AIA

planes

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OFFICIAL PUBLICATION OF THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA

TEAMWORK SPARKS SATELLITE PROJECT

Jet Engines Set Overhaul Record

If there were a road to the moon, 239,000 miles long, you could drive the family car there, drive around the planet 17 times—probably in a fruitless search for a parking space—and drive back home. Your speedometer, theoretically, would read about 600,000 miles.

Can you imagine that your car could travel this distance—or even one-sixth of this distance—without at least one major engine overhaul? You know perfectly well the family bus just wouldn't make it.

But an airplane has made it. This plane did not fly to the moon, of course; it flew routine training missions around our own planet, the earth. But it traveled approximately 600,000 miles without a major overhaul of its six jet engines, establishing a new record in aircraft jet engine durability.

The plane was a medium jet bomber of the Strategic Air Command, which has been flying training missions for more than 30 months, including the first non-stop transatlantic combat readiness mission by a SAC medium bomber wing. Its six jet engines were originally installed in November 1952, and went through a 600-hour inspection over a year ago with only minor parts replacement.

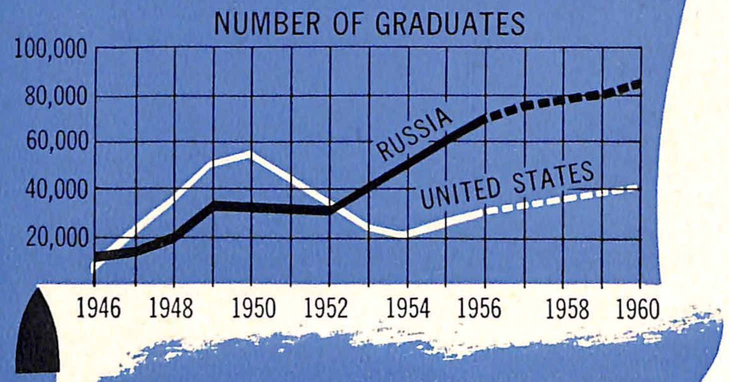
Although jet engines are quite new compared with piston engines, jet development has been rapid. Service life of the type of jet engine in the medium bomber which established the durability record has increased 800 per cent in the last four years, according to the manufacturer, and further increases are expected.

About 35,000 of this type of jet engine have been built since they went into production in 1948, and a little more than half of these have been produced for use in the medium jet bombers. These engines are accumulating flight time at the rate of 11,000 hours a day in several types of aircraft.

Commercial transport planes ordinarily carry lighter loads than their military counterparts and consequently are allowed a longer time between engine overhauls. The CAA has set a mandatory overhaul time of 1,200 hours for piston engines in a four-engine transport of comparable design.

ENGINEERING GRADUATES IN THE UNITED STATES AND RUSSIA 1946-1960

Today Russia is graduating almost three times as many engineers as the United States. While more American youth are turning to careers in science and engineering, trained technical manpower continues to loom as one of the most serious threats to continued U. S. leadership in aviation progress. It is vital to our national security and welfare that those who have been endowed with the talents meet the challenge and build careers for themselves and leadership for the United States in science and technology.



'PLANES'

Transmitting Amplifier Increases Ground-to-Air Communication Distance By Ten Times

To keep pace with continually increasing speeds and altitudes of modern planes, the aircraft industry has developed a transmitting amplifier that will make ground-to-air communication transmitting ten times more powerful.

The amplifier, operating on one kilowatt, ultra high frequency, will enable the Air Force to contact aircraft higher and farther away than with equipment now in use. It was designed by one of this nation's large aircraft systems manufacturers to meet both present and far-reaching anticipated needs for Air Force ground-to-air communication requirements.

The one kilowatt power output was chosen to provide the most efficient transmitting range, with the least interference, and at the lowest cost level.

The entire amplifier unit weighs less than a ton, and is multi-purpose in design and function. Its communication facilities can be permanent or mobile, and can transmit voice or data signals.

With the increased power provided by the new amplifier, the possibility of lost aircraft and personnel will be greatly reduced. The amplifier also helps to overcome the jamming techniques of enemy transmitters. This is a "slap on the wrist" created by unfriendly radio stations by sending out a signal to disrupt communication efforts. Use of the amplifier's increased power hinders the efforts of enemy jamming, thereby providing clearer reception for Air Force flying personnel.

'Vanguard' Uses Many Talents

When the first earth satellite is hurled into space during the International Geophysical Year, the tiny, globe-circling "moon" will represent not only a gigantic first step in the eventual conquest of space, but also a history-making example of teamwork by the outstanding creative talents of the aircraft industry, science and the government.

The satellite project, officially "Project Vanguard," represents countless thousands of man-hours in scientific and engineering work of the most exacting character, plus the sum of man's knowledge of the new frontier above our atmosphere.

As the world's first artificial satellite orbits above its "mother" planet, Earth, at between 17,000 and 18,000 miles an hour, 300 miles above the highest mountain, it will serve as a constant reminder of the progress science and industry have already achieved, and a challenge to further exploration of outer space.

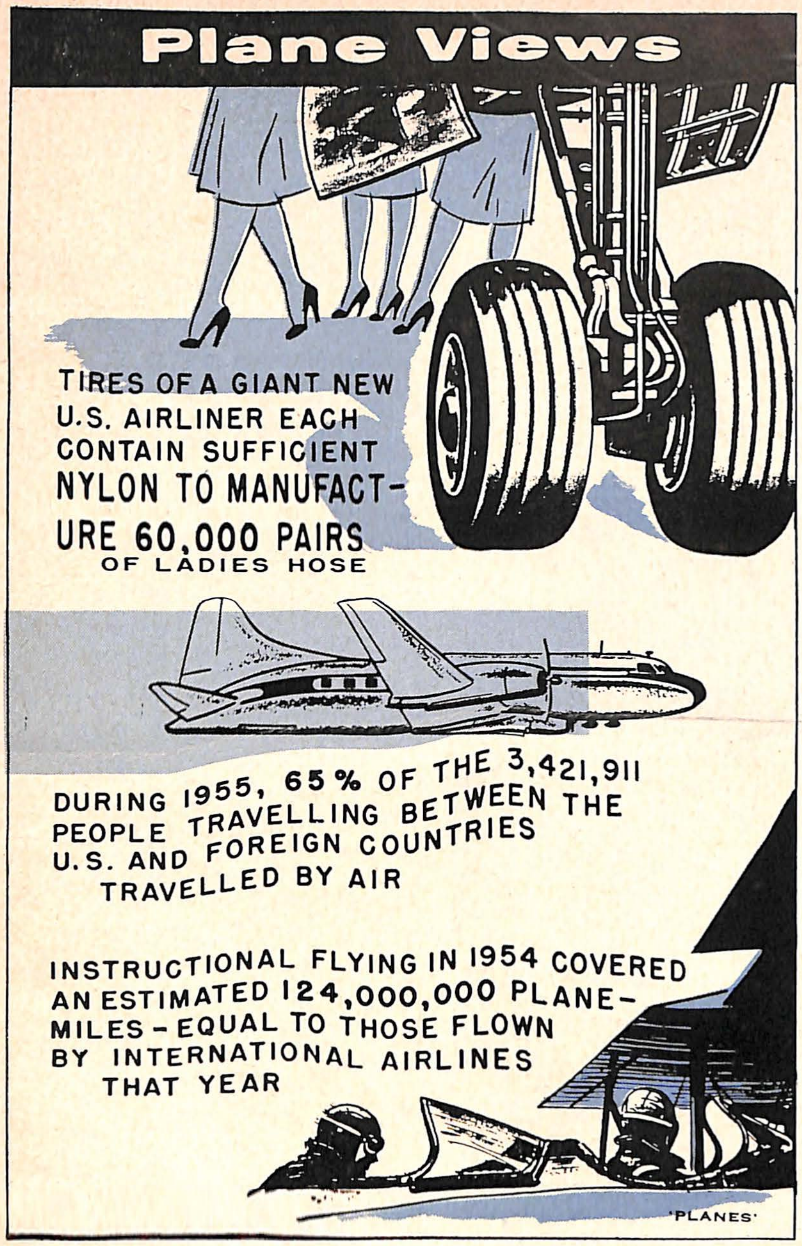
The satellite will also serve as a tribute to some very down-to-earth people in the aircraft, engine, systems and components industries, whose talents will have literally placed it in the galaxy as a new star.

The prime contractor and the majority of subcontractors for the Vanguard vehicle are members of the aircraft industry. Despite the competitive nature of the aircraft industry, member companies whose skills have been tapped for various phases of the satellite project are working together in close cooperation to launch man's first outer space vehicle.

This close cooperation is of the utmost necessity, since launching of a satellite demands more individual skills than are available in any single aircraft firm, or in any scientific laboratory. The theme of cooperation has also been manifested by the government. Although Project Vanguard is listed officially as a Navy project, it calls for the use of Air Force launching sites, Army tracking, plus contributions by literally scores of government scientists, technicians and administrators.

Possibly the best example of industry cooperation in the satellite project is in building the vehicle which will launch the artificial "moon" into space. Overall, the launching vehicle is a finless, three-

(Continued on page 7)



PLANE FACTS

• A brand new version of a giant commercial passenger plane weighs more than twice as much as its original model built 17 years ago; flies about twice as far; carries three times as much payload; and its cruising speed is 125 miles per hour faster.

• **Last year, interceptor aircraft of Air Defense Command performed 500,000 takeoffs and landings in various functions to keep America safe. At least the same number will be performed during 1957. This means that approximately 700 interceptor pilots are airborne in the national defense during each 24-hour period.**

• A modern jet engine, widely used in Air Force and Navy planes, can consume enough fuel in ten minutes to operate a new 1957 model automobile for 12,500 miles, or to heat a five-room house for a full winter.

• **Vapor trails, or "contrails," created when moisture in a plane's exhaust condenses, make surprise air assaults difficult. Work on diminishing vapor trails is currently under study by chemists at the Armour Research Foundation of the Illinois Institute of Technology.**

'Moonshiner's Still' Pre-Cools Jet Fuel

A "moonshiner's still" is used to pre-cool the jet fuel in some of this nation's latest fighter planes. The "still" consists of a round barrel about six feet deep, with coiled pipes inside, such as the old fashioned moonshiner used to employ. Cakes of dry ice are dropped in along with the jet fuel, to cool the solution to near freezing. Fuel is pumped into the coiled pipes inside the barrel from the refueling truck.

At the bottom of the tank, the fuel comes out of the coils at minus 70 degrees temperature, and is pumped through a protective hose into the plane's fuel tanks. The liquid-plus-ice around the coils "boils" vigorously during the fueling operation, as carbon dioxide is released.

This ingenious idea came about when aircraft industry engineers discovered that the use of pre-cooled fuel would permit more pounds of fuel to be stored in an airplane's tanks. Estimates are that between six and ten per cent more pounds of fuel can be carried in fuel tanks in this manner, although the total number of gallons in the tanks remains the same. Jet fuel shrinks as it cools. The fuel is of a special type resembling ordinary paint thinner, a high specific gravity fuel.

PLANES

Planes is published by the Aircraft Industries Association of America, Inc., the national trade association of the manufacturers of military, transport, and personal aircraft, helicopters, flying missiles and their accessories, instruments and components.

The purpose of *Planes* is to:

Foster a better public understanding of Air Power and the requirements essential to preservation of American leadership in the air;

Illustrate and explain the special problems of the aircraft industry and its vital role in our national security.

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Leadership And Experience

One of the significant moments in commercial air transportation occurred in October 1955 when a U. S. international carrier placed the first order for American-built U. S. turbojet transports. This action opened the gates to a new era of air transportation for the traveling public that is astounding. Travel time between distant points will be about half that for the finest piston transports flying today.

There have logically been many questions as to why U. S. jet transports will not be in operation until 1959 when U. S. military jets have been operating for years, and U. S. turbojet bombers today lead the world. U. S. manufacturers were well aware of the great potential of commercial jet transportation, but at the same time did not want to rush headlong into the commercial jet field until the airframe and engines had acquired the vital factor of experience necessary to prove their performance and reliability.

The U. S. aircraft industry firmly believes that before being ready to meet the grinding pressure of transport service, heavy military multi-jet equipment must be operated in quantity over a period of years to pave the way. The U. S. manufacturers have acquired this broad, expensive and essential background. The turbojet and turboprop aircraft which the U. S. is selling today for delivery within the next three years will have the same high degree of reliability, efficiency and economy as the piston-powered transports built by the U. S. which lead the world today.

The U. S. aircraft engine industry, according to a recent survey made by the Aircraft Industries Association, has built about 90,000 gas turbine engines since 1942. These engines have already compiled 24 million flying hours. There is no question that the U. S. leads the world in production of and flying experience with jet engines. Large numbers of multi-engine jet bombers have been produced by the aircraft industry, an output unequaled by any other country.

The engine selected for use on two of the U. S.-built turbojet transports has been powering military aircraft for a substantial period. The great refinements, including power increases and lower fuel consumption rate, will be available in commercial versions of the engine.

The preference for U. S.-built gas turbine engines is international. Five major American aircraft producers today have firm orders from U. S. and foreign airlines for 600 turbojet and turboprop transports valued at more than $2 billion. More than 100 of the total of 600 on order will be acquired by foreign airlines. The most recent turbojet order was placed by British Overseas Airways Corp. for 15 aircraft.

The overriding reason for the success of U. S. commercial transports is the highly competitive nature of the industry. Competition means that U. S. manufacturers must plow back huge sums of their earnings into research and development facilities if they are to stay in business. The drive to produce a better, less expensive aircraft keeps the U. S. aircraft industry ahead in both the commercial and military fields.

World carriers can continue to look with confidence and assurance to the U. S. aircraft industry to produce superior transport aircraft.

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Tomorrow's Engineers

By Gen. Joseph T. McNarney
Chairman, Board of Governors
Aircraft Industries Association

GEN. JOSEPH T. McNARNEY (USAF, Ret.), Chairman of the Board of Governors of the Aircraft Industries Association, served illustriously in World War II as Deputy Chief of Staff, U. S. Army, Deputy Supreme Allied Commander in the Mediterranean Theater of Operations, and Commanding General of the U. S. Army Forces in that theater. In September 1945, he became Acting Supreme Allied Commander in the Mediterranean Theater of Operations, and the following December, succeeded Gen. Dwight D. Eisenhower as Commanding General of the U. S. Forces in the European Theater and Commander-in-Chief of the U. S. Forces of Occupation in Germany. After returning to the United States from his overseas assignments, Gen. McNarney served as Commanding General of the Air Materiel Command, Wright-Patterson AFB, Ohio, from October 1947, to September 1949. Gen. McNarney holds numerous decorations for his military achievements. He was named President of Consolidated Vultee Aircraft Corporation—now the Convair Division of the General Dynamics Corporation—in March 1952, after more than 36 years in the Armed Forces.

ONE of the most potentially disastrous news stories of the atomic era is seldom found on the front page of your daily newspaper, but it is repeated, day after day, column after column, in the classified advertising section, under the heading:

"Help Wanted—Scientists and Engineers."

These ads, placed in newspapers all over the country, offering all sorts of benefits to scientists and engineers, point up the woeful shortage of trained technical personnel in this country today.

The chief circumstance which makes this shortage of scientists and engineers a national calamity is, of course, that we in the free world are locked in a struggle with the captive world for air supremacy to guarantee survival. Many leading spokesmen of our defense effort—including most of the generals and admirals concerned—have voiced the opinion that as a long-range proposition, this shortage poses an even greater threat to us than the air power of the Soviet Union.

But even without the urgent prodding of our national defense effort, there is still a serious problem to be faced—the relative indifference of modern youth to scientific and engineering study. The tremendous acceleration of scientific progress is constantly opening up new horizons which should not only be a challenge to the adventurous spirit of youth, but should also afford personal opportunities far greater than in almost any other field of human endeavor. No period in history has ever presented quite so many attractive vistas as this second half of the Twentieth Century.

Consider aviation alone. Our world has already become very small indeed. Not only have aircraft (only military aircraft, so far) moved beyond the sound barrier, but just ahead are commercial planes which will shrink our oceans and land masses until the two most distant spots on earth are just a few hours of comfortable flying time apart. In less than three years, our coasts will be only five hours apart—practically within commuting distance of one another. Within the next two years we expect to send a man-made satellite into outer space. Soon, we will possess other vehicles capable of flying outside the earth's atmosphere, then streaking to earth targets thousands of miles away. These are the intercontinental ballistic missiles. Manned space vehicles are not far away. Soon we will have atomic-powered aircraft which can circumnavigate the globe without stopping for refueling.

ATOMIC energy itself is opening unlimited new fields for the physicists and engineers. We are conducting important research studies on the "heat barrier" as aircraft attain supersonic and approach hypersonic speeds. All of these things open tremendous opportunities for every type of scientist and engineer.

Yet the fact remains that today's young people are not entering the fields of science and engineering in anything like the numbers needed for the tasks ahead. What, then, are we to do? How are we to show children and parents and teachers the great rewards that lie ahead in scores of interrelated fields? How are we going to challenge them to take up the adventure of man's only new frontier, the sky?

There has been a growing suspicion that the shortage of scientists and engineers is like the weather—everybody talks about it, but nobody does anything about it. It is satisfying to report that, as far as the aircraft industry is concerned, this suspicion is not well founded. We in the aircraft and engine industries *are* doing something about it, even though we hasten to add that we must do much more.

A new survey of its manufacturing members by the Aircraft Industries Association shows that in 1955, some $13,750,000 was spent for formal classroom technical training of more than 230,000 employees—over and above apprenticeship programs, "vestibule" training and on-the-job training. And this amount was spent by only some of the aircraft and engine manufacturing firms—a "representative group," not the entire industry.

That the steps already undertaken are worthwhile becomes apparent from Assistant Secretary of Defense Carter L. Burgess' letter to Admiral DeWitt C. Ramsey, President of the Aircraft Industries Association (see text). The Assistant Secretary for Manpower and Reserves said he was "truly impressed with the wide range of measures being taken by various firms in the industry to motivate, encourage, and in many cases finance young people of talent to pursue higher education in engineering and the sciences; by the ways in which assistance is being furnished to teachers and educational institutions, and by the extensive in-plant training programs."

The industry report is based on the thesis that "increased technology of the modern industrial world has brought a growing realization that industry and education are closely dependent upon each other. As both industry and education are a part of the same economic system, each prospers in relation to the health of the other, and each has an enormous stake in the well-being of the other."

WITH this basic premise in mind, industry has adopted many practices in its attempt to assist the school structure of America. These practices have not emerged with any sudden burst of activity, but have come about slowly and on a staggered basis over several decades. In dealing with industry assistance to the schools, the report reviews three major efforts:

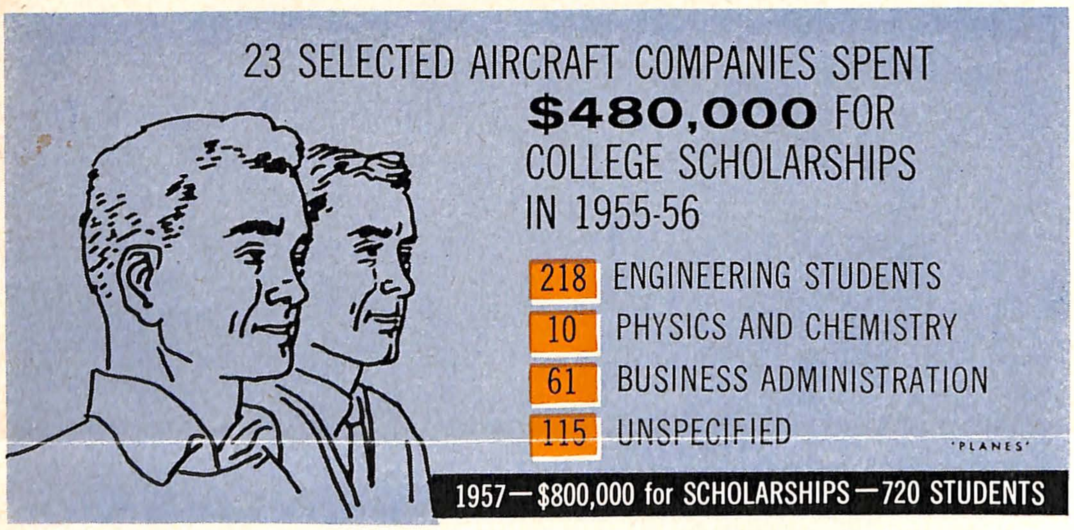
1. Efforts to identify and motivate young people of talent at the high school level toward careers in science and technology;

2. Efforts to improve and enrich science and mathematics curricula content at the high school level; and

3. Efforts to assist in other ways to strengthen the school and college structure.

A practice common to most of the firms in the aircraft industry is that of providing a scholarship program. First of all, this encourages talented high school students to take college courses leading to scientific, engineering and business careers vital to the industry.

Just how many high school students are attracted to compete for these scholarships is difficult to assess, since in most instances the scholarships, although underwritten by industry, are awarded by the schools rather than by the companies.



It is known, however, that in the academic year 1955-56, 23 selected companies surveyed among Aircraft Industries Association (by no means all of them, merely those selected in the sample) spent more than $480,000 to provide college scholarships for 404 students at the undergraduate level. These were distributed over the several academic fields as follows: 218 in Engineering; 10 in Physics and Chemistry; 61 in various phases of Business Administration; and 115 "open" or unspecified as to major field of study.

Scholarship plans on such a broad and extensive basis are relatively new. Cumulative records for these companies show that since the inception of the various plans, 1,452 college students have been granted scholarship aid, mainly in the areas of study applicable to the aircraft industry: Engineering, Science and Business Administration.

MOST of the companies in the sampling plan to extend their scholarship programs next year. Plans call for an expenditure of over $800,000 to provide scholarships for 720 students, or an increase of more than 60 per cent in funds and about 75 per cent in students, over the 1955-56 academic year.

Closely related to the scholarship grants for undergraduate education is the aid granted for fellowships and assistantships at the graduate level. About half of the companies surveyed have such plans in operation. During 1955-56, these companies spent over $1,125,000 to aid 487 individuals at the graduate level of study. Several of these same firms are planning to increase their grants at the graduate level for 1956-57.

Most of the grants in this latter category are substantial, an analysis of the data shows—the average annual grant at the undergraduate level is $1,190, while the average grant at the graduate level is more than $2,300 a year. In summary, it may be noted that the effort last year of these representative aircraft firms amounted to an outlay of more than $1,600,000 for 891 scholarships.

Additionally, there are many other ways in which the industry can and does interest and motivate high school students toward scientific and engineering careers. These are among the more widespread practices reported in the survey:

Participation with local school systems in sponsoring essay or scientific project contests;

Arrangements for students from local schools to make "field trips" to the various aircraft companies;

Procurement of lecturers for special school events, such as "Career Day";

Provision of teaching aids for use in science, mathematics and mechanical drawing courses;

Enrollment of high school seniors in summer employment.

AIA supports financially, and by much concentrated effort, an important materials of instruction program administered by the National Aviation Education Council. NAEC, which is made up mostly of educators, publishes teacher-prepared classroom materials on aviation subjects and sells them at cost to the schools.

IN 1955 THE AIRCRAFT INDUSTRY SPENT $13,750,000 ON FORMAL TRAINING FOR MORE THAN 230,000 EMPLOYEES

'PLANES'

MOST AIA firms take formal steps to publicize the need for more scientists and engineers through distributing pamphlets and brochures, writing articles for publication in house organs, newspapers and magazines, sponsoring special programs for the children of employees, and inclusion of such topics in personal counseling programs.

To improve science and mathematics curricula content at the high school level, most aircraft companies provide summer employment and supplementary training for teachers, prepare course material, subsidize teacher training programs, and provide memberships on advisory committees and school boards. This last category of industry cooperation with education creates a splendid opportunity to aid in the review and recommendation of course content at the decision-making level of the public school systems.

In other fields, aircraft and engine manufacturers have made grants to certain colleges and universities in support of special educational projects, such as developing a course in fluid mechanics, upgrading high school physics teachers, training science and math teachers in new teaching techniques, and providing special modern machines and equipment for classroom use. In all, grants in this category have amounted to $1,100,000 for the 1955-56 academic year.

Closely allied to these grants and endowments are those grants made on behalf of more specific school projects, such as wind tunnels, research studies, special laboratory equipment, and libraries. Over the past five years, AIA members in the survey granted some $3,000,000 for such specific school projects.

Since the survey was completed, one AIA member firm on the West Coast has made a grant of $1,000,000 to provide for a graduate program in science and technology in a major university's expansion program.

These practices, carried out in an enlightened manner by the aircraft industry, provide direct financial assistance to hundreds of students, and motivation toward science and engineering in countless hundreds of others; special experience and training to hundreds of teachers; counsel and material assistance to a number of school systems; and financial and technical support to many colleges and universities.

While the record of the aircraft and engine manufacturers is good in aiding the schools and improving the quality of technically trained personnel to be employed in the future, the question arises: What is the industry doing to train those people who are already at work within the industry?

It may be said in all fairness that industrial training practices and programs have been an extensive effort of the industry for more than a quarter of a century. The most widely known effort along these lines is in-plant, paid-time training.

IN-PLANT paid-time training ensures that aviation technicians become proficient in certain critical skills, which not only increases the number of skilled technicians needed to meet the demand created by the expansion of the industry, but also prepares the skilled worker to perform new jobs created by technological advances. During 1956, the representative AIA firms in the sampling collectively conducted some 1,500 courses for management supervisors, engineers of all types, draftsmen, technicians in laboratories, electronics, hydraulics and instrumentation, tool designers and planners, field service representatives, data transcribers and technical writers and illustrators.

From the foregoing, it may be seen that the industry has gone in for this particular sort of training in a big way. Just how big becomes apparent when one realizes that these courses were taken by 200,000 employees, representing more than 6,400,000 manhours of training—an average of virtually 32 hours of technical training for every employee trained.

Assuming that the earnings of these workers are representative of the industry, it can be conservatively estimated that these 6,400,000 manhours cost the industry at least $13,000,000, in addition to the expense incurred for instructors and facilities.

Another type of training effort, and one of much more recent origin, is the encouragement of employees to attend local schools for the additional and more up-to-date knowledge they need to perform their jobs more efficiently, under a tuition refund plan in which the company reimburses the employee in whole or in part for the costs of tuition, books and related items.

IN 1955, representative firms in the AIA survey reported approving the enrollment of more than 13,650 employees at a total tuition refund cost of more than $450,000—an average of approximately $31 per employee.

Besides in-plant, paid-time training and the tuition refund plan, most of the aircraft companies have developed and offer special training courses for their employees after working hours. The purpose of such courses is twofold: first, it gives employees an opportunity for self-improvement on a voluntary basis; and second, it supplements the curricula of local schools and colleges which may not offer courses of the same type. Participating firms report that during 1955, the cost of this program was over $250,000, and that approximately 17,600 workers took advantage of these after-hours courses.

In the near future, most companies believe they will have to expand their training practices. First, because of a declining skill level in the open labor market, many firms must be content to hire personnel with potential skills, or the aptitudes to learn them, and then design the necessary training programs to provide these people with appropriate knowledge and skills.

Secondly, technological advances have outdated the training of many who were previously considered well-schooled in their re-

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON 25, D. C.

MANPOWER, PERSONNEL AND RESERVE

SEP 5 1956

Dear Admiral Ramsey:

I certainly appreciated receiving a copy of the report which summarizes the constructive measures being taken by companies in the aircraft industry to promote development of technological manpower. I understand that this report will be furnished to all member companies of your Association.

I was truly impressed with the wide range of measures being taken by various firms in the industry to motivate, encourage, and in many cases finance young people of talent to pursue higher education in engineering and the sciences; by the ways in which assistance is being furnished to teachers and educational institutions; and by the extensive in-plant training programs.

In my opinion, the report itself represents an outstanding job and an outstanding service. It puts together for the first time a listing of the various constructive measures in very specific and concrete terms, and it indicates the degree to which they are being used throughout the industry. In that way, it furnishes highly desirable standards and guidance to all companies in the aircraft industry.

The programs which are outlined in the report exemplify the broad vision and industrial statesmanship that are characteristic of your dynamic industry. These affirmative measures will, of course, be of immediate benefit to the industry. In a larger sense, they will increase the Nation's supply of technically-trained manpower, which is so necessary to our Armed Forces and to the maintenance of our technological supremacy.

In behalf of my associates in the Department of Defense, I want to extend my sincere appreciation for the grand job which has been accomplished under the auspices of the Aircraft Industries Association.

Sincerely yours,

Carter L. Burgess

Carter L. Burgess

Admiral D. C. Ramsey, President
Aircraft Industries Association
610 Shoreham Building
Washington 5, D. C.

spective fields of endeavor. Again, this technological advance had been marked by drastic changes in methodology of work, which in turn will require the learning of new skills and techniques.

To aid in both employment and placement of personnel, some of the AIA firms have found it necessary to introduce job fractionation—the process of dividing fully integrated jobs into their basic elements, which permits a company to hire sub-professionally trained or semi-skilled technical personnel.

This, then, is what the aircraft industry has done up until now, to alleviate the nation's Number One problem in the air-atomic age. What more must we do?

One thing more we must do becomes appallingly clear when we study the negative attitude toward the sciences evidenced in a nationwide survey of high school students. This study, undertaken by the Division of Educational Reference at Purdue University, "not only indicates a lack of information about scientists and their work, but negative attitudes in place of such information."

RUSSIA

890,000 Scientists • Engineers

120,000 1956 Graduates

UNITED STATES

760,000 Scientists • Engineers

70,000 1956 Graduates

'PLANES'

Out of 15,000 high school students interviewed in all parts of the U. S.:

"Forty-five per cent believe their school background is too poor to permit them to choose science as a career.

"Thirty-five per cent believe that it is necessary to be *a genius* to become a good scientist.

"Thirty per cent believe that one cannot raise a normal family and be a scientist at the same time.

"Twenty-eight per cent do not believe scientists have time to enjoy life.

"Twenty-seven per cent think that scientists are willing to sacrifice the welfare of others to further their own interests.

"Twenty-five per cent think scientists as a group are more than a little bit 'odd.'

"Fourteen per cent think there is something 'evil' about scientists.

"Nine per cent believe that you cannot be a scientist and be honest."

That the ignorance of today's high school students toward science and scientists is abysmal becomes abundantly clear from the foregoing. Obviously, our job is cut out for us.

WE MUST undertake a massive re-education campaign to combat these widespread beliefs that today's scientists and engineers are long-haired, overworked, underpaid drudges who slave away over drawing boards and masses of retorts and tubing. Too often, in the mind of youth, the scientist is either the "mad genius" busily mixing a witch's brew of chemical elixirs in an attempt to build a Frankenstein monster with a criminal brain, or the "absent-minded professor" whose socks don't match and who is never quite sure whether today is Tuesday or Thursday.

This is an unfortunate caricature, and obviously far removed from the truth. Most scientists and engineers are scientists and engineers for the sheer joy of being scientists and engineers. They love what they are doing, and find every new task a tremendous mental challenge and stimulation.

The point we must drive home among the teen-agers—and their parents—is that science and engineering are rewarding careers, because what the men in these professions are doing is seeking the truth—the truth of how to design, build, construct, create something which was not there before; something which fills a need in man's eternal search for something better than he possessed yesterday.

Perhaps one of the most enlightening thoughts on the rewards of a career in science and engineering came recently from George Trimble, the youthful Vice President in Charge of Engineering for one of the major aircraft manufacturers. Speaking on The American Legion's radio program, "Survival in the Air Age," Mr. Trimble had this to say:

"In looking back over my own experience, I find that the reason I am an engineer and in the aviation business is because a young fellow named Charles Lindbergh flew across the Atlantic, from New York to Paris, years ago, and I find also in many companies that there seems to be a certain age strata now who all remember that very vividly. They were brought into the fold, so to speak, in this manner.

"I don't know whether we are going to have to have someone fly to the moon to get another group of people really charged up about being engineers and scientists and being in the aviation business, but it probably wouldn't hurt. The reason for being an engineer, as far as I'm concerned, is *because it's fun!* And this is why all the engineers I know are engineers—because they enjoy it!"

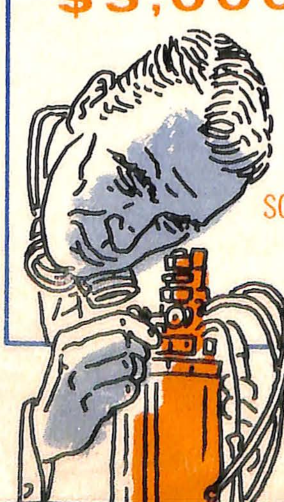
WE MUST overcome this false picture if we are to have the scientists and engineers we need for the future. And need them we will—desperately. It is estimated that the United States has doubled its population in the last half century. It is expected to double it again by the end of the century. With only seven per cent of the world's population and eight per cent of the world's land area, America already accounts for more than half of the world's production. To maintain its relative position in the world's economic structure, American industry, 10 years from now, must produce 40 per cent more than it produces today.

$3,000,000

IN GRANTS BY AIA MEMBERS for....

LABORATORIES, WIND TUNNELS, SCHOOL PROJECTS, and LIBRARIES

'PLANES



We can't do the job with the scientific manpower now on hand. There simply aren't enough qualified technicians to go around.

The shortage begins back in the high school level, where mathematics lays the only possible foundation for a career in science and engineering. But not nearly enough high schools are actively promoting the basic subjects—algebra, geometry and the physical sciences.

Consider these figures, supplied by Assistant Defense Secretary Burgess to a Senate Appropriations Subcommittee earlier this year:

"The average U. S. national high school student enrollment in physics is 4.4 per cent; in chemistry, 7.5 per cent; in geometry, 11 per cent; and in algebra, 25 per cent."

Consider also, these figures: The U. S. today, according to a report prepared for the Congressional Atomic Energy Committee, has 760,000 engineers and scientists. Russia has 890,000. Last year, Russia graduated 120,000 scientists and engineers; we graduated 70,000.

It would be foolish, of course, to become hysterical over the fact that Russia now has more technically trained people than we do.

WE MUST remember that Russian technology has a long way to go before there can even be any consideration of parity between their way of living and our own. And, in Russia, the incentive for a career in the sciences is something to behold. The Russian youth would not find much of a future as a lawyer. He cannot expect to become a successful dealer in stocks and bonds, nor can he look forward to choosing a career as a clergyman, or a big dealer in color television sets. These things are left to the "decadent capitalistic societies," such as our own.

The Russian youth for whom a career in science or engineering is chosen can, after he is thoroughly trained, begin to live like a "capitalist." He is provided by his government with a good salary (by Russian standards), some unusual comforts, plus the plaudits of the populace. If he falters and fails, great is his shame.

Here, his counterpart can have whatever of American plenty his capabilities can earn, and his opportunities for advancement are unlimited.

Today, American youth stands on the threshold of the greatest era of history—an age of clock-stopping speeds, of unheard of ranges, of movement in space, of "thinking" machines, of superhuman "eyes," of amazing materials and chemicals and communications. Man's comforts and conveniences, and even necessities, will be improved beyond measure.

These things will be accomplished, not by supermen, but by normal, inspired youth who prepare themselves for the adventure and satisfaction and personal advantages afforded the engineers and scientists of tomorrow.

Entire Vehicle Will Weigh 11 Tons; Vital Instruments Only 10 Pounds

(*Continued from page* 1)
stage rocket about 72 feet long, somewhat resembling a pencil.

The prime contractor, who has final responsibility for providing the eleven-ton vehicle which will lift the satellite some 300 miles above earth and establish it in its orbit, has subcontracted phases of the work to seven other firms.

The first stage rocket is powered by a rocket engine using liquid oxygen and gasoline as fuels. The second stage also contains a liquid rocket engine which uses white fuming nitric acid and unsymmetrical dimethylhydrazine as fuels. The third stage is a solid propellant rocket which carries the satellite itself inside the streamlined nose cone. The satellite, a 20-inch sphere weighing approximately 21½ pounds, will carry extremely delicate scientific "reporting" instruments, which will send back to earth hitherto only theoretical data on atmospheric density, cosmic rays, temperatures, and the composition and shape of the earth itself.

Since the shell of the satellite will itself weigh about half of the satellite's 21½ pounds, all the instrumentation and telemetering equipment combined must be pared to a weight of a little more than ten pounds. Scientists and engineers working on the project are thus thinking in terms of ounces—not pounds—in designing the equipment the satellite will carry.

The first stage will lift the entire rocket assembly to an altitude of approximately 36 miles, by which time the vehicle will be traveling at about 5500 feet per second, when the first stage fuel will have been exhausted. The first stage will then drop off into the ocean at an impact point estimated to be approximately 275 miles down range from the Air Force Missile Test Center at Cocoa, Florida.

At the time of the separation of the first stage, the second stage engine will be ignited. The thrust of this engine will propel the vehicle upward along a curved trajectory to an altitude of about 140 miles at time of the burnout. By then, the satellite carrier will be going at the rate of 13,400 feet per second.

The second and third stages will coast along the trajectory to an altitude of approximately 300 miles together. During this coasting period, the attitude of the launching vehicle will be controlled by an auto-pilot employing small jets of residual second stage pressurization gas. After it separates from the second stage, the third stage will accelerate the satellite "package" to its final velocity of approximately 26,000 feet per second before exhausting its fuel.

Then, the satellite itself will be separated from the third stage rocket. This final rocket will itself become a satellite, although the action of the releasing device will cause the rocket to travel at a slightly different speed and in a slightly different direction from the satellite. The empty rocket will thus gradually spiral back into the earth's atmosphere and burn itself out.

The job of the fins—stabilization in flight—is handled by gimbal-mounted rocket engines which take their orders from a highly sensitive automatic piloting device which possesses a "memory" for its pre-set course and can correct any yaw, roll or pitch. The gimballing of the rocket engines at each stage acts in the same manner as a juggler who balances a cane on the end of his nose. The cane stays upright, but the juggler's nose moves erratically to retain the balance.

In designing and building the launching vehicle, the contractor is faced with the problem of providing a structure of exceptionally light construction, since every pound of structural dead weight eliminated results in a proportional increase in attainable velocity. Aircraft manufacturing procedure is followed, and monococque construction is employed throughout to achieve light construction essential to a high mass ratio.

Aside from the twin factors of weight saving and directional tolerance over its entire length, the Vanguard structure is relatively simple. Actually, only a small percentage of the three-stage rocket is airframe structure—most of the weight is in fuel, propulsion units, control equipment, and the final payload, the satellite.

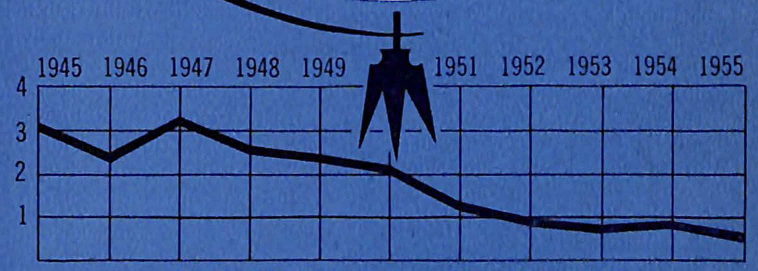
The three rockets are being separately engineered and built, and are to be delivered as units to the prime contractor. To achieve the required accuracy for the Vanguard project, tools will be produced from master gages built by the primary contractor. The subcontractors will then use these tools to maintain precision fitting of engines to airframe structures and to insure alignment between sections, so that splices are made accurately.

An unusually comprehensive test program is required during manufacture of the Vanguard launching vehicle because of the lightness of the structure in relation to its gross take-off weight, which is estimated at about 11 tons. Extensive static and dynamic load tests on various structural items must be performed, and additionally, the extreme environmental conditions which will be encountered at varying atmospheric densities and temperatures must be simulated.

For final assembly and testing, the Vanguard vehicle will be erected inside a vertical assembly building 90 feet high with two "elevator shaft" assemblies which permit two rockets to be assembled and tested simultaneously. Once tested, the combined three-stage vehicle is disassembled for ease in handling, and forwarded to the firing range in truck trailers, where it will be reassembled for the longest upward journey ever undertaken—300 miles into the exosphere.

WORLD AIR TRAVEL

Safety in airline travel is no accident. Providing safety for the air traveler is the prime objective of the United States aircraft industry and the world's scheduled airlines—most of whom fly U. S.-built airliners. In 1945, the scheduled airlines of the world flew approximately 5 billion passenger miles. In 1955, the world's scheduled airlines flew 70,000,000 passengers (slightly more than the combined populations of the British Isles and Canada) more than 38,530,000,000 passenger miles. Yet, despite this great increase in air travel, the fatality rate per 100 million passenger miles decreased to less than one fifth the 1945 rate.



YEARLY DECLINE IN FATALITY RATE
(Per 100 Million Passenger-Miles)
'PLANES'

New Turbine Transports Change Logistics

The fast, new medium and long-range turbojet and turboprop transport equipment coming onto the aerial scene in the foreseeable future will undoubtedly enable American commerce and industry to move goods and people faster than ever before. By the same token, the new jet transports will change, and in fact, have already changed, the thinking of military logistics experts.

Military provisioning and stockpiling is, of course, keyed to the length of time it takes to put men, equipment, supplies and weapons down at any given trouble spot at any given time. In the past, vast inventories of machines, weapons, ammunition and provisions had to be planned for, just to fill slow-flowing pipelines from the factories to distant depots or to the military units which were to use them.

Tomorrow's jet transports, however, together with improved ground-handling techniques, both military and civilian, will permit huge savings in military inventory and storage costs.

Because of its greater speed, one jet transport can deliver 900 men a month to Europe at a 140-hour-per-month utilization rate, while a four-engined piston-driven airliner averages only 246 men in the same time.

During the Korean War, it is estimated that about 40,000 troops were continually tied up in the surface manpower pipeline. A fleet of high speed jets could have cut that number to just 5,000—thus freeing 35,000 more men for combat assignments.

Transatlantic Television May Be By-Product Of Satellite Efforts

Man's effort to conquer space may result in an interesting by-product right in his own home—transatlantic TV.

The aircraft industry, which is charged with launching an earth-circling satellite in an orbit next year, reports that this operation may hasten the day of transatlantic television broadcasting.

Because the satellite is expected to orbit around the earth for days or longer, scientists will be able to learn much more about the ionosphere and the peculiarities of magnetic disturbances caused by sun spots.

We may learn, for example, that it will be quite possible to bypass known atmospheric disturbances that garble television pictures as we bounce TV waves off atmospheric layers around the curvature of the earth from Europe to New York.

High frequency sound and TV waves normally travel in straight lines and have to be retransmitted by relay stations. Ricocheting broadcast waves around the earth would be the answer to the impracticality and prohibitive cost of maintaining a string of relay stations mounted on ships scattered across the Atlantic.

Aviation Booklet for Children

Programs to stimulate the interest of Amercian youth in aviation have been accelerated by the National Aviation Education Council.

Composed of a group of distinguished educators, this non-profit organization has as its principal interest the general study enrichment features of aviation education. It is NAEC's aim to increase the student's understanding of aviation and its relation to the varied pursuits of American life. They are performing this vital public service by trying to reach through to youngsters in the school and in the home.

In line with their programs, the Council has published several teacher-prepared booklets with a sound educational and an accurate aviation point of view.

For the skillful parent who can divert the kiddies from TV long enough to indulge them in the good old fashioned occupation of reading, we recommend the booklet *Tilly The Tiger*.

A delightful fantasy for the 4 to 8 age group is *Tilly The Tiger*, a lovable little animal who gets restless in the confines of the jungle and wants to see what the outside world is like. Tilly gets her opportunity when Grandpa Tiger, an entertainer in a Washington, D. C. zoo, invites her to the States for a visit.

Mother and Father Tiger, being modern solicitous parents, decide that their baby shall travel the fastest, safest way—by plane, of course. And Tilly has the time of her life, spanning the ocean by air.

Charmingly written, this fanciful tale also contains some down-to-earth lessons on good behavior ingeniously blended into the story line —Tilly is a paragon of proper conduct, and she sets an exemplary example for her fellow passengers—Professor Rhino, Algy the Elephant, Dr. Equus the Zebra, and others. This two-color, illustrated booklet may be obtained by writing to the National Aviation Education Council, 1025 Connecticut Ave., Washington, D. C. The price is fifty cents. The National Aviation Education Council is sponsored by the Aircraft Industries Association.

Jet Electronic Equipment Costs, Weighs As Much As Pre-War Airliner

Electronic equipment on a new jet airliner may weigh as much as a ton, the manufacturer estimates, and cost as much as $140,000—more than the entire cost of a twin-engined pre-war airliner built by the same firm.

The electronic "black boxes" in the new jet plane will weight 1,200 pounds, with another 1,200 pounds in installation and wire weight. Between four and five *miles* of wire will be used to interconnect the equipment, which will operate 26 radio systems. These systems will require 20 antennas.

Agriculture pilots flew 672,000 hours in 1954* to assist the nation's farmers in producing greater crop yields per acre. During that flying time, these pilots treated 36,969,000 acres —an area nearly as large as the States of Texas, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota, combined. They applied 215,859,000 pounds of chemical dusts; 57,699,000 gallons of spray; 143,213,000 pounds of seed; 250,988,000 pounds of fertilizer; and 32,012,000 gallons of spray in defoliation activities. This great aid to the nation's agriculture industry is a typical case in point of the way the aircraft industry contributes to bettering the nation's health, welfare and economy.

**The latest year for which complete statistics are available.*

'PLANES'

Voice 'Squeezer' Boosts Radio Range

Invention of a gadget which "squeezes" the human voice into a narrow range for improved radio transmission, satisfies two top priority military needs—more intelligibility and a 50 per cent longer range in voice transmission in field communications equipment.

The new device, a "transistorized instantaneous speech compressor," was developed by an aircraft electronic engineer at a Southwest plant. In use, the speech compressor "squeezes" peak values of voice sounds to nearly the same level as average sounds.

Research carried on during World War II indicated that vowel sounds have the major proportion of speech "power" but contribute very little to intelligibility. Consonants, on the other hand, contain almost no speech power but contribute materially to intelligibility. The new "squeeze" device pares consonant sounds to near the level of vowel sounds. Since intelligibility is more important than quality of speech in military field communications, the narrow, almost monotone range of speech compressed to a 24 decibel limit serves admirably for clarity of voice communication.

Tests of ground-to-air equipment with the new gadget have shown that the maximum range can be increased 100 percent by use of the compressor, which also lessens background noises including those made by aircraft engines.

New Runway Sweeper May Eliminate Jet Engine Damage from Debris

Damage to jet engines from sand, wood, rags, bolts, small tools and other debris sucked into the air intakes during taxiing or engine run-up operations may become a thing of the past.

Tests of a new runway sweeper, now in use at a southern aircraft plant, promises to virtually eliminate the runway litter problem and at the same time cut costs in the loss of miscellaneous small parts, lost tools and salvageable scrap.

It is impossible to estimate the overall dollar value of damage to the nation's aircraft in engine overhaul and tire replacement brought on by runway litter, but one aircraft firm estimates it runs into "thousands of dollars annually" at one of its plants.

Development of the new sweeping device is another example of the ingenuity of the aircraft industry in finding ways to reduce costs and avoid wasteful damage.

The new runway sweeper generates a powerful "tornado" type of suction, and can render a littered runway as clean as a hound's tooth. The six-ton unit has an overall length of 24½ feet, and is powered by a diesel engine. The engine has a lateral power takeoff from the transmission which operates the sweepers and the suction cleaner.

A special exhaustor, driven by the engine, produces a vacuum in the dirt chamber. This is transmitted as a suction force, through flexible hoses to the suction hood over the sweeping brushes. The brushes do not actually sweep in the usual sense. They agitate the surface air instead, creating an upward centrifugal force. When this is coupled with the vacuum action, a man-made "tornado" is created.

Runway litter is swept by the revolving brushes into the suction field of the suction hood. The air leaving the exhaustor is returned through hoses, and this air flow assists the revolving brushes in removing debris. Separation of the air from scrap materials takes place through a series of filters in the filter chamber.

In all, the sweeper can pick up objects ranging from a tiny grain of sand to a one-and-a-half-pound tool, which cannot escape from the dirt container. This latter, which has a three-ton payload, can be dumped hydraulically.

Working at speeds up to 25 miles per hour, the sweeper cleans a 7 foot 4 inch swath, or approximately a million square feet per hour. Both lifting and lowering of the sweeping device is effected by compressed air in the driver's cab.

With the help of a magnetic bar mounted on a beam attachment behind the sweeping device, the unit can also retrieve any metal objects missed by suction action. Height of the sweeper can be adjusted to within fractions of an inch above ramp or runway level.

In cold weather conditions, the sweeper can also operate as a snow plow which will clear a width of 5 feet 9 inches.

$85 Million Expended for 1953 Research

An army of 5,000 scientists and engineers in commercial laboratories and non-profit research institutes spent $85,000,000 in 1953 in all the various facets of scientific research, according to a survey made for the National Science Foundation.

In the commercial laboratories, approximately $35,000,000 was earmarked for scientific research, and about $4,000,000 for basic research, the survey indicates, while equivalent figures for non-profit research institutes were over $50,000,000 for scientific research and more than $3,000,000 for basic research.

Industry, including the aircraft and related defense industries, was responsible for about half of the money expended for scientific research in the commercial laboratories, and the government supported about an equal amount. The non-profit research institutes, however, received about twice as much money from the government as from industry, the survey stated.

Purer Silicon Possible with New Method

A technique for producing an almost pure silicon, which will greatly advance the art of making transistors heat resistant up to very high temperatures and will thus pave the way for better functioning aviation electronics systems at high speeds which produce great heat, was recently reported to the American Chemical Society by Dr. Bernard Rubin of the Air Force Cambridge Research Center.

The near pure silicon—which has only one part of contaminants in six billion parts of the element—permits production of transistors able to withstand heat up to nearly 600 degrees Fahrenheit. Present germanium transistors operate at temperatures in the range of 200 degrees Fahrenheit.

'Sky-Hopping' Replaces Whistle-Stopping

With the elections all over and some 220,000 air miles having been traveled in the campaigns, the Republicans and the Democrats can agree on at least one point—"sky-hopping" has just about replaced "whistle-stopping" as a means of transporting candidates.

The 1956 campaign was the most extensive aerial campaign in history, with spokesmen for both major parties estimating that party workers covered more than 220,000 air miles in their bid for votes—about 25 per cent above the total miles flown in the 1952 campaign, which was 178,275.