final CACR standings when concluding emission testing was

completed on Aug. 31 and Sept. 1.

In preparation for being flagged away from Cambridge on Aug. 24, all the transcontinental competitors also participated in meetings and symposia relating to the technical aspects of their vehicles.

The Race itself followed a predetermined westerly route over public highways en route to Pasadena, a continent away. Contestants were due there on Aug. 30.

The Race had six legs, each an average 600-miles-per-day drive and each consisting of a rally-type run. A "normalized time" was announced in advance of each day's trip, with demerits being applied for finishing a leg earlier or later than the normalized time.

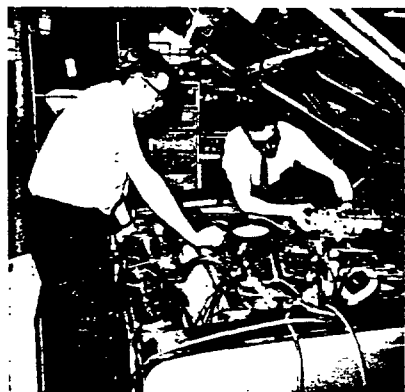
The final part of the competition took place in California at the conclusion of the transcontinental drive. This was the emission rating phase, similar to measurements taken during a two-day stop-over at Detroit en route.

Emission measurements on internal combustion engine cars were to be made after a specified driving cycle was completed by each vehicle. Emissions were to be computed in terms of grams of pollutant per kilogram of fuel consumed during the test run. This factor was to be multiplied by the kg of fuel consumed in the race in order to arrive at a total emission rating for the car.

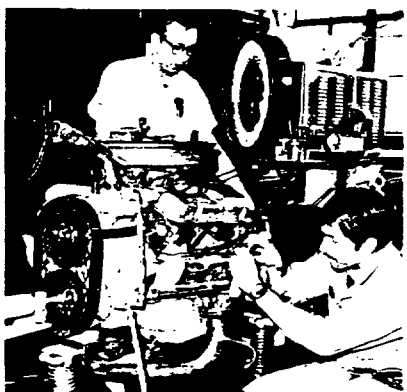
Electric vehicles, on the other hand, were to be assessed an emission penalty based on the kilowatt/hour of power consumed and on an average rating of emission per kw/hr for U.S. power companies as determined by the Department of Health, Education and Welfare. Hybrid vehicles were to be penalized for both fuel consumption and kw/hrs consumed, according to the amount of each required for the cross-country trip.

All points scored by each vehicle in each part of the competition—the pre-race trials at Cambridge, the Detroit emission measurements, the leg-by-leg Race itself and the final California emission measurements—were tallied by a judging board.

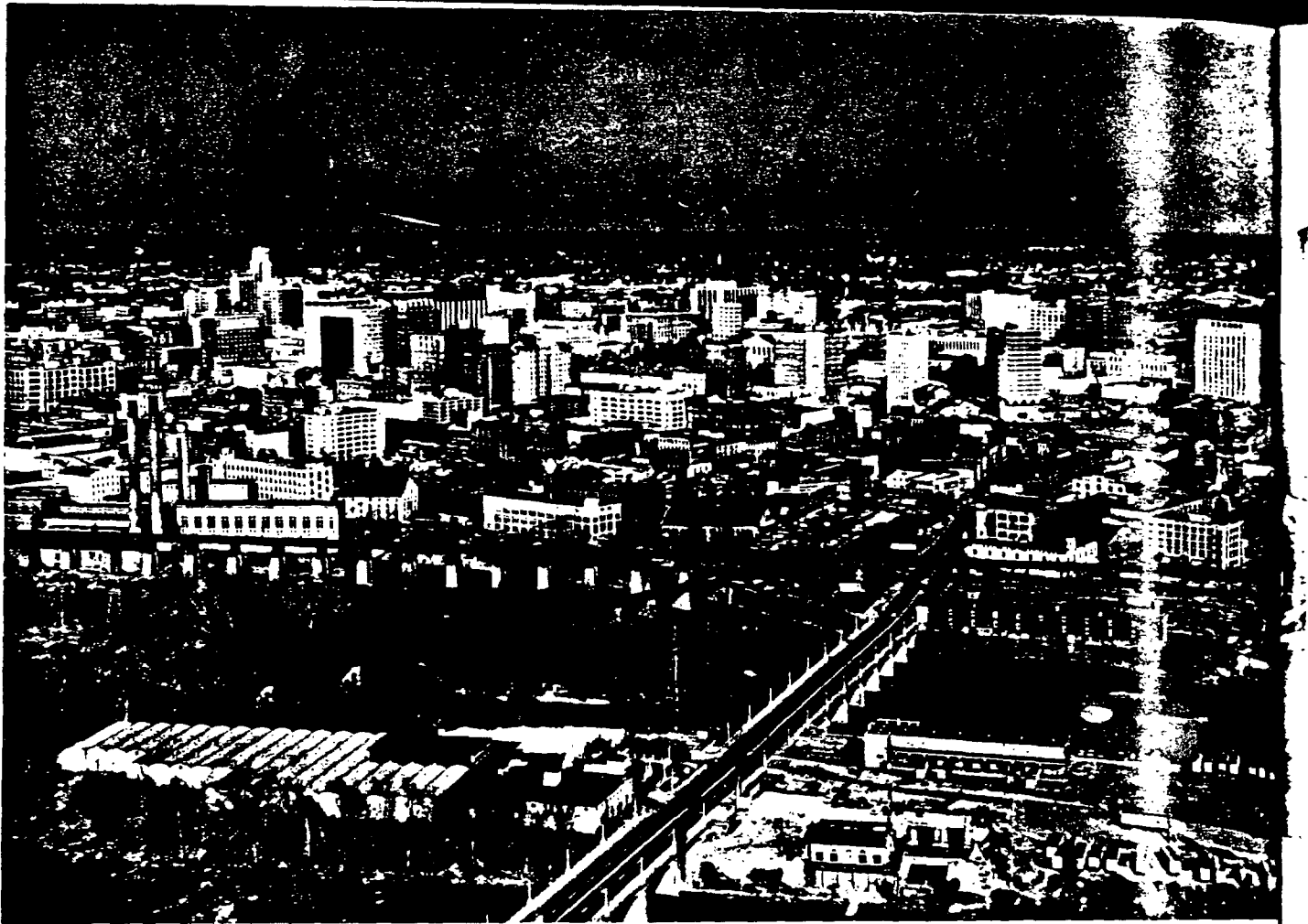
What meaning the CACR will hold for the future, in terms of air pollution control advances, must wait to be seen, of course. Meanwhile, one thing is certain: each member of the student teams will have spent perhaps the most unusual, the most eventful and the most productive summer he has ever experienced. □



Like Michel Wall, right, each LSU driver spent months before the contest at Ethyl's Detroit Labs on Lean Reactor Car familiarization.



How to make emergency engine repairs en route was part of thorough pre-race training for Harry D. Coffee, Jr., right, and teammates.



*Downtown Richmond has this metropolitan look today. Plans for its extension call for riverfront improvements and developing wooded islands nearby, including two at lower left. City Planning Commission architects project (right) an innovative complex of business, residential, park and recreational facilities like these.*

## New Dimensions for Prospering Richmond

### NOW RICHMOND . . .

The second of a series of feature articles about distinctive American cities, this Ethyl Magazine presentation focuses on significant developments and trends affecting Virginia's capital.

Is it possible to look backward, concentrate on what's needed today, and get ready for the future—all at the same time?

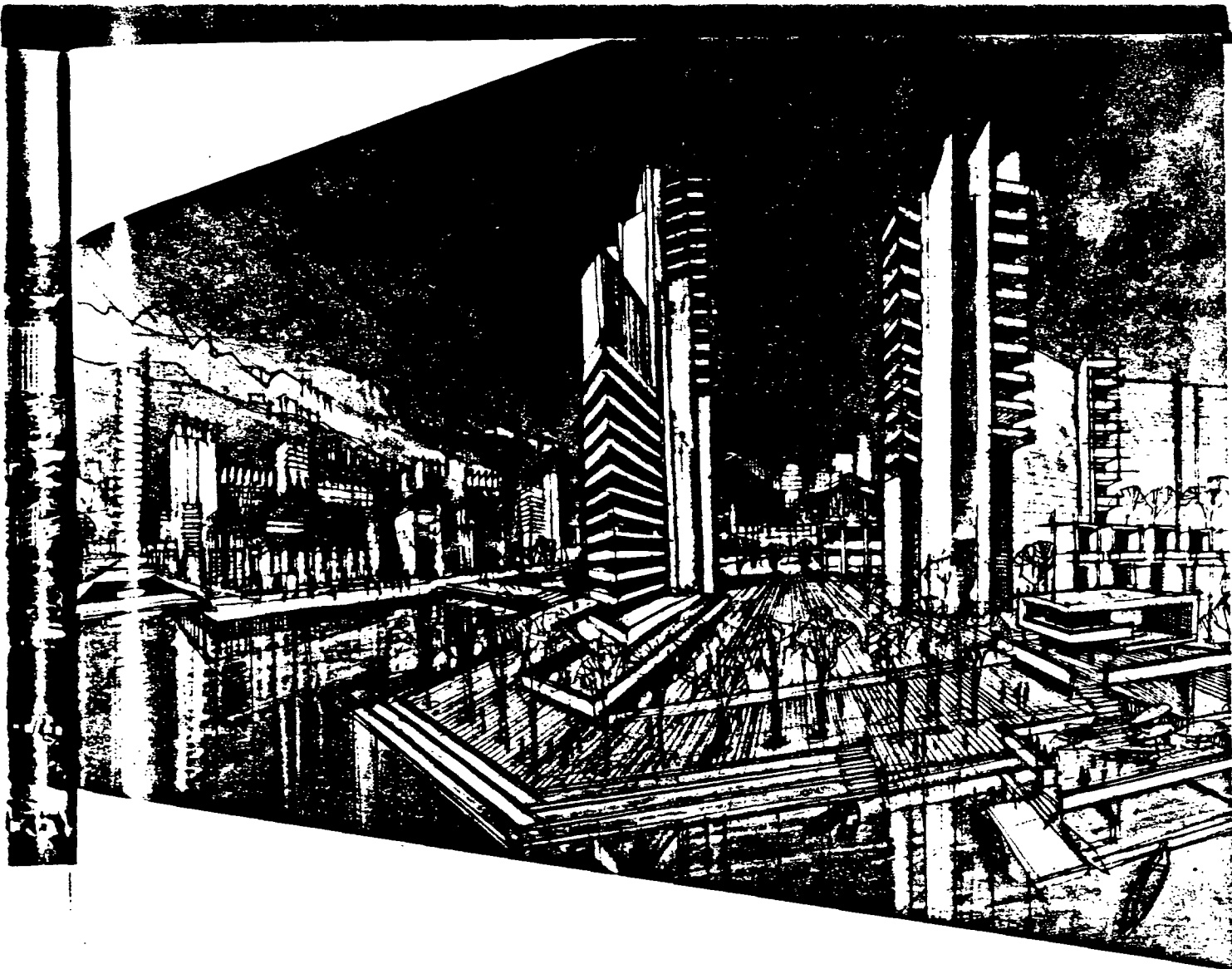
At least one major southern city is proving that it definitely can be done.

Richmond, the commercial as well as the political capital of Virginia, finds inspiration in its historic past and advantages in its cultural heritage.

Yet growth and progress are self-evident throughout the metropolitan area, with modern capabilities expressed realistically.

And far more than dreaming about the future in technicolor, the city and its surrounding area are concentrating actively on making today's Richmond an even better place to live and work in tomorrow.

As difficult as simultaneous follow-through can be with so many different elements, Greater Richmond is following through successfully and adding solid dimensions to its



contemporary stature, as well as assuring a still brighter future for the metropolitan area.

Here are some typical specifics about Richmond today:

Since 1960, some \$900 million has been invested in new industrial, commercial and residential facilities in the metropolitan area. Thirteen new high-rise buildings, costing in excess of \$100 million, have been completed in the downtown section alone.

Unprecedented locally, the past decade's construction boom shows little sign of diminishing.

Presently taking shape downtown is a \$23 million Sports Coliseum with an air-conditioned seating capacity of more than 12,000. The domed complex is being built municipally, and is scheduled for completion in September, 1971. Another milestone for 1971 is a new \$17 million City Hall, a 20-story structure designed to house municipal employees in a modern, utilitarian environment.

A fully-automated post office has just been completed

at a cost of \$10 million. Six more office buildings are in the final construction stages.

In Richmond's financial area, major construction projects just ahead include a \$30 million headquarters building for the Fifth District Federal Reserve Bank. There are plans, too, for a \$30 million skyscraper for the First & Merchants National Bank. Five of the state's major banks have their headquarters in Richmond.

Overlooking the James River, the Federal Reserve's new facilities are expected to trigger substantial development of what has been a neglected part of downtown Richmond. Plans for the building's site also call for an outdoor plaza, with reflecting pools and pedestrian walkways to be constructed over the proposed Richmond Expressway, which would run past the Federal Reserve's new location.

In maintaining its corporate headquarters within the city, Ethyl is among major companies sharing the advantages of Greater Richmond's strategic location as a focal point of

what has been labeled Virginia's urban corridor.

Growing at a rate two-and-a-half times faster than the national average, this corridor extends from Washington, D.C. to Richmond and on to Norfolk. It is a prospering industrial and commercial belt of diversified enterprises.

Originally built on rolling hills overlooking the James River, Richmond today covers 62.5 square miles, with the adjoining counties of Henrico, Chesterfield and Hanover included in the metropolitan area.

According to the 1970 census, Greater Richmond's population exceeds 515,000, or 18 percent more than the 436,000 people it had in 1960. More significantly, the metropolitan area is increasing its population by an estimated 10,000 annually.

Much of this influx represents personnel brought in by expanding commerce and industry, and by companies newly moving into the area.

In July, Ethyl's Oxford Paper Company Division transferred its headquarters from New York to Richmond. Ethyl's Corporate Public Relations Department and its Advertising and Sales Promotion Department, formerly headquartered in New York, also moved to Richmond in July. Earlier this year Ethyl opened a \$2 million polyvinyl chloride (PVC) plant in the area—its second plastic product manufacturing facility to be located in Greater Richmond. The first was a polyethylene plastic bag plant, in operation since last year.

Other firms headquartered in metropolitan Richmond include Reynolds Metals Company, Robertshaw Controls Company, A. H. Robins Company, Philip Morris, Inc., and the Seaboard Coast Line Railroad, which maintains general offices in the city as well as in Jacksonville, Fla.

Total employment in Greater Richmond has reached 235,000, an increase of 65,000 since 1960. At the same time, the community's unemployment rate of two percent is well below the recent national average of 4.3 percent.

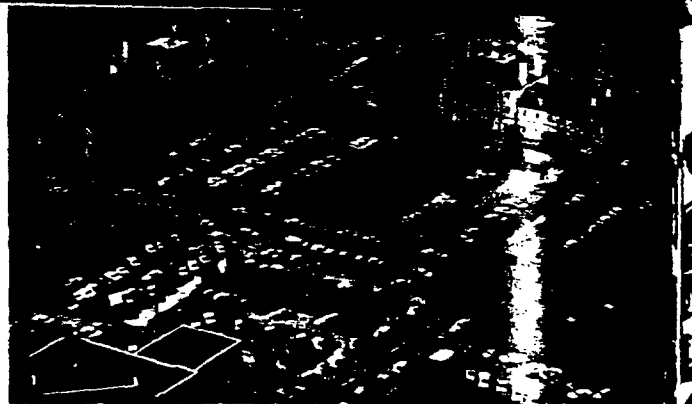
Personal incomes in the metropolitan community exceeded \$2 billion in 1969. This total represents a per family income of \$3,294, substantially above the national average.

The city of Richmond traces its origin to the same pioneers who established the first permanent English settlement at Jamestown, Va. in 1607. During the spring of that year, they pushed inland by boat until thwarted by cataracts and rocky James River islands.

At this point, which was to become the future city of Richmond, they landed and planted a cross, claiming the surrounding countryside for England. It was to take another 130 years, however, before life on the frontier became stable enough to permit the new community's settlement.

In 1775 the Second Virginia Convention met in St. John's Church on Richmond's Church Hill to seek ways of averting war with England. It was here that Patrick Henry delivered his immortal "Give me liberty or give me death!" oration. The historic church, still in use today, is one of the principal attractions for sightseers, together with beautifully restored homes nearby.

Shortly after the state's capital had been transferred to Richmond from Williamsburg in 1779, Governor Thomas



(1) Ethyl's corporate headquarters complex.

(2) The new Sports Coliseum being built downtown.

(3) More skyscrapers mean a busier financial district.

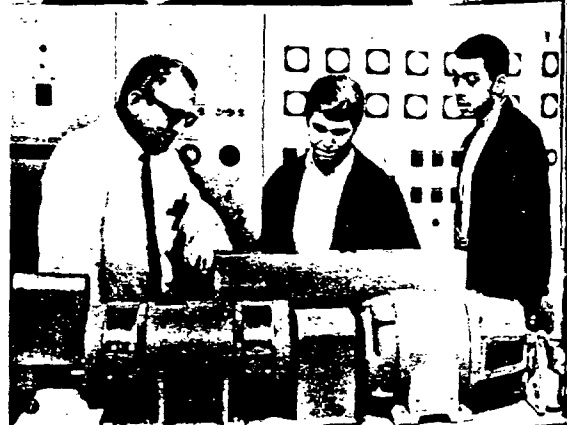
(4) First meeting (1966) of the Community Relations Commission, which fosters inter-racial harmony.

(5) Richmond's new City Hall.

(6) Home office building of Reynolds Metals.

(7) Employment skills being taught at the Technical Training Center.

(8) A modern highway system expedites traffic flow.





Jefferson had to flee to escape capture by renegade Benedict Arnold. The turncoat's troops pillaged and burned the city, but in rising from ashes and ruins into a large center of commerce, it entered a new era of prosperity.

It was in Richmond and environs that the first American iron and bricks were made, that the first New World coal was mined, and that the tobacco industry had its inception.

With the Civil War's outbreak, world attention was riveted on the Old Dominion city. Ratification of the South's Articles of Secession, which triggered the tragic conflict, took place in the stately capitol building which Jefferson had designed. General Robert E. Lee took command of the Confederate Army in the same setting. After the Confederacy's capital was moved from Montgomery, Ala., Richmond was the South's seat of government from June, 1861 until the end of the war.

Today thousands of people from all parts of the nation and the world stroll through the tree-shaded Virginia state capitol and its grounds for first-hand appreciation of these and other historic events. Another attraction near the capitol is the mansion where Confederate President Jefferson Davis lived and worked. It contains a wealth of Civil War memorabilia and is called the "White House of the Confederacy."

General Lee's brick home in downtown Richmond is another historic shrine open to the public. As a memorial to the Confederate leader, an imposing equestrian statue marked simply "Lee" overlooks the city's picturesque Monument Avenue. Bronze figures of Matthew Fontaine Maury, President Davis and such Civil War heroes as Generals "Stonewall" Jackson and J.E.B. Stuart are among the avenue's other commemorative statues.

Throughout its history, Richmond has been closely identified with the tobacco industry, with the result that it has long been known as "The Tobacco Capital of the World." Since its early years in this field, industrial Richmond has grown to some 850 manufacturing plants, including the Du Pont Company's huge nylon production facility, the world's largest of its kind. Following chemical and tobacco companies, the largest employers in Greater Richmond are the paper, printing, textile and apparel industries.

One measure of an area's commercial stature lies in the measurement of its "value added by manufacture." Statistics for Greater Richmond show that over the past decade this index climbed by \$258 million, an increase of approximately 50 percent. It reached \$778 million last year.

Blueprinting Richmond's continuing economic growth, Philip Morris, Inc. recently announced that it will construct "the world's largest cigaret plant" at the company's central operation complex. The \$80 million facility is expected to begin production in 1973.

Plans also have been announced for locating two major industries in Greater Richmond. Brown Boveri Corporation of Baden, Switzerland, is scheduled to build a \$10 million turbine generator assembly plant. ICI America, the American subsidiary of Britain's Imperial Chemicals Industries, Ltd., has broken ground for a \$50 million polyester film production center.

With the area's business and industrial growth, city and suburban residential sections are expanding and changing, too. Some 43,000 new homes have been built in the past decade, with hundreds of others being restored or remodeled.

In many neighborhoods, sizeable lawns surround homes of varied architectural design, including adaptations from colonial Williamsburg, which is just 50 miles away. Residential builders and developers consistently preserve such natural assets as pleasant vistas, streams, slopes and trees in new residential tracts. These areas blend harmoniously with other tree-lined boulevards and avenues in other parts of the city.

Prompted by deep appreciation for local architectural heritages, many Richmonders have turned to renovating houses built a century or more ago. It is in such parts of the city that fascinating projects of reclamation and renovation are bringing back to life much of the distinctive charm of bygone Richmond.

Underway for more than two decades, scores of such enterprises are not only making older houses more attractive and serviceable, but they are contributing as well to the steady appeal of mid-city townhouse living.

It is obvious from these renovation and remodeling projects that Richmond and its people are making a sincere effort to stem the tide of urban decay, a problem Richmond shares with other American cities.

Richmond, to be sure, has had its share of problems associated with its rapid growth in recent years and with the exodus of large numbers of people to the surrounding suburbs. These developments have made it increasingly difficult for the city to provide adequate municipal services within its fiscal means. Similarly, a related problem has been the need for modern housing to accommodate low income residents.

As former Mayor Phil J. Bagley, Jr. points out, "There always will be tough problems to lick, here or anywhere else." He notes that in a city like Richmond, where 45 percent of its population is Negro, "more and better housing for low income groups is still needed," although many poverty-ridden neighborhoods have been renewed through the efforts of private developers and the Richmond Redevelopment and Housing Authority.

The city's newly-elected mayor, Thomas J. Bliley, 38, adds that the population of the city will have to unite in finding solutions to the pressing problems facing inner city dwellers.

Among major challenges seen by City Manager Allen F. Kiepper are financing more facilities for occupational instruction and training. Concentrated now in the recently-built Richmond Technical Training Center, a \$5.6 million component of the local public school system, such job preparation is qualifying hundreds of area residents for employment in a wide variety of technical and vocational fields.

In other educational sectors, the area has several colleges and universities. They include the University of Richmond and its sister Westhampton College; Virginia Union

University, a predominately Negro institution; Randolph-Macon College for men, Union Theological Seminary, and the area's largest—Virginia Commonwealth University, with an enrollment of 13,700.

VCU is the result of the 1968 merger of Richmond Professional Institute and the widely-known Medical College of Virginia. The Medical College of Virginia (now the Health Sciences Division of VCU) is the pioneer hospital in the field of kidney transplants. Doctors at the Medical College Hospital also have performed heart transplants. One of their heart recipients is currently the world's longest living, having received a transplanted heart on August 24, 1968. Also of local educational stature is John Tyler Community College, which offers a two-year college course to area students.

In the field of racial relations, Richmond has established a Human Relations Commission that advises and consults the city's government on matters of human needs and problems. Also active is the Richmond Community Action Program (RCAP), which is designed to help the poor help themselves through education and work. The Greater Richmond Chamber of Commerce sponsors a summer employment program, providing jobs for many area teen-agers.

In the area of recreation, the city has constructed swimming pools in low-income neighborhoods. There are parks and playgrounds located strategically throughout Richmond, with special emphasis on summer programs and activities for neighborhood youngsters.

Metropolitan Richmond is also active in the areas of air and water pollution control. The city has committed \$48 million on more trunk sewers and new treatment plant facilities and has spent \$35 million of that allocation since the 1950's. Also, through its Air Pollution Control Bureau, the city has 12 stations throughout the area to sample and compile data on the quality of Richmond's atmosphere.

Culturally, Richmonders enjoy a wide variety of opportunities. There are plays staged by the Virginia Museum Theater, the drama departments of Virginia Commonwealth University and the University of Richmond. There are several dinner theaters in the metropolitan community. Broadway road shows are also booked into the city from time to time by local sponsors.

The first state-supported art museum in the United States, the Virginia Museum of Fine Arts has distinctive collections in its recently-enlarged building of Georgian architecture. The museum also sponsors a mobile gallery and statewide theatrical performances. There are several other galleries and historical museums throughout the metropolitan area too, including the Valentine Museum which specializes in art related to Richmond and its history.

Seasonal highlights of cultural Richmond include Garden Week Tours in April, Richmond Symphony Orchestra concerts, the Richmond Public Forum which arranges discussions of various topics by nationally known speakers, the annual Tobacco Festival and a summer-long Festival of Arts. Staged in an amphitheater, the Arts festival provides seasonal entertainment ranging from plays for children and

band concerts to ballet programs and Richmond Symphony performances.

Greater Richmond's cultural life will be broadened and its recreational and entertainment facilities expanded in keeping with plans for developing a sizeable area along the banks of the James.

According to long-range projections, tracts involved will extend eventually for nine riverfront miles and cover 3,300 acres. Included in the first stage, which has just been completed, are nature trails on the river's edge and footbridges to tree-tufted islands.

One of the goals of this development program is preserving the natural environment and peaceful charm of the James River bank area. When various projects are completed, Richmonders will be able to follow island-hopping trails, enjoy family picnics, sketch or paint, pitch tents on

sheltered camp sites, and go boating or perhaps swimming and fishing.

Projected coordinately are high-rise office and apartment buildings interspersed with small parks and plazas, with moving sidewalks connecting these new buildings with existing business and shopping areas. Gourmet restaurants and facilities for theatrical performances, dances, exhibitions, concerts and other special events will complement the area, according to present expectations.

Timetables and cost estimates for finishing projects of such size and diversity are not yet final.

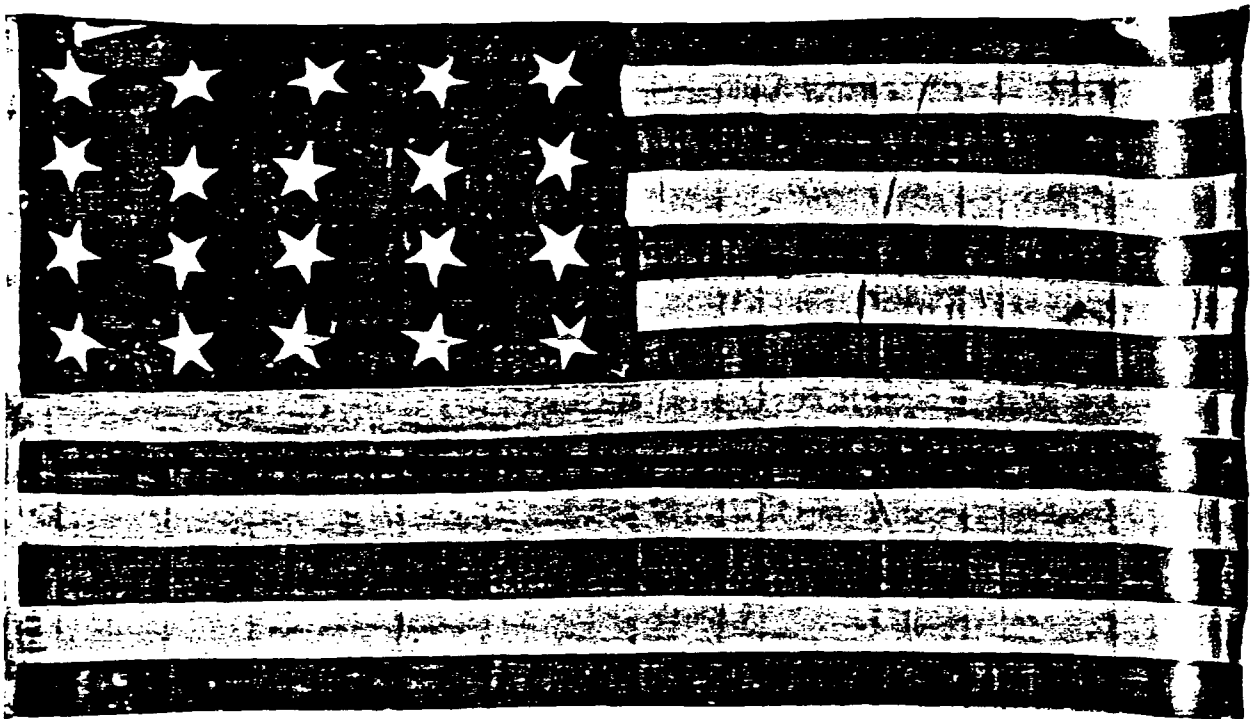
Richmonders familiar with their community's early years find it appropriate—in connection with the upcoming construction—to recall what pioneering Colonel William Byrd wrote in his diary after the city's original site was laid out in 1773:

"We build not castles only, but cities in the air." □

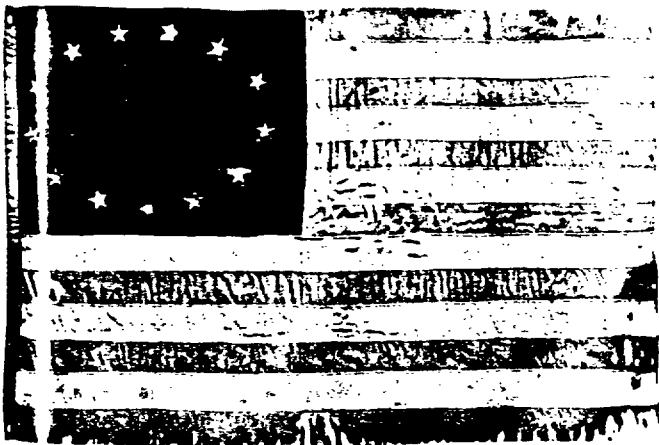


(1) The church where Patrick Henry made his plea to "Give me liberty or give me death!" (2) Equestrian statue of General Robert E. Lee. (3) Virginia's historic state capitol building. (4) Typical early 19th century homes restored to their former charm.

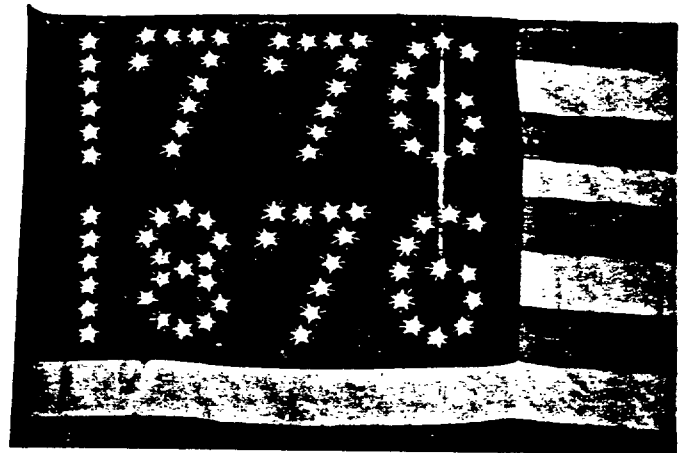
# RARE VERSIONS OF OLD GLORY



*One of the rarest existing United States flags, this 20-star edition was hoisted for the first time over the national capitol in Washington on April 13, 1818, after Mississippi's admission to the Union. By so doing, Congress ignored its own stipulation about introducing new flags on July 4.*



*Speculation has it that this silk Revolutionary War flag, with gold stars and some 1,000 stitches in each hand-sewn seam, could have been made for George Washington.*



*Such liberties as this were taken with Old Glory's field when the country celebrated its centennial. Although there were then 37 states, designers used as many stars as they chose.*

**As the United States approaches its bicentennial in 1976, patriotic Americans are bound to appreciate with increasing fervor and more respect than ever the inherent symbolism of our country's flag. Attention to the fascinating history of Old Glory is also certain to gain substantial momentum in the years just ahead.**

Meanwhile, it is equally true that few people today are fully aware of the number and variety of the flag's official and unofficial designs since the legendary needlework of Betsy Ross in 1776.

Not even the Smithsonian Institution in Washington, unquestionably the leading repository of American flags dating from Colonial times, has all of them.

*(Continued)*

Of the comparatively few privately-owned collections, an especially unique one belongs to a dedicated New York couple. Some of their flags are among the rarest known.

Incalculably valuable, the collection includes not only some 200 different interpretations of the Stars and Stripes dating from the republic's earliest years, but also comparable variations on the Confederacy's Stars and Bars. All of these flags are authentic originals.

Shown here are a few representative items from this fascinating treasury of historic Americana.

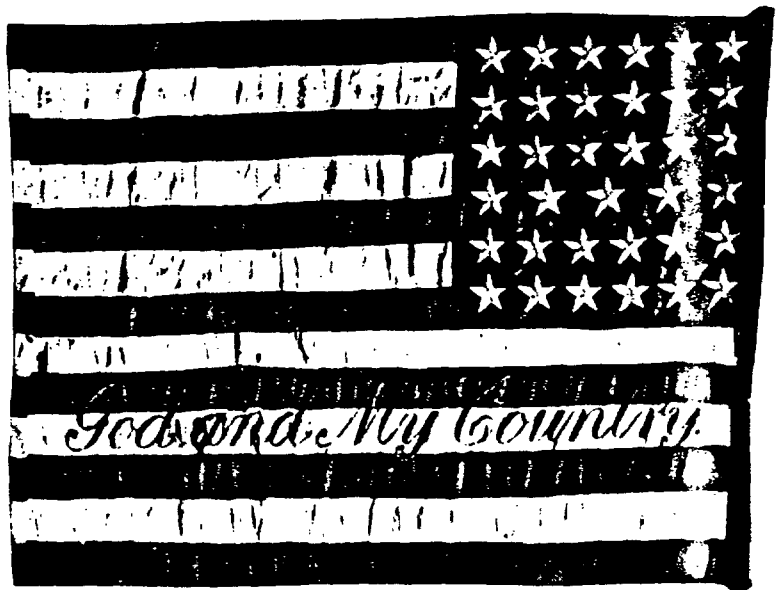
The collection owes its existence to a Polish-born editor, publisher, art connoisseur and antiquarian rather than to a native American. Boleslaw Mastai has assembled it during more than 30 years of applied expertise and devotion to the heritage of his adopted country af-



Collection-owner Boleslaw Mastai with a flag made from bits of uniform by a captured American while he was in an English prison during the Revolution.



Obsolete before it might have flown, this 39-star flag was made in anticipation of a single new state in 1890. Instead, Congress admitted five simultaneously—both Dakotas, Montana, Washington and Idaho.



Before there were laws prohibiting such practices, it was permissible for General George B. McClellan to add his campaign motto to this flag used in 1864 when he was running against Lincoln for the presidency.

ter being stranded in the United States by the outbreak of World War II.

With mounting enthusiasm since that time, Mr. Mastai and his scholarly American wife have been pushing ahead with their world-wide search for more flags. Some are so fragile that they must be sealed between sheets of transparent plastic. The couple's efforts are continuing.

Mr. and Mrs. Mastai welcome opportunities to share appreciation of their collection with others. From time to time they arrange its free public exhibition under the aegis of historical,

patriotic, cultural, civic, educational and similar organizations.

Ultimately the Mastais want to donate all of their priceless acquisitions for the nucleus of "a permanent American flag museum, authoritatively sponsored."

They hope that such an innovative focal point would not only serve scholars, but help promote more widespread response to what Thomas Jefferson once said: "How little do my countrymen know what blessings they are in possession of, which no other people enjoy." □



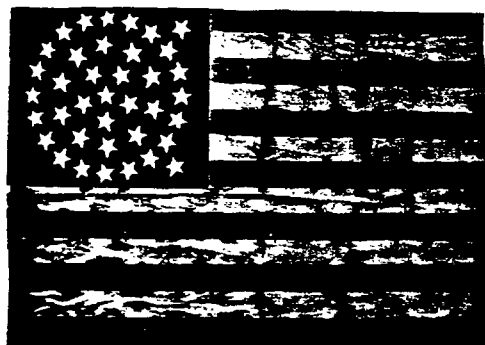
Nebraskans cheered on July 4, 1867, when statehood for them meant a 37th star.



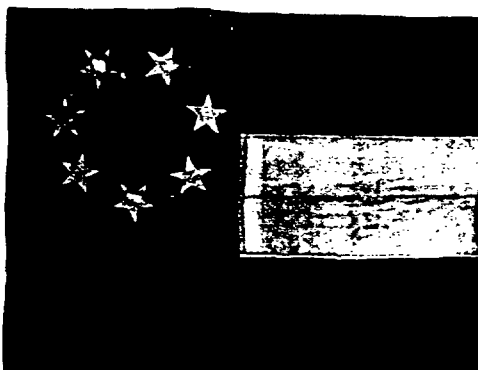
California's admission made the star tally 31 from July 4, 1851 until 1858.



Kansas would have missed becoming the 34th state in 1861 if it had accepted slavery.



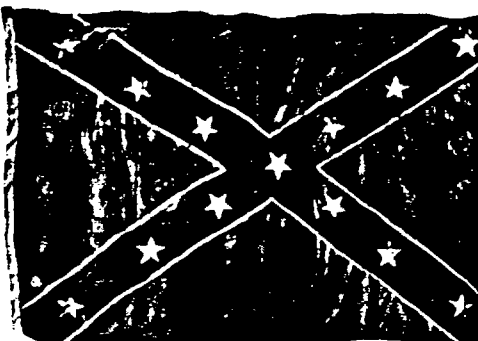
President Grant's administration brought this globularly-arranged field of 38 stars.



The first of Confederate Stars and Bars, this one is inscribed "Savannah, May, 1861."



An earlier field design became official in 1837 with Michigan's statehood.



The secession states' most familiar flag was their 1863 "southern cross" edition.

# aluminum: from terra

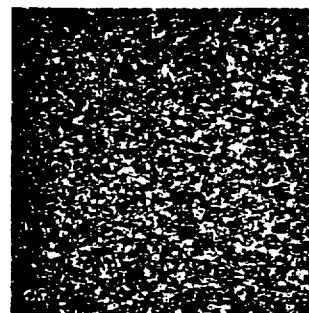
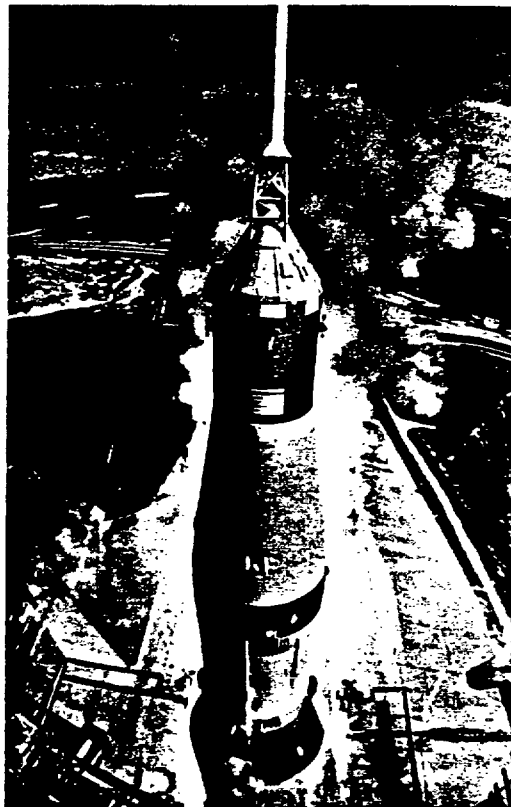


ETC 18074

# a firma to firmament



Left, aluminum extrusions being produced for construction markets by the Wm. L. Bonnell Co., Ethyl subsidiary. Left above, development in Ethyl laboratories of foamed aluminum. Center, huge Saturn V moon-mission rocket containing 500 tons of aluminum. Top right, texture of Ethyl slab of fine pore, closed cell, high density aluminum foam.



"It seems to have been created for the express purpose of furnishing us with the material for our projectile."

Rather than a modern space engineer's comments, this quotation is more than a century old. It comes from Jules Verne's prophetic "From the Earth to the Moon," published in 1865.

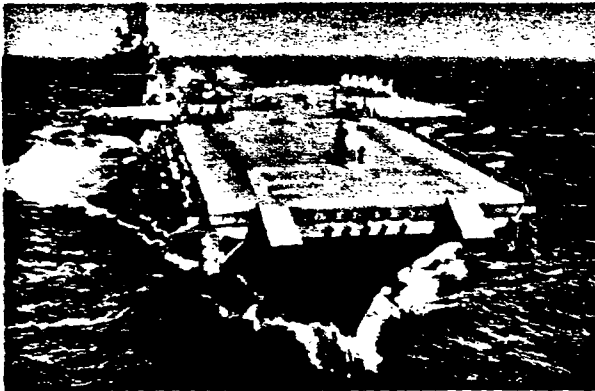
He was the first to put aluminum into space, if only in science-fiction. A fantasy then, of course, but bland indeed today in comparison not only with American extraterrestrial achievements, but in the light of aluminum's yeoman work everywhere on earth.

The discovery and channeling of the metal's almost unlimited service capabilities add up to one of the most impressive success stories of modern times. Second only to iron/steel as the world's most widely used metal, aluminum bows to no other in versatility and doing jobs superbly. More often than not, aluminum satisfies requirements which other materials cannot meet.

Propensities like these underlie the choice of aluminum for major components of aerospace rockets, modules, instrumentation and the sophisticated assembly, launching, control and guid-

ance systems involved in all Apollo moon missions. Globe-circling satellite roles for the metal are making possible world-wide television, better international communications and more accurate weather forecasting.

More than a million pounds of aluminum go into a single Saturn V rocket for blasting astronauts into trajectories for lunar orbitings and landings. Standing 36 stories high when poised for launching, a Saturn's components include sheets of plate weighing close to five tons each. Huge rings circling the rocket's first stage are forged aluminum.



To build and equip carriers like the USS Forrestal, some 3 million pounds of aluminum are required.



Aluminum is specified for this innovative truck-trailer with two 27-foot units in tandem.

Pioneering by the aluminum industry has been instrumental in the extensive and diversified uses of aluminum in space. Among pivotal research and development achievements are the creation of alloys capable of withstanding the tremendous heat, sub-zero cold and phenomenal stresses encountered within and outside the earth's environment. New machining and welding techniques are typical of other major innovations.

Such invaluable weaponry, in tandem with the combination of aluminum's innate properties, is indispensable not only in assuring optimum performance by the mammoth Saturn V, but also in the functioning of its piggyback riders to the moon—complex command, service and landing modules. Saturns and modules for future Apollo missions will be duplicates of their predecessors in all major respects, including specifications for aluminum.

Each module employs the metal in a variety of forms. They include aluminum honeycomb between alloy sheets, thin skin over exterior insulation, spun fibers bonded to honeycomb cores, foil, beams machined and chemically milled to precise dimensions and protective panels. Instrumentation and equipment for astronauts require aluminum too.

All space pioneers who leave footprints on the moon do so while wearing pliant aluminum-impregnated clothing. It not only provides lunar explorers with easy mobility, but affords them protection against environmental hazards.

In the light of aluminum's twentieth century record of increasing usefulness in multiplying numbers of ways, the metal's roles in still another area—even as challenging as space—follow logically enough.

During the past three decades, national consumption of aluminum has doubled, redoubled and then some—

with commensurate impact in so many ways that proceeds from the metal's bounty are being shared around the clock, day in and day out, by every man, woman and child.

Aluminum is of major and burgeoning importance in such fields as building/construction, transportation, communications, electric lighting and power, machines and industrial processing, consumer durables (furnishings, appliances, kitchenware), pharmaceuticals, health and safety, research, education and recreation, natural resources development and national defense.

More than twice as much aluminum is being used for all purpose today as in 1960. Total United States shipments of ingots and aluminum mill products topped 10 billion pounds for the first time last year. This increase approaches nine percent over 1968—typical of the industry's continuously vigorous growth.

The properties of aluminum, coupled with diversified processing adaptabilities, are major factors in the zooming of its markets. The metal is light, strong, durable and an exceptional conductor of electricity and heat, for example, as well as aesthetically attractive. It is immune to rust, resistant to corrosion and withstands chemical attack. Neither toxic nor magnetic, aluminum's alloyability and ready fabrication either alone or in combination with other materials are noteworthy assets too. It can be cast, forged, rolled, machined and extruded through dies into a variety of shapes. Ethyl is a growing source for aluminum extrusions.

Government sources and The Aluminum Association pinpoint building/construction as the largest market for the metal in multiple forms and ways. They reached a total of 2.36 billion pounds in 1969. Transportation uses last year were firmly in second place, accounting for

1.99 billion pounds. Annual demands from such other markets as electrical and container/packaging also have reached billion-pounds-plus dimensions. Aluminum-oriented consumer durable sales climbed 20 percent last year.

There is general agreement in knowledgeable quarters that building/construction markets—ranging from sheds through homes and commercial requirements—are likely to continue their demand-leadership in the years just ahead.

Residential applications are burgeoning particularly, with the use of aluminum siding up 214 percent within the past decade. More than three million homes now have aluminum-covered exteriors, adding up to a 350-million pounds-per-year market escalating with new home construction and the modernization of older dwellings. Aluminum siding adds durability to outside walls, protects against fire, assures reduction in home heating and cooling requirements and keeps maintenance/repair costs low.

Increasingly numerous householders are also depending on windows, doors, ventilators and related apertures with frames, screens or other aluminum accoutrements. Demand for the metal in these forms is one of the liveliest on residential fronts. Home owners are turning more often these days not only to aluminum gutters, downspouts and awnings, but to entire roofs of aluminum. As pigments, the metal is adding advantageous properties to paints and enamels.

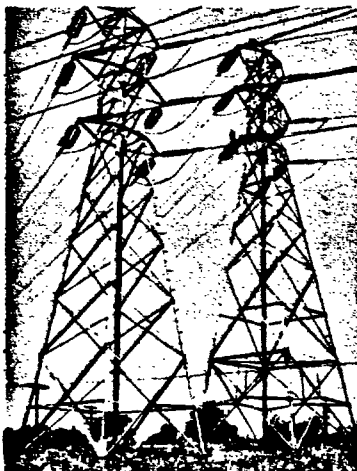
Porch, garden and other aluminum furniture is more popular today than ever, with sales continuing upward. More and more aluminum also is going into such domestic essentials as refrigerators, vacuum cleaners, air conditioners, washing machines, lawnmowers and other household equipment. Close



Above, assembly line for aluminum windows being made by Capitol Products Corp., Ethyl subsidiary.



Above, Boeing 747 superjets contain close to 80 tons of aluminum in structural parts, equipment and cabin fittings.



Long distance power transmission systems are among growing markets for aluminum.



Left, demand for outdoor and indoor aluminum furniture is growing by leaps and bounds.

to 90 percent of all cooking utensils and auxiliary kitchenware is aluminum-made.

Multiplying numbers of Americans are living in some 2.5 million mobile homes built largely of aluminum. These semi-permanent living quarters can be moved from one site to another as circumstances warrant. Still more thousands of people-on-the-go enjoy outings and vacations in almost 14 million fabricated aluminum house trailers easily towed behind the family car. The metal is used extensively in furnishings and equipment for mobile homes and trailers.

In much the same way that residential demands for aluminum are climbing and proliferating, so are the metal's uses in other structures.

One of the dramatic ways in which cities are utilizing aluminum is in new skyscraper monoliths of burnished metal and glass. Exterior aluminum curtain walls, representing a 100-million-pound market annually, are fabricated and hung

either in natural silvery finish or colored so permanently by an anodizing process that fading or chipping never occurs.

Offices depend on aluminum for much the same purposes as homes do—among them doors and windows, furniture, electric wiring and paints—plus, of course, business machines, cabinets, communications systems and such structural necessities as stair railings, treads and elevator components. A novelty until recent decades, aluminum store fronts and fixtures are everywhere today.

Ethyl and its aluminum subsidiaries are supplying the building/construction and transportation markets to an increasing extent. Output is primarily extrusions—shapes for end-uses. The company has remelt/casting and fabrication facilities too.

Collectively, these extrusions are marketed either as finished consumer needs or to supply other aluminum fabricators. Among Ethyl's finished products are

doors, windows and screens of aluminum, molding and trim, and materials for the floor covering industry.

In its custom extrusions business, which is growing substantially, Ethyl is meeting such specialized requirements for aluminum as those of manufacturers of curtain walls, entrances, store fronts, marquees and signs; carports, patios, greenhouses and other enclosures; cabinets, tubs and sinks; sliding door tracks and weather stripping; stair nosings, railings, dividers, louvers and shelves; pipe, tubing, conduits and ovals; mobile homes, trailers, boats and marine hardware. The company also has expertise, production and fabrication equipment for other purposes. Billets of aluminum are being marketed to various processors.

Ethyl's aluminum production is a major part of the company's broadly diversifying enterprises. It is concentrated in the Pennsylvania, Georgia and Tennessee plants of two subsidiaries—the William



*A comfortable but out-of-date home (left) gains a new lease on life when its aging shingles are replaced by permanently-colored aluminum siding.*



*Awnings and window-frames of aluminum are among uses for the metal in modern home communities.*

L. Bonnell Company and Capitol Products Corporation. Among new facilities either added recently or about to be in operation are heavy-duty extrusion presses, more casting equipment, and installations for polishing, rippling and hard coat finishing.

In pointing out that Ethyl estimates sales of \$60 million from its aluminum business this year, compared with \$37 million in 1969, Ethyl's president, Bruce C. Gottwald, told *The Wall Street Journal* recently that "We have a broad, well-anchored market position in aluminum, and we can take it from here . . . we can go just as basic as we want to." Explaining further, he added that Ethyl might go all the way into smelting and even mining. Mr. Gottwald hinted that in any case, the company is likely to

increase its participation in selected aluminum-oriented enterprises.

Even cursory consideration of the transportation field—aluminum's second largest market—shows that the metal's uses are inseparable from aviation progress. The example most frequently cited today is the new Boeing 747 super-jet. It contains 165,000 pounds of aluminum and its alloys—more than half of the behemoth's weight of almost 160 tons. Ranging from structural parts to components of engines, instruments and other equipment, these end-uses of the metal represent the largest and most complex package of aluminum aloft commercially.

More generally, aluminum is continuing as the material of overwhelming choice for airframes in practically all

commercial, military, personal and business aircraft now being built or in design stages. The metal is preferred too for wheels and landing gear.

Large diesel line-haul tractors depend on aluminum in engines, bodies, electrical systems and forged disc wheels. Door-to-door cargo containers are another important and growing market for fabricated aluminum sheets.

Passenger cars use more of the metal in automatic transmission systems than for any other purpose, with 80 to 90 pounds required per vehicle. Other uses for aluminum in automobiles include trim, grilles, headlight bezels, moldings, seat shields and safety belt parts. Aluminum radiators are in development stages.

In transportation by rail, recently-introduced Turbo-service for high speed runs between New York and Boston depends on sleek passenger cars with skins of smooth, heavy-gauge aluminum. Standard passenger trains have more aluminum seat and window frames. Railroads are acquiring additional freight cars built either entirely of the metal or partially so. Locomotive efficiencies go up when diesel engines have aluminum pistons.

The metal does rugged work afloat, whether as 1,000 tons in the superstructure of Britain's Queen Elizabeth 2 or aboard smaller commercial vessels. More than half of the nation's 8.6 pleasure boats have watertight hulls of fabricated aluminum. When the metal goes into marine engines, gear and fixtures, they work better and last longer. Sailboats with aluminum spars are more numerous today than ever. In fact most waterborne markets for aluminum are growing by leaps and bounds annually.

Aluminum and the nation's electric

utilities grew up together, playing interchangeable roles of producer and consumer since the 1890's—with aluminum production contingent on its needs for electricity. Today the electrical industry is increasing its use of the metal more rapidly than any other enterprise, especially in long distance transmission.

Largely because it is a better conductor, stronger, lighter and less expensive than competitive metals, aluminum is currently going more often into electrical distribution systems and interior wiring. The metal's applications in electrically-powered equipment and other machinery for industry, the home and elsewhere are multiplying continuously. Practically all light bulbs these days, incandescent or fluorescent, have aluminum bases.

Among the host of other diversified users of aluminum for commercial purposes, the requirements of fabricators of packaging and containers for the food, beverage and pharmaceutical industries are experiencing phenomenal growth. Cans with "pull-out" tabs are almost making conventional openers obsolete. There is apparently an inexhaustible market for billions of aluminum screw-on and snap-on bottle closures. On the heels of household versatility, aluminum foil is winning still more laurels in consumer packaging and as an industrial tool.

In technical roles for the metal, Ethyl pioneering in research, development, manufacturing and commercial applications of comparatively new aluminum compounds are contributing substantially to efficiencies and economies in major

sectors of the industrial chemical field.

These compounds are organometallics, known as aluminum alkyls, aluminum alkyl halides and aluminum alkyl hydrides. They are going into the manufacture of diversified plastics, synthetic rubbers, plasticizers, resins and related synthetics in widespread use and accelerating demand. In other directions the alkyls are contributing to the production of biodegradable detergents and soaps. More generally, as industrial workhorses, the aluminum chemicals are serving as catalysts, reducing agents and intermediates. They are being used too as pyrophoric (self-igniting) ingredients of exotic jet and missile fuels.

The world's leading source for aluminum alkyls and their halides, Ethyl is currently producing and marketing them in multi-million-pound quantities annually. This achievement has origins in company work on new routes for manufacturing lead alkyls going into antiknock compounds. New directions for this technology are developing from Ethyl's continuing efforts to establish additional important uses for it.

The company is investigating, for example, how aluminum alkyls could be used in the manufacture of edible synthetic fats and oils with properties superior to those of natural products. Related research is concerned with more efficient and economical synthesis of man-made flavors and fragrances via Ethyl's organo-aluminum technology.

In other directions relating to uses for the metal, Ethyl laboratories are now offering development quantities of aluminum foam produced by the com-

pany's chemically innovative process. The foam is cellular and finely sponge-like in structure but rigid in physical properties. It has such assets as lightness, high strength-weight ratio, durability, shock-resistance and insulating efficiency. Aluminum foam can be cast as slabs, fabricated into sandwich panels, laminated with plastics and die-cast or machined into required forms, including intricate shapes.

Ethyl market surveys point to potentially heavy demands for foam in building/construction (floors, walls, partitions, ceilings, roofs) and in transportation (truck, trailer bodies, parts, automobile components).

All aluminum comes from bauxite ores. They are natural deposits found throughout the world, usually at surface levels accessible for open-pit mining. Treating bauxite chemically yields alumina (crude aluminum) for high temperature reduction (smelting) in electrolytic cells. Molten metal is then cast into ingots or billets. These, in turn, undergo further processing into finished aluminum end-products.

Aluminum is always ready to move in new directions, whether in space or on earth. Sensitized cylinders of the metal are being used currently to study intense bursts of gravitational radiation from our galaxy's center. Aluminum will travel some 370 million miles in 1972 in a package of instruments for fly-by checking of the planet Jupiter's atmosphere. Closer to home, there are promising uses for aluminum in the upcoming field of cryogenics, which involves extremely low temperatures. More applications for lasers—high energy beams—may hinge on how aluminum might help.

All this is a far cry from early millennia in which mankind first knew aluminum only as a mysterious ingredient of pottery clays. It made primitive cooking and storage vessels stronger and more durable. Thousands of years were to go by before the element was even identified, but it has taken only little more than a century to touch off the metal's domino-effects on the world as we know it today.

Bearing in mind that collective markets for aluminum have surged upward some 250 percent during the past two decades alone, the industry's official projection of an average eight percent increase in annual demands during the early 1970's seems more than assured.

In any case, awareness that the limits of aluminum's versatility are by no means in sight means that its future is as bright as the metal itself. □



Light, strong and leak-proof aluminum hulls are features of some 4 million pleasure boats today.

# DEVELOPMENTS



C. Raymond Hailey

**C. Raymond Hailey** has been promoted to president of Oxford Paper Company, a division of Ethyl Corporation. William H. Chisholm has been named chairman.

Mr. Hailey came to Oxford last year as an executive vice president after 28 years with Albemarle Paper Company, a former Ethyl subsidiary. In addition to his new Oxford responsibilities, Mr. Hailey remains a corporate vice president of Ethyl.

Mr. Chisholm continues as an Ethyl executive vice president, executive committee member and a director. Before Oxford Paper became a component of Ethyl in 1967, he served Oxford successively as vice president, president and a director.

Other recent changes at Oxford include two appointments: Russell H. Chambliss, Jr. to vice president/sales and Samuel D. Dillon to vice president national accounts/west.

**Ethyl in July announced its entry** into the field of air quality measurement systems and related products and services by acquiring Air Monitoring, Inc., of Ferndale, Mich., the Detroit suburb where Ethyl maintains research laboratories and modern vehicle emission testing facilities.



Roland J. Ostrander

In announcing the acquisition, Floyd D. Gottwald, Jr., Ethyl's board chairman and chief executive officer, said that purchasing AMI represents a modest investment and is not a major capital expenditure.

He added that although a small and young enterprise, established late in 1969, AMI "offers a favorable growth potential in a new field that is destined to become more important as air pollution control efforts accelerate."

So far, car manufacturers and government agencies have been the principal customers for AMI's custom-built monitoring and measuring equipment for use in laboratory analyses of automotive exhaust gases. Other potential market outlets include automotive maintenance facilities and oil company laboratories. AMI will be prepared to market exhaust surveillance systems when such equipment becomes necessary to insure that vehicles on the road actually meet emission standards specified by car manufacturers.

In functioning as an Ethyl subsidiary, Air Monitoring, Inc. will maintain headquarters in Ferndale. Roland J. Ostrander, technical director of Ethyl's Petroleum Chemicals Division, is serving as AMI president and a director. Arthur C. Coleman and Richard C. Sewell, principal AMI stockholders before Ethyl acquired it, are now

general manager and sales manager, respectively. Frederick P. Warne, Ethyl corporate secretary and Frank J. McNally, Ethyl's treasurer, are filling similar positions with the new subsidiary.

**Drilling for oil and gas** on leased acreage under the North Sea and in western Canadian provinces are in directions in which Ethyl is moving to extend its business.

A North Sea discovery well off the Dutch coast, tested at 2,000 barrels daily, was announced in May by the four-company international partnership operating there. Ethyl Netherlands, a subsidiary, is one of them. Further exploration is continuing.

In Canada, Ethyl Development Corporation, Triad Oil Company Ltd. and B.P. Exploration Canada Ltd. are investing up to \$6 million in drilling for oil and gas in Alberta, British Columbia and Saskatchewan.

**A new plant for the production of** a brominated hydrocarbon intermediate useful in the field of industrial chemicals will be built by Ethyl next year at Magnolia, Ark.

Costing several million dollars, the new plant is to adjoin the Bromet Company's installations for extracting bromine from brine—facilities in which Ethyl has an 80 percent interest. The new plant, however, will be totally owned by Ethyl.

Its output will be the first brominated chemical to be marketed by the company other than ethylene dibromide, an antiknock compound ingredient. The agricultural chemical and textile-treating markets, which Ethyl is already serving, are among major consumers of bromine-oriented products.

**The first book of its kind,** on the rapidly growing uses of aluminum alkyls in organic chemical synthesis,

has been published by Ethyl as a service to the chemical industry. Copies are available through the company's Industrial Chemicals Division.

Reviewing in detail the many possible reactions of aluminum alkyls with organic compounds, *The Use of Aluminum Alkyls in Organic Synthesis* has been prepared with emphasis on the chemicals' existing or potential utility in the pharmaceutical, fragrance, agricultural and organic specialty fields.

Ethyl is the world's leading manufacturer of aluminum alkyl compounds, which are of major industrial importance.



Thomas A. Coerver



Lawrence G. Cliver

**Ethyl's Houston plant** at Pasadena, Texas, has a new resident manager. He is Thomas C. Coerver, whose appointment became effective July 1 to succeed the late Melvin C. Hudgins.

Formerly operations manager at the Ethyl plant in Baton Rouge, La., Mr. Coerver has held a variety of maintenance, construction and operations positions at both plants since joining the company in 1948. His BS and MS degrees in chemical engineering are from Louisiana State University.

Lawrence G. Cliver is Mr. Coerver's successor in Baton Rouge, currently serving as acting manager of operations.

**To insure adequate supplies** of its chlorinated solvents for projected market demands during the next few years, Ethyl is increasing by some 50 percent its capacity for producing these important chemicals.

Already largely completed at company manufacturing facilities in Baton Rouge, La. are changes underlying the current availability of additional quantities of significantly improved 1,1,1-trichloroethane. Increased output of trichlorethylene and perchlorethylene will follow later this year.

Known as Multi-Purpose Grade (MPG), the improved 1,1,1-trichloroethane offers more versatile performance in general solvent use, vapor degreasing and cold cleaning in a wide variety of industrial, business and home-use products and services. Applications for MPG are almost unlimited.

#### **A new Push Button Octane Number**

instrument for automatic laboratory determination of gasoline quality has been developed by Ethyl. It is currently available for oil industry uses through the company's Petroleum Chemicals Division.

Designated as PBON II, Series 70, the new instrument is a redesigned and improved version of the original automatic octane determinator which Ethyl developed and introduced early in 1963. Since that time its use, in

conjunction with an ASTM engine, has provided knock testing laboratories with a means for obtaining octane numbers quickly and with minimum cost by Push Button operation.

Like the original device, PBON II incorporates compression ratio technique for octane determination as the basic test procedure. Changes and improvements in design and the use of electronic components are among factors contributing to the new instrument's reliability, easy maintenance and flexibility of operation. The new PBON is smaller than its predecessor and requires less laboratory installation space.

**On International Division fronts:** In addition to continuing as managing director of Brussels-based Ethyl S.A., an overseas subsidiary of the company, **William J. Rusher** has been appointed to the newly created position of general sales manager for the Division. **Robert J. Riggs**, Latin American sales director, has been assigned additional responsibilities too—as the Division's New York representative.

## **PRODUCTION NOTES**

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# Taking the lead out of gasoline can increase more than the price. It can increase the smog.

It's a fact. Removing lead from gasoline can cause more smog—not less.

The reason is simple. If you take the lead out, something (called aromatics) has to take its place to raise the octane to the levels many car engines require.

The Bureau of Mines of the U.S. Department of Interior has studied the effects of gasoline composition in their laboratories. They have consistently reported that non-leaded gasoline of today's octane quality emits more smog-causing hydrocarbons than leaded gasoline.

Their most recent report (Bureau of Mines Report of Investigations 7390, May 1970) states:

*"The photochemical reactivity of automobile emissions was found to be increased by as much as 25% when fuel was changed from typical U.S. leaded gasoline to prototype unleaded gasoline of comparable*

*octane quality. The increase is attributed to characteristics of blending components that were used to obtain the required octane quality without using lead."*

We don't understand what sense it makes to ask you to pay several cents more per gallon of gasoline to *increase* the smog. Adding lead antiknocks holds down the cost of gasoline *and* holds to a minimum the components which cause smog if they're not properly burned up in automobile engines.

For the full report by the Bureau of Mines, plus other information that will show you why the removal of lead is unnecessary—even undesirable—write Ethyl Corporation, Dept. PC.

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