AVIATION FACTS and FIGURES

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AVIATION FACTS AND FIGURES 1956

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PREFACE

This is the fourth edition of Aviation Facts and Figures recording statistically and textually pertinent facts about United States air power, military and civil, and the aircraft industry which designs and produces aircraft and missiles in support of our nation's security and economy.

Today, and for the foreseeable future, air power is the dominant factor of defense. The vast production potential of the aircraft industry is a prime national asset, and its products are great deterrents to a potential aggressor. But, in no field is the necessity for advance planning more crucial than in the research and development of high performance aircraft and missiles, engines and electronic gear, needed to defend America.

Some of our aircraft travel faster than bullets; they carry equipment that works faster than man's brain; they are powered by great engines that are marvels of scientific ingenuity and efficiency; they carry weapons whose destructive power staggers the imagination; they carry tons of cargo safely at high speeds and over great distances.

Because of the ever increasing technical advances of aircraft as vehicles of commerce, as well as weapons of defense, public understanding of aviation is of extreme importance.

The contents of this 1956 volume of Aviation Facts and Figures are not works of original research. They represent a compilation of facts gleaned from hundreds of sources in the world of aviation during the past year which have been considered of importance or interest.

It is hoped that this edition may serve as a standard aviation reference work of value to legislators, administrators and managers in government and industry, writers and editors, analysts and students.

President, Aircraft Industries Association
D. C. Ramsey, Admiral, USN (Ret.)
May, 1956

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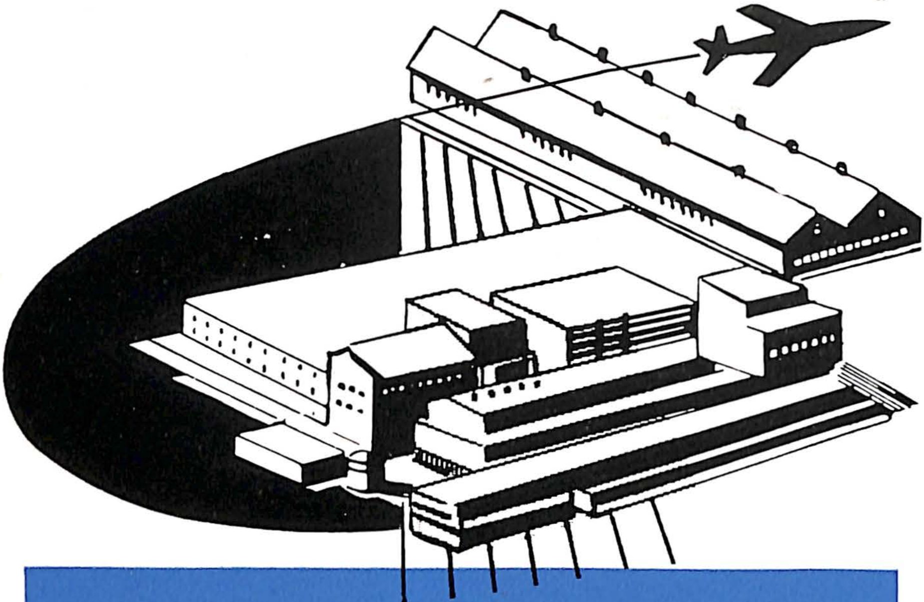


PRODUCTION and FACILITIES

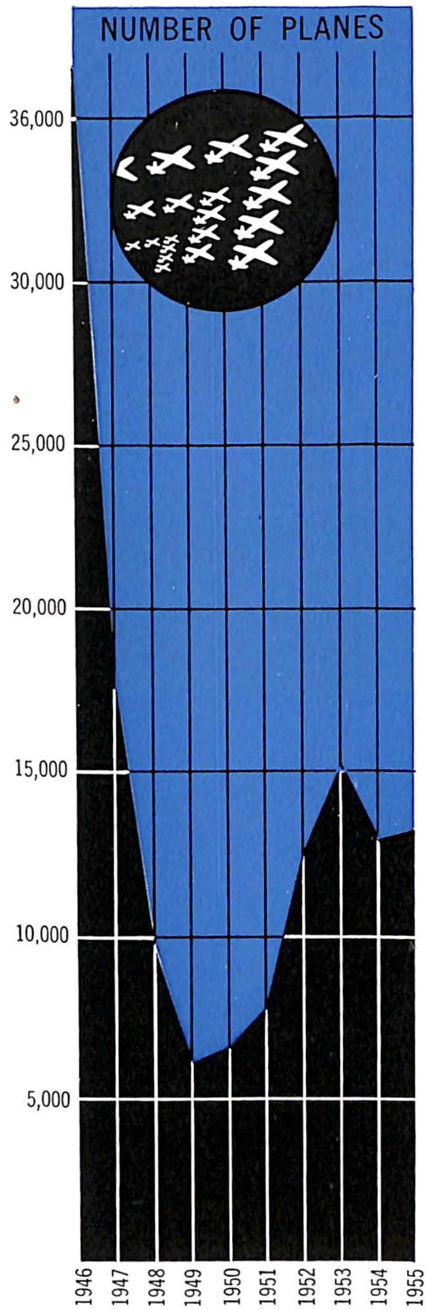
The history of aircraft has been one of continuing increases in performance and size with emphasis on speed, range and dependability. The modern aircraft, particularly in its military application, is one of the most highly developed, and certainly among the most complex, instruments of power devised by human ingenuity.

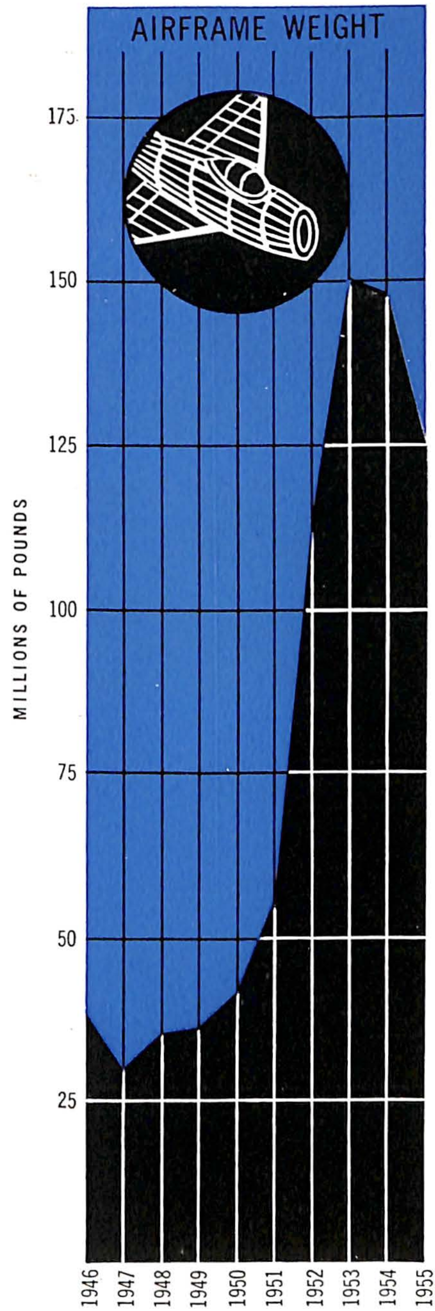
With each new advance in aeronautical progress, new techniques, new methods, new tools and new processes, have been necessary. And usually this progress can be measured by the necessity for, and intensity of, research and development efforts into completely unexplored fields of human knowledge.

Despite aeronautical achievements beginning with the breathless instant that Orville Wright lifted his frail craft for twelve seconds from Kill Devil Hill, December 17, 1903, plus the prophetic warnings of a few far sighted men, it wasn't until World War II that the full military significance of the airplane was realized. Air power emerged as the dominant and decisive factor of any conflict in the forseeable future.

Its prowess for ranging high across the natural barriers of earth and

AIRCRAFT PRODUCTION since 1946





U. S. AIRCRAFT PRODUCTION
1909 TO DATE
(Number of aircraft)

Year	TOTAL	Military	Civil
1909	N.A.	1	N.A.
1910	N.A.	—	N.A.
1911	N.A.	11	N.A.
1912	45	16	29
1913	43	14	29
1914	49	15	34
1915	178	26	152
1916	411	142	269
1917	2,148	2,013	135
1918	14,020	13,991	29
1919	780	682	98
1920	328	256	72
1921	437	389	48
1922	263	226	37
1923	743	687	56
1924	377	317	60
1925	789	447	342
1926	1,186	532	654
1927	1,995	621	1,374
1928	4,346	1,219	3,127
1929	6,193	677	5,516
1930	3,437	747	2,690
1931	2,800	812	1,988
1932	1,396	593	803
1933	1,324	466	858

(*Continued on next page*)

atmospheric elements of storm, heat and cold, has made imperative a startling reassessment of roles and mission of armies and navies.

Development of the atomic bomb during World War II and the frightful message it carried to the world via Nagasaki has left little doubt in the minds of men as to the totality of destruction that could be wreaked by aircraft—manned or unmanned—in future conflict.

Since that time, an even more fearful weapon has been devised, the thermonuclear bomb. It is difficult for the human mind to grasp the destructive threat of this weapon except by statistical comparison. In World War II, a typical "heavy" bomber carried a four-ton bomb load.

U. S. AIRCRAFT PRODUCTION
1909 TO DATE (cont'd)
(Number of aircraft)

Year	TOTAL	Military	Civil
1934	1,615	437	1,178
1935	1,710	459	1,251
1936	3,010	1,141	1,869
1937	3,773	949	2,824
1938	3,623	1,800	1,823
1939	5,856	2,195	3,661
1940	12,804	6,019	6,785
1941	26,277	19,433	6,844
1942	47,836	47,836	—
1943	85,898	85,898	—
1944	96,318	96,318	—
1945	49,761	47,714	2,047
1946	36,670	1,669	35,001
1947	17,717	2,100	15,617
1948	9,586	2,284	7,302
1949	6,089	2,544	3,545
1950	6,520E	3,000E	3,520
1951	7,877E	5,400E	2,477
1952	12,509E	9,000E	3,509
1953	15,134E	11,000E	4,134
1954	12,989E	9,600E	3,389
1955	13,153E	8,400E	4,753

N.A.—Not available.
E Estimate.
Sources: 2, 3, 9, 17, 23, 32, 34, 47, 75, 82.

AIRFRAME WEIGHT OF U. S. MILITARY PLANES, BY TYPE, 1944 AND 1955
(Pounds)

Type	1944	1955
Heavy bombers	49,000	115,000
Medium bombers	10,100–24,700	55,000
Light bombers	7,800–14,700	25,000
Fighters—day	5,000	8,000– 12,000
Fighters—all weather	10,000	12,000– 20,000
Heavy transports	20,100–61,800	55,000–100,000
Medium transports	7,800–16,400	30,000– 55,000
Light transports	2,300– 3,800	20,000– 30,000
Trainers	600–16,800	1,500– 22,000

Sources: 2, 7.

The statistician would illustrate this by representing a one-inch cube as equalling one ton of bombs. The bomb load of the World War II "heavy" then, was a four-inch high stack of cubes. Statistically, the Nagasaki atomic explosion would be represented by a stack of one-inch cubes *sixteen hundred and sixty-six feet high.* The thermonuclear bomb of today is represented by a stack of one-inch cubes *SIXTY THREE MILES HIGH.*

With such weapons available, not only to this country but to our principal adversary, it follows logically that decisive actions in another major conflict would almost certainly come at once. Another war could no longer be won, as was the case in the last two great wars, by the intervention of forces, mobilized, armed and deployed months after the outbreak of war.

A strong aircraft industry, then, is the key to the security of America. While civil aviation production provides a large measure to the productive economy of the United States, indeed to the world, that production still represents only a small percentage of the industry's annual output. The military annual purchase of aeronautical products accounts for between 85 and 90 per cent of the industry's annual volume. As a result, the principal difficulties that have beset the industry in its half-century of history have resulted from fluctuations between peak producion efforts in wartime and dramatic cutbacks in peacetime.

Today, the manufacture of aircraft in itself is a costly operation, not counting the cost of the plane, the missile, the great engines, etc. For example, for each pound of empty aircraft weight produced, the aircraft industry consumes approximately two pounds of aluminum, two pounds of steel alloy, and four pounds of carbon steel. These tremendous quantities consumed by the industry include also the metals that go into the power plant, fixed equipment, spare parts, jigs and dies, and scrap.

Production Facilities

The expansion of the aircraft industry which followed the outbreak of the Korean War, is largely complete. While the 1950 buildup required a broad-scale expansion of aircraft production facilities—land, buildings, machinery and equipment—the job, though difficult, fortunately was made easier because of the immediate experience drawn from World War II, only a decade earlier.

There were considerable facilities still in "stand-by" status dating from the global war. However, a substantial number of these had been made obsolete by technological advances in the physical sciences embraced by the aircraft industry.

Despite the fact that in 1950 we were producing less aircraft per

SALES OF MANUFACTURERS OF COMPLETE AIRCRAFT, AIRCRAFT ENGINES, PROPELLERS AND PARTS 1948 TO DATE
(Millions of Dollars)

Year	TOTAL	Complete Aircraft and Parts			Aircraft Engines and Parts			Aircraft Propellers and Parts			Other Products and Services
		TOTAL	U.S. Military	Other	TOTAL	U.S. Military	Other	TOTAL	U.S. Military	Other	
1948[a]	$1,158	$ 748	$ 626	$122	$ 265	$ 222	$ 43	$ 48	$ 36	$12	$ 97
1949	1,781	1,098	927	171	508	461	47	62	50	12	113
1950	2,274	1,416	1,255	161	583	519	64	75	62	13	200
1951	3,456	1,883	1,657	226	879	779	100	110	89	21	584
1952	6,497	3,897	3,442	455	1,609	1,440	169	148	122	26	843
1953	8,511	5,179	4,661	518	2,378	2,189	189	203	176	27	751
1954	8,305	5,226	4,626	600	2,062	1,872	190	183	151	32	834
1955	8,470	5,164	4,605	559	1,933	1,728	205	134	112	22	1,239

[a] Total for last three quarters of 1948 only.

Source: 25.

month than we were in 1940, the floor space required for aircraft production had increased greatly. In June, 1950, approximately 60 million square feet were being used in the manufacture of aircraft as compared to just under 10 million square feet in 1939.

Overall floor space available for the manufacture of jet fighters, bombers, guided missiles and civilian aircraft of all types, is approximately 131.3 million square feet—about twice that used in 1950. The cost value, before depreciation, of facilities devoted to aircraft and related production by 12 major aircraft companies is approximately one billion two hundred and eighty-two million dollars. About one-third is company-owned facilities, the balance is government owned:

	Cost Value of Facilities before Depreciation (Millions of Dollars)	Percent
TOTAL	$1,281.7	100.0%
Company-owned	385.9	30.1
Government-owned	895.8	69.9

CONSUMPTION OF SELECTED MATERIALS BY AIRCRAFT AND PARTS INDUSTRY
1947–1953
(Short Tons)

Year	All Metal-working Industries	Aircraft and Parts Industries	Aircraft and Parts As Percent of All Metal-working
CARBON STEEL			
1947	36,411,380	22,934	.1
1949	36,707,265	51,279	.1
1950	43,025,011	72,474	.2
1951	47,381,914	120,608	.3
1953	44,104,294	327,942	.7
STEEL ALLOYS			
1947	2,670,257	24,017	.9
1949	2,789,855	41,464	1.5
1950	3,853,858	53,716	1.4
1951	4,563,142	112,672	2.5
1953	4,041,774	137,754	3.4
ALUMINUM			
1947	461,001	33,936	7.4
1949	460,315	40,098	8.7
1950	712,233	59,884	8.4
1951	662,844	116,529	17.6
1953	846,793	164,137	19.4
COPPER AND COPPER-BASE ALLOYS			
1947	942,902	326	.1
1949	1,027,118	N.A.	N.A.
1950	1,334,222	3,102	.2
1951	1,393,821	9,705	.7
1953	1,159,787	10,554	.9

N.A.—Not available.

Source: 22.

VALUE OF AIRCRAFT AND PARTS PRODUCED
1914 TO 1939
(Thousands of Dollars)

Date	Value of Products	Value Added by Manufacture	Cost of Materials, Supplies, Fuel, Purchased Electric Energy, etc.
1914	$ 790	$ 656	$ 134
1919	14,373	7,246	7,127
1921	6,642	4,235	2,407
1923	12,945	9,116	3,829
1925	12,525	9,665	2,870
1927	21,162	13,645	7,517
1929	71,153	43,785	27,368
1931	40,278	27,177	13,101
1933	26,460	18,503	7,957
1935	45,347	30,986	14,361
1937	149,700	93,144	56,556
1939	279,497	183,247	96,250

Source: 2, 20.

SALES BY MANUFACTURERS OF
COMPLETE AIRCRAFT, AIRCRAFT ENGINES AND PARTS
1947 TO DATE
(Thousands of Dollars)

Year	Sales		Value Added By Manufacture
	TOTAL	Aircraft, Engines, Propellers and Parts Only	Aircraft, Engines, Propellers and Parts
1947	$1,200,000E	$1,100,000	$ 883,826
1949	1,781,000	1,668,000	N.A.
1950	2,274,000	2,074,000	1,405,559
1951	3,456,000	2,872,000	2,346,639
1952	6,497,000	5,654,000	3,727,816
1953	8,511,000	7,760,000	4,556,276
1954	8,305,000	7,471,000	4,460,000E
1955	8,470,000	7,231,000	4,480,000E

E Estimate.
N.A.—Not available.
Sources: 22, 69.

AIRCRAFT ENGINE PRODUCTION, 1917 TO DATE

Year	TOTAL	Military	Civil
1917–1919	N.A.	44,453	N.A.
1926	N.A.	842	N.A.
1927	N.A.	1,397	N.A.
1928	3,252	2,620	632
1929	7,378	1,861	5,517
1930	3,766	1,841	1,925
1931	3,776	1,800	1,976
1932	1,898	1,085	813
1933	1,980	860	1,120
1934	2,736	688	2,048
1935	2,965	991	1,974
1936	4,237	1,804	2,433
1937	6,084	1,989	4,095
1938	N.A.	N.A.	3,800[E]
1939	11,172	N.A.	N.A.
1940	30,167	22,667	7,500[E]
1941	64,681[E]	58,181	6,500[E]
1942	138,089[E]	138,089	—
1943	227,116	227,116	—
1944	256,911	256,911	—
1945	111,650[E]	109,650	2,000[E]
1946	43,407	2,585	40,822
1947	21,159	4,808	16,351
1948	N.A.	N.A.	9,032
1949	N.A.	N.A.	3,982
1950	N.A.	N.A.	4,314
1951	N.A.	N.A.	4,580
1952	31,382[R]	26,000[R]	5,382
1953	41,147[R]	34,500[R]	6,647
1954	27,519[R]	22,000[R]	5,519
1955	20,639[E]	13,000[E]	7,639

N.A.—Not available.
[E] Estimate.
[R] Revised estimate.
Sources: 2, 3, 20, 23, 24, 34, 47

PURCHASES FROM SMALL BUSINESS BY A TYPICAL AIRCRAFT INSTRUMENT AND GUIDED MISSILE CONTROL MANUFACTURER
July-December 1955

	(Thousands of Dollars)	Percent
Total Purchases from Unaffiliated Concerns	$34,044.5	100.0
From Small Business[a]	12,452.3	36.6
From Large Business	21,592.2	63.4

[a] Small Business concerns are those having less than 500 employees.
(A company designing and producing commercial instruments and controls for maritime and aeronautical use, and designing and producing for the Armed Services guided missiles, gunfire control systems, and radar and navigational systems.)

Source: 93.

Lead Time for Production

The production of aircraft, following research and development and ultimate decision to produce, involves thousands of inter-related actions and months of time in assembling needed parts, materials and components. Some elements of production time are virtually irreducible; others already have been shortened by the aircraft industry through continuing advances in manufacturing techniques.

This very complexity of the aircraft manufacturing process is, perhaps, the prime factor in the time consuming operation in the production of an aircraft. This nation's latest heavy jet bomber, for example, upon which the United States Air Force will spearhead its strategic air capability for the next several years, took nine years incubation from

FLOOR SPACE OF AIRFRAME, ENGINE AND PROPELLER FACILITIES, 1939 TO DATE
(Millions of Square Feet)

Date	TOTAL	Airframe	Engine	Propeller
Jan. 1, 1939	9.5	7.5	1.7	.3
Jan. 1, 1940	13.1	9.6	3.0	.5
Jan. 1, 1941	25.5	17.9	6.5	1.1
Jan. 1943	117.1	77.5	31.8	5.2
Dec. 1943	175.0	110.4	54.2	6.8
Dec. 1944	167.4	103.0	54.9	7.9
1947 (estimate)	54.1	39.0	13.5	1.6
1950 (estimate)	63.5	47.5	14.0	2.0
June 30, 1952	122.8	82.3	38.4	2.1
June 30, 1953	135.8	91.1	42.1	2.6
Sept. 30, 1954	127.5	91.0	33.7	2.8
Dec. 31, 1955	131.3	96.5	32.1	2.7

Sources: 2, 4, 14, 76.

drawing board O.K. to first production roll out."

The time factor involved in the production of a modern military warplane, among others, includes: (a) the time required for military experts to establish strategic requirements and to translate these requirements into performance specifications, (b) the time required for design competitions and for contract awards, (c) the time to build experimental models and test them, (d) the time to prepare the production plan—a project that requires knowledge of the production time needed for each of the thousands of parts and materials that go into the finished aircraft and, (e) the time required to test, analyze, and sometimes modify, the first production aircraft.

However, recent technological breakthroughs along all aeronautical fronts—engines, aircraft, missiles, electronics, etc., have made imperative the construction of huge new research and development facilities as well as facilities for production. Much of this expansion, in widely dispersed areas of the nation, is being undertaken by the industry as rapidly as proper reinvestment of its funds can be made.

U. S. AIRFRAME WEIGHT PRODUCTION, 1939 TO DATE

Year	Weight in Millions of Pounds (Excluding Spares)		
	TOTAL	Military	Civil
1939	12.5	10.1	2.4E
1940	27.8	23.1	4.7E
1941	86.1	81.4	4.7E
1942	275.9	275.9	—
1943	654.7	654.7	—
1944	962.4	962.4	—
1945	542.2	540.5	1.7
1946	38.4	12.9	25.5
1947	29.3	11.4	17.9
1948	35.3	25.2	10.1
1949	36.5	29.8	6.7
1950	41.0R	35.0R	6.0
1951	55.0E	50.0E	5.0
1952	117.3R	108.0R	9.3
1953	151.4R	141.0R	10.4
1954	140.5R	130.0R	10.5
1955	124.2E	114.0E	10.2

E Estimate.
R Revised estimate.
Sources: 2, 23, 34, 36, 43.

LABOR

Employment in the aircraft industry during 1955 was characterized by its stability, a direct result of the military policy of procuring aircraft on the basis of the "long pull in an age of peril."

Average monthly employment in the industry was 750,900 workers compared with 768,100 employed in 1954. The aircraft industry today is the second largest manufacturing employer in the U. S.

The aircraft industry historically has been subject to violent fluctuations in its number of employees. During World War II, more Americans worked to build military aircraft than had been engaged in any other single manufacturing effort in history. The industry rose from 41st among U. S. employers at the beginning of World War II to first with 1,342,500 workers employed directly by aircraft manufacturers at the end of 1943 and an additional 650,000 employed by subcontractors and suppliers. At the end of World War II, industry employment had slumped to 219,100.

Aircraft industry employment started a slow climb in 1948 when Congress appropriated funds for a 70-group Air Force and a proportionate buildup of strength in Naval air power. In June 1950, North Korean Communists struck across Korea's 38th Parallel and for the second time in a decade the aircraft industry was called upon to produce, in great urgency, large quantities of modern aircraft. This triggered a substantial manpower recruitment program. Employment in 1951 spurted to 463,600 workers and substantial increases were made each following year until the number started to level off in 1955.

The aircraft industry did not experience any critical shortage of workers during the Korean buildup, with the notable exception of employees in the highly skilled categories—scientists, engineers, technicians and craftsmen. Shortages in these categories have grown steadily more critical. Approximately 9 per cent of the total employees in the aircraft industry are engineers, compared with 4 per cent during World

AVERAGE HOURLY EARNINGS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE
(Includes Overtime Premiums)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	$0.83	N.A.	N.A.
1940	N.A.	N.A.	.83	N.A.	N.A.
1941	N.A.	N.A.	1.00	N.A.	N.A.
1942	N.A.	N.A.	1.21	N.A.	N.A.
1943	N.A.	N.A.	1.26	N.A.	N.A.
1944	N.A.	N.A.	1.31	N.A.	N.A.
1945	N.A.	N.A.	1.28	N.A.	N.A.
1946	N.A.	N.A.	1.34	N.A.	N.A.
1947	$1.38	$1.36	1.41	$1.44	$1.41
1948	1.49	1.47	1.55	1.57	1.55
1949	1.57	1.55	1.60	1.63	1.61
1950	1.64	1.62	1.70	1.73	1.70
1951	1.79	1.75	1.89	1.93	1.80
1952	1.90	1.87	1.98	2.05	1.88
1953	2.00	1.99	2.03	2.05	1.99
1954	2.08	2.08	2.09	2.09	2.08
1955	2.17	2.17	2.17	2.18	2.17

N.A.—Not available.

Sources: 69, 70.

EMPLOYMENT IN THE AIRCRAFT AND PARTS INDUSTRY, 1939 TO DATE
(Thousands of Employees)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	63.2	45.1	11.3	N.A.	N.A.
1940	148.6	101.8	31.4	N.A.	N.A.
1941	347.1	234.6	75.3	N.A.	N.A.
1942	831.7	549.6	192.0	N.A.	N.A.
1943	1,345.6	882.1	314.9	N.A.	N.A.
1944	1,296.6	815.5	339.7	N.A.	N.A.
1945	788.1	489.9	210.9	N.A.	N.A.
1946	237.3	159.0	49.9	N.A.	N.A.
1947	239.3	158.5	50.1	7.8	23.0
1948	237.7	158.0	48.6	7.7	23.3
1949	264.1	175.3	53.5	8.2	27.0
1950	281.8	188.4	55.8	8.3	29.3
1951	463.6	313.3	90.8	10.8	48.8
1952	641.6	413.9	134.7	14.0	79.1
1953	779.1	472.4	174.7	17.7	114.2
1954	768.1	473.4	158.9	15.9	119.9
1955	750.9	482.2	145.6	13.7	109.4

N.A.—Not available.
Sources: 69, 70.

War II. The aircraft industry employs nearly 10 per cent of the total research and development personnel employed by American industry as a whole.

The decline in number of engineering graduates has produced an intense competition in U. S. industry for these talents. In 1949, about 47,000 engineers were graduated from U. S. schools. In 1955, the engineering schools graduated only 20,000, at a time when more and more engineers were needed to design, develop and produce today's highly complex aircraft and missiles.

In 1955, the average worker in the aircraft industry worked 41.3 hours per week, and his weekly earnings were $89.62—about $4.55 per week more than his 1954 wage. In most cases, rate of pay is based upon a job classification analysis which sets a rate-range for each of the

AVERAGE WEEKLY EARNINGS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE
(Includes Overtime Premiums)

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	$36.93	N.A.	N.A.
1940	N.A.	N.A.	38.82	N.A.	N.A.
1941	N.A.	N.A.	47.65	N.A.	N.A.
1942	N.A.	N.A.	60.14	N.A.	N.A.
1943	N.A.	N.A.	61.24	N.A.	N.A.
1944	N.A.	N.A.	62.68	N.A.	N.A.
1945	N.A.	N.A.	55.34	N.A.	N.A.
1946	N.A.	N.A.	55.66	N.A.	N.A.
1947	$54.98	$53.99	56.30	$59.68	$56.50
1948	61.21	60.21	63.40	62.13	63.59
1949	63.62	62.69	65.24	66.83	68.08
1950	68.39	67.15	71.40	73.90	70.81
1951	78.40	75.78	85.81	89.17	78.66
1952	81.70	79.66	86.92	92.25	81.22
1953	83.80	82.19	87.29	90.69	85.17
1954	85.07	85.07	85.06	85.[illegible]0	85.70
1955	89.62	89.40	88.97	82.[illegible]5	90.49

N.A.—Not available.

Sources: 69, 70.

LABOR TURNOVER IN THE AIRCRAFT AND PARTS INDUSTRY, 1950 TO DATE
(Rates per 100 Employees per Year)

Date	Total		Aircraft (Airframes)		Aircraft Engines and Parts		Aircraft Propellers and Parts		Other Aircraft Parts and Equipment	
	Accessions	Separations	Accessions	Separations	Accessions	Separations	Accessions	Separations	Accessions	Separations
1950	62.8	33.8	67.2	37.1	48.2	21.3	32.0	17.6	59.6	27.6
1951	94.8	50.0	97.5	52.4	86.9	39.6	52.7	27.6	89.6	44.5
1952	63.1	45.9	64.1	49.0	60.1	40.8	49.1	25.1	65.3	41.3
1953	47.5	42.7	47.2	42.7	47.4	43.2	33.2	28.3	52.7	47.8
1954	28.2	31.8	28.2	29.5	21.6	36.3	13.1	41.7	33.0	37.1
1955	33.1	29.8	38.0	27.4	30.7	28.8	22.7	38.2	43.3	52.5

E Estimate.
Sources: 2, 69, 70.

AVERAGE WEEKLY HOURS IN AIRCRAFT AND PARTS PLANTS
1939 TO DATE

Monthly Average for the Year	TOTAL	Aircraft (Airframes)	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	N.A.	N.A.	44.6	N.A.	N.A.
1940	N.A.	N.A.	46.6	N.A.	N.A
1941	N.A.	N.A.	47.6	N.A.	N.A.
1942	N.A.	N.A.	49.7	N.A.	N.A.
1943	N.A.	N.A.	48.6	N.A.	N.A
1944	N.A.	N.A.	47.7	N.A.	N.A.
1945	N.A.	N.A.	43.2	N.A.	N.A.
1946	N.A.	N.A.	41.6	N.A.	N.A.
1947	39.9	39.7	39.9	41.5	40.1
1948	41.0	41.1	40.9	39.7	41.0
1949	40.6	40.5	40.7	41.0	40.0
1950	41.6	41.4	42.1	42.4	41.7
1951	43.8	43.3	45.4	46.2	43.7
1952	43.0	42.6	43.9	45.0	43.2
1953	41.9	41.3	43.0	41.9	42.8
1954	40.9	40.9	40.7	39.4	41.2
1955	41.3	41.2	41.0	41.6	41.7

Sources: 69, 70.
N.A.—Not available.
Sources: 2, 69, 70.

AIRCRAFT AND TOTAL MANUFACTURING EMPLOYMENT, 1914 TO DATE

Year or Month	Aircraft Employment (in thousands)	Total Manufacturing Employment (in thousands)	Aircraft as Percent of Total Manufacturing
1914	.2	7,514	[a]
1919	4.2	9,837	[a]
1921	2.0	7,557	[a]
1929	18.6	9,660	.2
1933	9.6	6,558	.2
1939	64.0	9,527	.7
Dec. 1941	423.0	13,817	3.1
Nov. 1943	1,342.5	17,858	7.5
Aug. 1945	351.4	15,343	2.2
Including subcontractors			
Dec. 1941	567.0	13,817	4.1
Nov. 1943	2,101.6	17,858	11.8
Aug. 1945	519.9	15,343	3.4
1948	237.7	15,321	1.6
1950	281.8	14,967	1.9
1953	779.1	17,238	4.5
1954	768.1	15,989	4.8
1955	773.3	16,552	4.5

[a] Less than .05 percent.

Sources: 19, 20, 34, 69, 70.

Salaries and Wages in the Aircraft Industry
1914 to Date
(Thousands of Dollars)

Year	Total	Salaries	Wages of Production Workers	Average Weekly Earnings
1914	$ 196	$ 61	$ 135	$15.45
1919	6,908	2,001	4,907	26.63
1921	3,235	1,033	2,202	30.36
1923	6,160	1,638	4,522	29.97
1925	N.A.	N.A.	4,222	30.06
1927	9,146	2,289	6,857	29.82
1929	31,448	9,524	21,924	28.66
1931	N.A.	N.A.	15,481	30.16
1933	13,824	3,516	10,308	25.36
1935	21,475	6,582	14,893	25.16
1937	46,867	13,514	33,353	26.72
1937[a]	N.A.	N.A.	43,827	27.74
1939	108,286	30,798	77,488	30.56
1947	703,693	227,396	476,297	56.33
1949	956,189	311,821	644,368	62.98
1950	1,132,017	371,773	760,244	69.12
1951	2,102,913	642,821	1,460,092	77.42
1952	3,140,534	1,003,510	2,137,024	81.05
1953	3,941,133	1,301,286	2,639,847	84.50
1954	4,000,000[E]	1,400,000[E]	2,600,000[E]	85.78[E]
1955	4,150,000[E]	1,600,000[E]	2,550,000[E]	90.37[E]

N.A.—Not available.
E Estimate.
[a] This line and all following lines include data for aircraft engine manufacturers which are not available for prior years.

Sources: 2, 19, 20, 22.

thousands of different jobs existing in the industry. Employees can advance within the rate-ranges through merit or length of service, or both.

Most aircraft industry employees receive a paid vacation and other fringe benefits such as seven or eight paid holidays per year, insurance, hospitalization benefits and pension plans.

Most of the aircraft industry is organized by labor. Most workers are affiliated with the International Association of Machinists (which entered the aircraft industry in 1934) or the United Automobile Workers (which received a charter covering aircraft workers in 1937).

PRODUCTION WORKERS IN THE AIRCRAFT AND PARTS INDUSTRY
1939 TO DATE
(Thousands of Production Workers)

Monthly Average for the Year	TOTAL	Aircraft	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Aircraft Parts and Equipment
1939	49.2	34.5	9.5	N.A.	N.A.
1940	117.0	78.4	26.6	N.A.	N.A.
1941	275.9	181.9	65.2	N.A.	N.A.
1942	669.0	429.5	168.8	N.A.	N.A.
1943	1,080.4	685.0	279.8	N.A.	N.A.
1944	1,006.9	609.8	291.4	N.A.	N.A.
1945	585.0	356.7	165.5	N.A.	N.A.
1946	159.5	111.8	34.1	N.A.	N.A.
1947	175.1	116.1	36.6	5.1	17.2
1948	173.6	116.1	35.0	5.1	17.3
1949	194.7	130.8	38.6	5.5	19.8
1950	206.4	138.9	40.0	5.5	22.1
1951	341.9	232.3	63.7	7.6	38.3
1952	483.5	311.6	98.8	10.4	62.7
1953	568.7	343.0	124.7	13.3	88.0
1954	544.3	333.8	108.8	11.3	90.5
1955	513.9	330.0	94.5	9.3	80.1

Sources: 69, 70.
N.A.—Not available.
Sources: 2, 69, 70.

WORK-INJURY RATES FOR THE AIRCRAFT AND ALL MANUFACTURING INDUSTRIES 1939 TO DATE

Year	Aircraft Industry		Aircraft Parts Industry		All Manufacturing	
	Injury-Frequency Rates[a]	Severity Rates[a]	Injury-Frequency Rates[a]	Severity Rates[a]	Injury-Frequency Rates[a]	Severity Rates[a]
1939	12.9	1.9	[b]	[b]	14.9	1.4
1940	15.8	1.3	[b]	[b]	15.3	1.6
1941	10.4	1.4	[b]	[b]	18.1	1.7
1942	11.4	0.7	9.5	0.9	19.9	1.5
1943	9.7	0.7	11.7	0.8	20.0	1.4
1944	8.8	0.6	10.1	0.6	18.4	1.4
1945	9.4	1.2	10.6	1.7	18.6	1.6
1946	5.2	0.8	13.7	2.1	19.9	1.6
1947	4.8	0.7	11.1	0.6	18.8	1.4
1948	4.9	0.8	10.2	0.8	17.2	1.5
1949	4.3	1.0	9.2	1.0	14.5	1.4
1950	4.0	0.9	5.9	0.6	14.7	1.2
1951	4.5	0.6	7.1	0.9	15.5	1.3
1952	3.7	0.3	6.7	0.4	14.3	1.3
1953	3.8	0.6	6.3	0.5	13.4	1.2
1954	3.2	0.7	5.8	0.5	11.9	1.0
1955	2.7	N.A.	4.9	N.A.	12.1	N.A.

N.A.—Not available.

[a] The injury frequency rate is the average number of disabling work injuries for each million employee-hours worked.

The severity rate is the average number of days lost as a result of disabling work injuries for each 1,000 employee-hours worked. The computations of days lost include standard time charges for fatalities and permanent disabilities.

[b] Included with "Aircraft."

Sources: 68, 74.

WOMEN EMPLOYEES IN THE AIRCRAFT INDUSTRY, 1942 TO DATE

Date	Number (thousands)	Percent
Jan. 1942	23.1	5.0
Nov. 1943	486.1	36.7
Oct. 1947	28.5	11.8
Sept. 1949	33.3	12.5
Sept. 1950	36.2	12.4
Sept. 1951	88.6	17.7
Sept. 1952	117.9	18.0
Sept. 1953	133.4	17.6
Sept. 1954	132.3	16.6
Oct. 1955	118.4	15.7

Sources: 21, 69, 70, 71.

WORK STOPPAGES IN THE AIRCRAFT AND PARTS INDUSTRY
1927—TO DATE

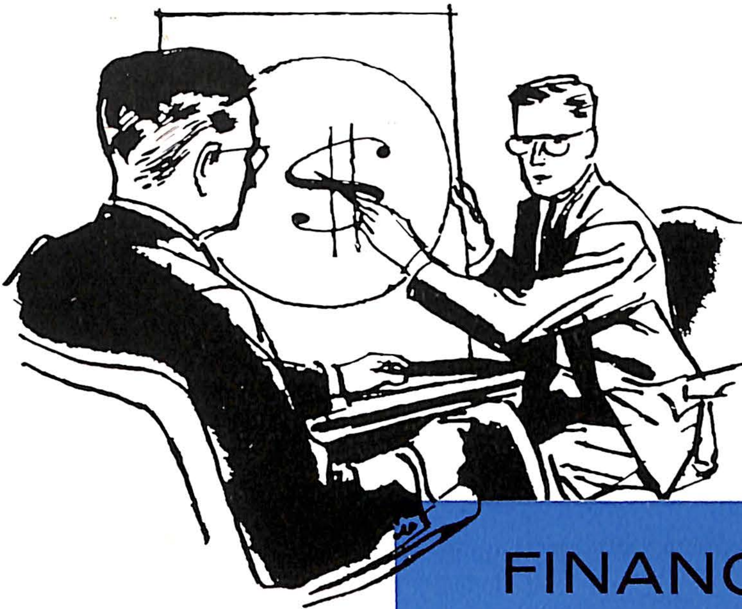
Year	Number of Strikes	Number of Workers Involved	Man-Days Idle in Year
1927–1933	4	1,153	18,965
1934	4	3,207	111,048
1935	1	1,700	6,800
1936	—	—	—
1937	6	9,390	90,964
1938	N.A.	N.A.	N.A.
1939	2	1,263	85,419
1940	3	6,270	36,402
1941	29	28,422	112,549
1942	15	6,584	12,416
1943	60	52,481	130,112
1944	103	189,801	386,371
1945	85	150,200	581,000
1946	15	21,300	557,000
1947	10	3,520	67,900
1948	8	21,400	1,100,000
1949	10	10,300	451,000
1950	18	23,900	145,000
1951	29	48,800	765,000
1952	44	81,000	927,000
1953	31	57,800	1,350,000
1954	11	6,350	171,000

N.A.—Not available.
Source: 67.

GEOGRAPHICAL DISTRIBUTION OF EMPLOYMENT IN THE AIRCRAFT AND PARTS INDUSTRY, 1939 TO DATE
(In Percent of Totals)

Date	TOTAL	East Coast	Central	West Coast
1939	100.0	54.5	4.5	41.0
Nov. 1943	100.0	30.8	43.5	25.7
June 1950	100.0	32.0	28.8	39.2
Feb. 1953	100.0	29.3	40.1	30.6
June 1954	100.0	31.0	34.4	34.6
June 1955	100.0	29.2	33.9	36.9

Sources: 20, 34, 66



FINANCE

The aircraft industry has achieved an established position in American industry. It has become one of the nation's largest employers, and attracted and developed individuals of the highest technical and administrative talents. It has contributed significantly to the planning and molding of the national defense.

This stature and maturity was not easily achieved. On the contrary, though the need particularly for financial stability has been manifest throughout its history, it was not always perceived by its prime customer, the government.

Today's aircraft and missiles are enormously expensive because they are *revolutionary* in design, incredibly *intricate* in construction and almost *miraculous* in performance. They have become so because of the frightful threat of the air-atomic age in which we live.

Because of the great expense in the provisioning of U. S. air superiority, the aircraft industry and the military services independently and cooperatively are striving to eliminate inefficiency and to promote savings. In this regard, only the most capable and imaginative managers can bring significant improvements in quality and efficiency to the science and art of aircraft and missile production. As a result, the aircraft industry—indeed all industry—attempts to attract and retain through various incentives personnel of top caliber. To ignore top talent, or to "make-do" with less, threatens second rate air weapons performance and invites disaster to the national security.

The aircraft manufacturing industry, in financial parlance, is a "contracting industry" and is capitalized accordingly. This requires that the capitalization of companies (1) provide the credit stability and financial strength needed to support a high volume of sales, and yet (2) avoid the costly burden of over-capitalization during the prolonged periods of low volume.

Furthermore, as is the case with other contracting industries, the most economical and efficient method of financing production is for the customer (whether civil or military) to provide some of the financing needed for performance of the contract. If such were not the practice, and if contracting industries were capitalized to handle their infrequent peak volume, it would be necessary during years of low volume for the price of the end product to include the carrying costs of excess capitalization.

During World War II the customer provided financing in the form of "advances" or contract deposits. During the Korean buildup, customer financing was provided primarily on a "pay-as-you-go" basis of progress payments.

Data contained in the tables in this chapter cover financial activities of the 12 major airframe manufacturers, based upon each of the years 1937 through 1955.

Effect of Emergency Production Expansion on Financial Condition

The degree to which a suddenly expanded military production program affects the financial condition of the industry is shown by the following changes in the financial status of the 12 major airframe companies during the period 1950-1955.

	(In Millions of Dollars) 1950	1955
Net Worth	$ 380.0	$ 741.6
Working Capital	287.7	545.4
Inventory Net	220.4	638.2
Receivables	215.3	463.9
Plant	82.8	214.0
Sales Volume	1,388.2	5,188.1
Working Capital Turnover (Times)	4.8	9.5

Between 1950 and 1955 the total net worth of the 12 companies was increased by $361.6 million, most of which represented invested earnings. A major portion of this increased capitalization went into needed production facilities—brick and mortar, as well as machine tools, and essential research and development facilities.

Balance Sheet Comparisons, 12 Major Airframe Companies
1950 to Date
(Thousands of Dollars)

	1950	1951	1952	1953	1954	1955
Assets						
Current assets:						
Cash	$106,560	$ 159,676	$ 216,470	$ 261,932	$ 295,365	$ 295,506
Securities	27,206	8,484	5,613	5,478	26,437	29,372
Receivables	227,443	360,165	479,506	526,400	461,910	463,848
Inventories	208,304	373,429	531,020	583,923	592,056	638,208
Miscellaneous	5,020	13,102	18,569	27,467	12,934	23,040
Total current assets	$574,533	$ 914,856	$1,251,178	$1,405,200	$1,388,702	$1,449,974
Total net plant	82,844	124,457	154,010	166,077	186,406	214,077
Investments	6,567	9,264	9,531	9,208	6,278	5,679
Development, etc., expenses	—	—	1,780	2,202	—	—
Deferred charges	4,745	13,271	11,932	13,644	19,731	19,410
Miscellaneous	12,743					
Total assets	$681,432	$1,061,848	$1,428,431	$1,596,331	$1,601,117	$1,689,140
Liabilities						
Current liabilities:						
Payables	$121,124	$ 369,910	$ 541,006	$ 544,162	$ 396,217	$ 375,822
Accruals—taxes—renegotiation—refunds due U. S.	113,860	209,048	297,102	406,906	409,039	375,642
Advances—contracts deposits	39,999	48,087	91,550	92,540	121,403	127,246
Reserve	6,206	4,923	3,618	3,458	8,851	12,317
Miscellaneous	5,624	8,474	9,577	8,347	11,112	13,509
Total current liabilities	$286,813	$ 640,442	$ 942,853	$1,055,413	$ 946,622	$ 904,536
Bank loans, etc.	12,722	27,782	30,763	8,648	8,589	36,756
Contingency reserve	—	—	500	—	—	
Capital stock	61,939	66,164	94,831	95,460	125,706	135,499
Capital (paid) surplus	62,561	61,371	68,927	77,181	100,331	110,216
Earned surplus	255,516	260,828	283,366	353,885	415,443	495,861
Miscellaneous	1,881	5,261	7,191	5,744	4,426	6,272
Total liabilities	$681,432	$1,061,848	$1,428,431	$1,596,331	$1,601,117	$1,689,140
Net current assets	$287,720	$ 274,414	$ 308,325	$ 349,787	$ 442,080	$ 545,438

Source: 5.

COMPOSITION OF CURRENT ASSETS, 1937 TO DATE, 12 MAJOR AIRFRAME COMPANIES
(In Percent of Total)

Year	Total Current Assets	Cash and Securities	Inventories	Receivables	Miscellaneous
1937	100.0	17.6	35.2	46.6	.6
1938	100.0	35.1	33.8	30.3	.8
1939	100.0	37.9	48.9	13.1	.1
1940	100.0	46.4	35.7	12.2	5.7
1941	100.0	23.2	52.3	24.4	.1
1942	100.0	25.1	33.8	40.9	.2
1943	100.0	27.6	25.5	45.9	1.0
1944	100.0	26.7	22.7	49.1	1.5
1945	100.0	34.1	13.7	48.9	3.3
1946	100.0	32.9	43.8	23.2	.1
1947	100.0	18.6	54.9	25.6	.9
1948	100.0	23.9	40.1	35.3	.7
1949	100.0	26.8	41.6	30.5	1.1
1950	100.0	23.3	36.2	39.6	.9
1951	100.0	18.4	40.8	39.4	1.4
1952	100.0	17.8	42.4	38.3	1.5
1953	100.0	19.0	41.6	37.5	1.9
1954	100.0	23.1	42.6	33.3	1.0
1955	100.0	22.4	44.0	32.0	1.6

Sources: 5, 6.

NET PROFIT AS PERCENT OF SALES,
Seven Selected Industries,
1950 TO DATE
(After Taxes)

Industry	1950	1951	1952	1953	1954	1955
Nonferrous Metals	9.8	8.8	7.7	6.9	7.3	9.5
Petroleum Products	10.8	11.5	10.5	10.6	10.7	10.6
Autos and Trucks	8.9	5.2	5.5	4.4	6.4	7.4
Railway Equipment	5.5	4.8	3.8	3.3	4.1	4.7
Iron and Steel	8.1	5.8	5.0	5.7	6.0	7.8
AIRCRAFT AND PARTS	4.5	2.2	2.4[a]	2.4[a]	3.8[a]	3.9[a]
Total Manufacturing	7.7	6.2	5.4	5.3	5.9	6.7

[a] Subject to renegotiation.

Source: 51.

Working capital in the same period increased $257.7 million. With this expansion of working capital, these companies were able to finance a $666.4 million increase in accounts receivable and inventory. To accomplish this financing, working capital turnover was increased from 4.8 times per year to 9.5 times per year.

Because of the nature of the aviation product with its inevitably high unit cost and 16 to 30 month manufacturing cycle, working capital turnover of this magnitude requires careful and close control—both of the amount of the working capital and the manner in which it is used. Under these conditions, the length of time between receipt of cash and its disbursement is extremely short and any disturbance in the flow of incoming cash inevitably has a serious effect upon an individual company's —or an industry's—entire operations.

Control of Accounts Receivable and Inventories

Control of the manner in which working capital is used requires that constant effort be exerted to keep the amount of funds tied up in accounts receivable and inventories at an absolute minimum and thus to retain in the form of cash sufficient amounts to meet vastly expanded payrolls and to keep on a current basis with mercantile creditors. As an example of the effects of such control, the $227.4 million in accounts receivable at the end of 1950 represented an average collection period of 57 days, based upon a sales volume of $1,388.2 million; by 1955, the average collection period for accounts receivable had been reduced to 33 days.

Inventory figures shown in this chapter are net, after deducting progress payments received from the customer during performance of the contracts. The turnover of total gross inventory (not shown in the accompanying tables) was 3.3 times in 1950 at the start of the production buildup, and had slowed to 2.9 times in 1955. In the overall program, however, this inventory turnover has improved considerably. For the year 1956 as the production program continues to level out and deliveries in volume are made to the military services, the inventory picture will improve even more.

Aircraft Industry Earnings

The earnings of the aircraft industry are subject to a number of profit control measures, including renegotiation, price redetermination clauses, and various types of cost disallowances. During 1955, the average aircraft industry rate of profit to sales of 3.9 per cent was less than the average rate of profit on sales earned by all manufacturers. This comparatively low rate of earnings is not unusual (See Page 28, covering the years 1950 to date.) The average earnings for the 12 major airframe manufacturers from 1950 to 1955 inclusive was 2.9 per cent on sales. During the same period all manufacturing industries reported a return of 6.2 per cent.

Reinvestment of Profits

Every major aircraft company has made very substantial commitments toward capital improvements and research and development facilities. During the past ten years the industry has reinvested upwards of $1 billion in these activities. And fourteen companies have indicated that their current planning contemplates expenditures in excess of $370,000,000 for capital improvements during 1956-1958.

For the first time the aircraft industry is in a position to make, and is making, a determined effort to provide with its own resources substantial portions of the facilities and equipment needed to sustain the costly weapons of defense for the national security.

INCOME ACCOUNTS, 12 MAJOR AIRFRAME COMPANIES, 1937 TO DATE
(Millions of Dollars)

Year	Net Sales	Total Income	Total Federal Taxes, net	Net Profit
1937	$ 61.8	$ 3.6	$ 1.3	$ 2.3
1938	88.5	10.1	2.1	8.0
1939	141.0	19.1	4.5	14.6
1940	247.4	45.1	13.3	31.8
1941	812.6	168.7	108.6	60.1
1942	2,788.9	341.8	281.2	60.6
1943	5,209.0	429.8	357.0	72.8
1944	5,766.3	322.1	263.5	58.6
1945	3,965.3	215.1	147.7	67.4
1946	519.0	(37.0)	26.3[cr]	(10.7)
1947	545.0	(115.4)	73.5[cr]	(41.9)
1948	843.4	24.2	21.8	2.4
1949	1,131.7	57.8	21.7	36.1
1950	1,388.2	111.1	48.5	62.6
1951	1,979.3	98.9	68.0	30.9
1952	3,731.1	220.5	138.8	81.7[a]
1953	5,120.1	317.1	200.5	116.6[a]
1954	4,926.8	371.0	188.4	182.6[a]
1955	5,188.1	370.7	191.9	178.8[a]

[a] Subject to renegotiation.
[cr] Credit.
Figures in parentheses indicate loss.
Sources: 5, 6.

FINANCIAL RATIOS, 12 MAJOR AIRFRAME COMPANIES
1937 TO DATE

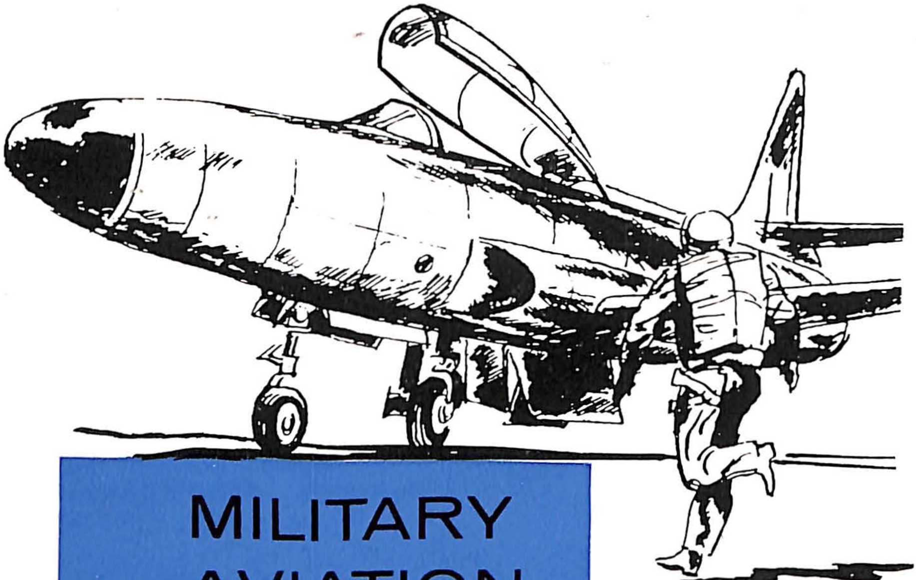
Year	Net Federal Taxes as Percent of Total Income	Net Profit as Percent of Sales
1937	26.5	3.7
1938	21.9	9.1
1939	19.8	10.3
1940	26.9	12.9
1941	59.5	7.4
1942	72.6	2.2
1943	72.0	1.4
1944	71.7	1.0
1945	57.5	1.7
1946	Not applicable	(2.1)
1947	Not applicable	(7.7)
1948	82.3	0.3
1949	37.5	3.2
1950	43.7	4.5
1951	68.6	1.6
1952[a]	62.9	2.2
1953[a]	63.2	2.3
1954[a]	50.8	3.7
1955[a]	51.8	3.4

Figures in parentheses indicate net loss as a percent of sales.
[a] Subject to renegotiation.
Sources: 5, 6.

BACKLOG OF ORDERS REPORTED BY MANUFACTURERS OF COMPLETE AIRCRAFT, ENGINES AND PROPELLERS, 1948 TO DATE
(Millions of Dollars)

December 31	Total	Aircraft and Parts	Aircraft Engines and Parts	Aircraft Propellers and Parts	Other Products and Services
1948	$3,104	$2,094	$ 786	$103	$121
1949	3,010	2,013	749	91	157
1950	5,039	3,102	1,470	145	322
1951	12,665	8,126	3,531	241	767
1952	17,653	11,222	5,172	298	961
1953	16,753	11,604	4,080	218	851
1954	14,852	10,639	2,929	187	1,097
1955	15,776	10,682	3,123	130	1,841

Source: 25.



MILITARY AVIATION

In the decade since World War II, the aircraft industry and the government of this nation have moved forward to develop aircraft and nuclear weapons that dwarf in magnitude the weapons of the late global war. Aeronautical and nuclear developments both in the free world *and* behind the Iron Curtain have made air power the dominant military force.

United States military aviation has enjoyed a pre-eminent air power position since about mid-way in World War II. After Japan's surrender, air power of the United States, coupled with our *atomic monopoly,* was the principal factor in maintaining a world balance of power. This was true even though U. S. military aviation was all but completely demobilized, so great was the power of this one weapon.

In 1947, the National Security Act gave air power equal status with military surface forces—naval and land forces. On September 18 of that year the United States Air Force was established.

Since World War II, the Soviet Union has made astonishing strides in improving its technical position, not only in aircraft and missiles and electronics, but also in the realm of atomic and thermonuclear weaponry. In addition, the Soviets, because of the military economy under which their government operates, are producing air power that quantitatively surpasses ours.

TOTAL FEDERAL EXPENDITURES AND EXPENDITURES FOR MILITARY AIRCRAFT AND RELATED PROCUREMENT
1922 TO DATE
(Dollar Figures in Millions)

Fiscal Year	Total Federal Expenditures	Total Military Expenditures	Expenditures for Aircraft and Related Items[a]	Percent Aircraft of Total Federal	Percent Aircraft of Military
1922	$ 3,373	$ 935	$ 6	.2	.6
1923	3,295	730	7	.2	1.0
1924	3,049	689	10	.3	1.5
1925	3,063	717	10	.3	1.4
1926	3,098	677	12	.4	1.8
1927	2,974	688	14	.5	2.0
1928	3,103	732	22	.7	3.0
1929	3,299	791	29	.9	3.7
1930	3,440	839	31	.9	3.7
1931	3,652	832	31	.8	3.7
1932	4,535	834	29	.6	3.5
1933	4,623	784	25	.5	3.2
1934	6,694	706	13	.2	1.8
1935	6,521	924	23	.4	2.5
1936	8,493	1,147	44	.5	3.8
1937	7,756	1,185	58	.7	4.9
1938	6,938	1,240	67	1.0	5.4
1939	8,966	1,368	68	.8	5.0
1940	9,183	1,799	205	2.2	11.4
1941	13,387	6,252	587	4.4	9.4
1942	34,187	22,905	2,915	8.5	12.7
1943	79,622	63,414	10,072	12.6	15.9
1944	95,315	75,976	12,828	13.5	16.9
1945	98,703	80,537	11,521	11.7	14.3
1946	60,703	43,151	1,649	2.7	3.8
1947	39,289	14,769	593	1.5	4.0
1948	33,791	11,983	703	2.1	5.9
1949	40,057	13,988	1,248	3.1	8.9
1950	40,156	13,440	1,705	4.2	12.7
1951	44,633	20,821	2,536	5.7	12.2
1952	66,145	38,967	5,712	8.6	14.7
1953	73,982	47,565	8,605	11.6	18.1
1954	67,772	40,336	9,247	13.6	22.9
1955	64,570	35,533	8,794	13.6	24.7
1956[E]	64,270	34,575	7,763	12.1	22.5
1957[E]	65,865	35,547	7,907	12.0	22.2

[a] Includes Guided Missiles.
E Estimate.
Sources: 8, 29, 30, 49, 82.

The United States, in the best interests of its citizens, conducts its national affairs on a dual "guns and butter" economy. As a result, it cannot be interested in participating in a quantitative arms race with the Soviets. That it *could,* on the other hand, is not held in doubt by *any* nation, as U. S. wartime industry production proves. The aircraft industry during the peak year of World War II, produced 96,000 completely equipped combat aircraft—more aircraft than had been produced in the history of aviation *by all* of the nations of the world combined prior to World War II.

Instead, United States air power is based upon qualitative superiority —maintaining the capability to react to aggression with irrevocably crushing force—as an effective deterrent to war. The tenet bluntly stated: *One cannot kill an enemy twice.* There is no need to match the potential aggressor plane for plane, missile for missile, bomb for bomb.

United States air power, as 1955 drew to a close, was 160 per cent greater in combat strength than it was at the beginning of the Korean War in 1950. Aircraft speeds and altitudes doubled, while firepower, with thermonuclear weapons and guided missiles capability, increased almost beyond estimate.

During 1956, the initial equipping of the 137-wing Air Force largely will be completed and thereafter production will level off at the rate needed to sustain and keep modern this force and its naval air equivalent. To sustain a 137-wing force of modern planes—aircraft far more complicated and expensive than pre-Korea models will require an annual investment in new aircraft comparable to the *entire* Air Force budget of 1950.

In 1950, this nation entered the Korean War with an Air Force strength of 47 wings. Today the Air Force mounts 128 combat wings, and this year will have largely achieved its air strength goal of 137 wings. Naval aviation during the same period has grown proportionately.

At the beginning of the Korean outbreak, United States bombers were, for the most part, piston-engined, war-weary types that had fought the enemy from Paris to Berlin and over the Pacific Islands to Tokyo. The Communist air forces outnumbered United Nation's by four-to-one.

The U. S. aircraft industry once more was ordered into high gear to meet and overcome the aggressor's lead. But it wasn't until early 1952—nearly a year and a half later—that powerful new U. S. jet fighters began in numbers to sweep Korean skies clear of the enemy. Later that year, the United Nations' plane-kill ratio over that of the enemy began to climb to an eventual 14-1.

Less than five years have passed since the World War II type piston-engined bombers were pounding the Chinese Communists in North

Appropriations and Expenditures for Military Aviation
1899 to Date
(Millions of Dollars)

Fiscal Year	U. S. Air Force		Naval Aviation	
	Total Cash Appropriations	Expenditures	Total Cash Appropriations	Expenditures
1899	$ .05	N.A.	$ —	N.A.
1909	.03	N.A.	—	N.A.
1912	.12	N.A.	.03	N.A.
1913	.10	N.A.	.01	N.A.
1914	.17	N.A.	.01	N.A.
1915	.20	N.A.	.01	N.A.
1916	.80	N.A.	1.0	N.A.
1917	18.7	N.A.	3.8	N.A.
1918	735.0	N.A.	61.5	N.A.
1919	952.3	N.A.	220.4	N.A.
1920	28.1	N.A.	25.7	N.A.
1921	35.1	$ 30.9	20.0	N.A.
1922	25.6	23.1	19.1	$ 14.3
1923	13.1	18.1	14.8	14.2
1924	12.6	11.0	14.7	14.3
1925	13.5	11.7	15.7	15.5
1926	15.9	14.9	18.2	18.1
1927	15.3	16.8	22.4	22.0
1928	21.1	19.4	20.3	19.8
1929	28.9	23.3	32.3	32.1
1930	34.9	28.1	31.6	31.1
1931	38.9	38.7	32.1	31.0
1932	31.9	33.0	31.2	31.7
1933	25.7	22.1	25.4	31.2
1934	31.0	17.6	29.8	15.5
1935	27.9	20.5	32.1	17.2
1936	45.6	32.2	40.8	20.5
1937	59.6	41.3	38.9	27.5
1938	58.9	51.1	51.6	59.8
1939	71.1	83.4	48.2	47.9
1940	186.6	108.5	111.8	50.8
1941	2,173.6	605.9	453.0	193.6
1942	23,049.9	2,555.2	6,190.0	993.1
1943	11,317.4	9,392.4	5,258.0	3,966.4

(Continued top next page)

APPROPRIATIONS AND EXPENDITURES FOR MILITARY AVIATION
1899 TO DATE—*Continued*
(Millions of Dollars)

Fiscal Year	U. S. Air Force		Naval Aviation	
	Total Cash Appropriations	Expenditures	Total Cash Appropriations	Expenditures
1944	23,656.0	13,087.7	4,583.7	4,490.1
1945	1,610.7	11,357.4	2,539.6	5,166.0
1946	.5	2,519.4	795.0	1,065.7
1947	1,200.0	854.3	770.8	749.1
1948	608.1 } [a] 829.8 }	1,199.1	906.0	747.9
1949	939.8	1,830.7	588.3	875.1
1950	4,139.4	3,669.1	1,041.5	989.4
1951	15,791.1	6,549.4	3,815.3	1,237.3
1952	22,979.0	12,594.9	5,266.5	2,205.2
1953	22,081.7	15,267.8	4,873.0	3,061.3
1954	11,410.5	15,539.6	2,322.0	3,235.6
1955	11,637.1	15,536.8	2,749.5	2,554.8
1956E	15,490.1	15,988.0	1,720.7	2,500.0
1957E	15,430.0	16,545.0	2,551.3	2,560.0

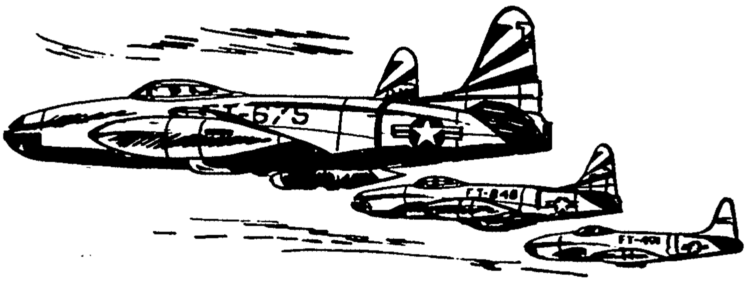
N.A.—Not available.
E Estimate.
[a] FY 1949 Construction of Aircraft & Related Procurement appropriation enacted in FY 1948.
Sources: 4, 8, 49, 82.

Korea. Yet aeronautical science of the United States aircraft industry since that time has progressed rapidly.

Multi-engined jet bombers slip through the air at speeds close to sonic, and each possesses a bomb carrying capability more destructive than that of all of the bombers of World War II combined. American-manufactured jet fighters are the finest in the world, qualitatively, and their firepower has infinitely increased over their World War II predecessors. United States Air Force and Navy jet fighters, today, for the most part are capable of speeds in or beyond the sonic range, and their powerful American jet engines can ram them from a standing ground start to 10,000 feet in one minute or less.

USAF Wing Structure

Included in the current 128-wing Air Force are 51 trategic Air Wings. Several of these are equipped with the world's largest and longest ranged piston-engined bomber. These, although considered "first line," are currently being replaced by a giant eight-jet bomber just now coming into operational use. This new jet bomber possesses high subsonic



speed characteristics. Medium strategic bomb wings are completely jet bomber equipped. These aircraft, coupled with aerial refueling and forward bases, give our strategic air forces the capability of striking all targets in any nation that threatens our security.

The light bombers and fighters of USAF's tactical forces also possess nuclear weapons capabilities and may be refueled while in flight. There are 34 wings in Tactical Air, and their fighter elements are being equipped with supersonic fighters.

There are 30 Air Force wings in Continental Air Defense Command, and while these comprise the bulk of that command, these forces are greatly augmented by naval air units. The Air Defense interceptor system is all jet-equipped and will soon become a completely supersonic force, armed with deadly air-to-air missiles.

The remaining 13 Air Force wings are troop carrier units.

Organizations of Wings, Air Groups

Air Force: The basic organizational unit of the United States Air Force is the "wing". A wing is comprised of a combat group and necessary administrative and service units. The number of airplanes in a wing depends on its mission; for example, a group of heavy bombers has 45 planes, a medium bomber group has 45, a light bomber group 48, a day fighter group 75, an all-weather fighter group 36-75—depending upon type of plane and operational mission. The USAF also operates separate squadrons for rescue, support and in-flight refueling. Aircraft comprising these squadrons vary from 8 to 25 planes depending upon type of plane and squadron mission.

Navy and Marines: Navy carrier air groups usually are composed of four fighter and one attack squadrons, and another unit is comprised of night fighters, minelaying aircraft, helicopters and other aircraft. Aircraft carriers (CV) have a complement of from 80 to 137 aircraft depending upon the size of the carrier and the type and size of plane carried. Super aircraft carriers of the *Forrestal* Class (60,000 tons) have 117 to 137 aircraft. Large *Midway Class* (55,000 tons) carriers have from 100 to 137 aircraft while medium size carriers of the *Essex* Class (33,000 tons) have a complement of 80-90 aircraft. Anti-submarine squadrons attached to light and escort carriers average about 23 aircraft

Research and Development key to—

SPEEDS and ALTITUDES TODAY and TOMORROW

America's aircraft industry, striving continuously to insure U.S. aerial supremacy, has made great strides during the last decade in the development and production of efficient, high performance engines for aircraft and guided missiles. But only an adequate, long-range research and development program will guarantee their continued progressive rise to meet the ever increasing demand of military necessity and civil economy.

SPEED The accomplishments of scientists and engineers of the aircraft industry during the last decade are reflected in this chart. In the realm of military aviation, World War II fighters, were hard pressed to reach 450 miles per hour. Today jets exceed the speed of sound with ease and piloted research planes have travelled at speeds upwards of 1,650 miles per hour—more than twice the speed of sound.

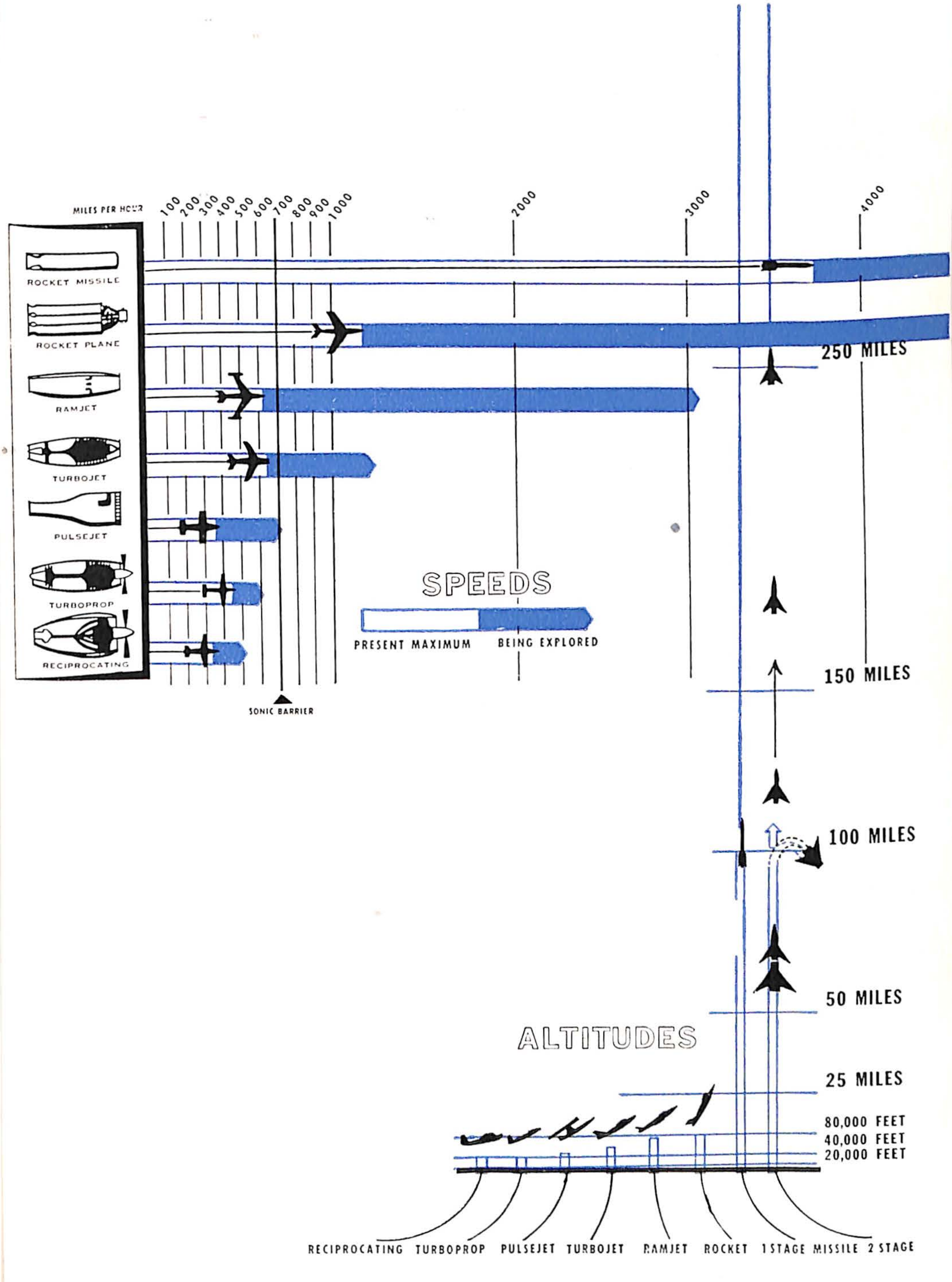
A decade ago, commercial piston-powered aircraft moved at cruising speeds up to 225 miles per hour. Today's luxurious airliners cruise at just under 400 miles per hour. Turboprop engines will bring these speeds up to just under 500 miles per hour, while turbojet power plants will make possible cruising speeds above 550 miles per hour.

Applications of the ramjet to planes and missiles will see speeds possibly to 3,000 miles per hour. Rocket engines, now in comparative infancy are virtually limitless in relation to speed. But solving the problem of the sonic barrier has been relatively simple in relation to solving the problem of the thermal barrier. The faster the speed within the earth's atmosphere, the greater the heat generated by the friction of the air over the skin surfaces. The problems are stupendous, but not insurmountable, and men and women of science and industry are working ceaselessly to find the answers.

ALTITUDE In military operations, altitude is almost as important as speed. During World War II, fighter planes were barely able to reach 30,000 feet, while today's fighters maneuver with ease at altitudes above 50,000 feet. Research aircraft have been flown at altitudes in the neighborhood of 90,000 feet—17 miles straight up.

Commercial aircraft of the decade past flew at altitudes seldom over 10,000 feet, while today's luxurious airliners cruise safely and comfortably at altitudes from 18,000 feet to more than 25,000 feet. Turbojet engines, just now being applied to passenger transport planes, will enable these new airliners to fly at altitudes of 45,000 feet—above all turbulence, clouds or storm.

The rocket engine, unlike any of the others, carries its own oxygen supply and is not limited to flight within the atmosphere. This, plus the enormous power-for-weight ratio, makes it the only known engine that can drive manned or unmanned vehicles into space. Altitudes reached so far are 136 and 250 miles for one and two-stage missiles respectively, but the rocket engine's ultimate ceiling is limited only by the amount of propellant it can carry.


MILES PER HOUR
100
200
300
400
500
600
700
800
900
1000
2000
3000
4000
ROCKET MISSILE
ROCKET PLANE
RAMJET
TURBOJET
PULSEJET
TURBOPROP
RECIPROCATING
SONIC BARRIER
SPEEDS
PRESENT MAXIMUM
BEING EXPLORED
250 MILES
150 MILES
100 MILES
50 MILES
ALTITUDES
25 MILES
80,000 FEET
40,000 FEET
20,000 FEET
RECIPROCATING
TURBOPROP
PULSEJET
TURBOJET
RAMJET
ROCKET
1 STAGE MISSILE
2 STAGE

and shore-based patrol squadrons have nine planes each. Marine fighter squadrons are assigned 24 aircraft.

Army: The United States Army currently has approximately 4,000 light liaison and utility airplanes and helicopters for support of its ground units. That number includes some 600 aircraft which are assigned to National Guard activities.

The main concern of the aircraft industry and the government for

PERSONNEL IN THE UNITED STATES AIR FORCE, 1912 TO DATE

As of June 30	TOTAL	Officers	Aviation Cadets	Airmen
1912[a]	51	12	—	39
1914	122	18	—	104
1916	311	63	—	248
1918[b]	195,023	20,708	—	174,315
1920	9,050	969	—	8,081
1922	9,642	958	113	8,571
1924	10,547	884	119	9,544
1926	9,674	954	142	8,578
1928	10,549	1,055	280	9,214
1930	13,531	1,499	378	11,654
1932	15,028	1,659	325	13,044
1934	15,861	1,545	318	13,998
1936	17,233	1,593	328	15,312
1938	21,089	2,179	342	18,568
1940	51,165	3,361	1,894	45,910
1941	152,125	10,611	8,627	132,887
1942	764,415	55,956	50,213	658,246
1943	2,197,114	205,874	99,672	1,891,568
1944	2,372,292	333,401	82,647	1,956,244
1945	2,282,259	381,454	16,764	1,884,041
1946	455,515	81,733	7	373,775
1947	305,827	42,745	53	263,029
1948	387,730	48,957	1,338	337,435
1949	419,347	57,851	1,860	359,636
1950	411,277	57,006	2,186	352,085
1951	788,381	107,099	2,476	678,806
1952	973,474	128,401	6,782	838,291
1953	977,593	130,769	9,157	837,667
1954	947,918	129,752	9,072	809,094
1955	959,946	137,149	4,384	818,413

[a] As of November 1.
[b] As of November 11.
Source: 8.

WARPLANE PROGRESS SINCE THE SECOND WORLD WAR

	1945	1953	1955
Fighter.	P–51	F–100	F–104
Speed	470 mph	Supersonic. 755.149 mph*	Ultrasonic (Mach 2+)
Range	Over 2,000 miles	Over 1,000 miles	Range and armament not disclosed.
Fire power	Six 50-cal. guns in wings. Can carry ten 5-inch HVAR with zero launchers or two 1,000-lb. bombs.	20 mm canons	
Bomber.	B–17	B–47	B–52
Speed	285 mph	600 mph class	620 mph class
Range	2,500 miles	Over 3,000 miles	Over 6,000 miles
Fire power	Twelve 50-cal. machine guns	20 mm cannons in tail	Four 50-cal. machine guns
Bomb load	12,800 pounds	Over 20,000 pounds	Over 20,000 pounds

* Salton Sea, Calif., Oct. 29, 1953.
Sources: 11, 46.

NAVAL AVIATION PERSONNEL[a], 1941 TO DATE

Year as of June 30	TOTAL	Pilots	Enlisted Aviation Rates	Aviation Ground Officers
1941	23,148	6,300	14,848	2,000
1944[b]	299,968	47,276	228,356	24,336
1950	91,298	12,978	76,349	1,971
1951	162,214	18,287	139,838	4,089
1952	194,730	20,944	168,486	5,300
1953	196,813[c]	22,903	163,673	4,930
1954	179,783[c]	21,316	147,670	4,725
1955[d]	165,243[c]	21,352	133,424	4,885
1956[e]	188,904	22,082	160,905	5,301

[a] Navy and Marine.
[b] Pilots as of Aug. 31; others as of October 31.
[c] Includes non-pilots in flying status and formerly designated pilots.
[d] As of January 1.
[e] As of January 31, 1956.
Sources: 84, 95.

the coming years is the quality of our aerial weapons system. This depends upon the state of U. S. technology. American aircraft and guided missiles of 1960 or 1965 may be scientific marvels, but this nation can take pride in them only if they are better than the weapons in the hands of a potential enemy.

AIRCRAFT ON HAND
1939 TO DATE

Year	U. S. Air Force				Navy Total[b]
	Total[a]	Tactical	Trainers	Transport & Other	
1939	2,546	1,647	761	138	2,098
1940	3,961	1,760	2,069	132	2,166
1941	12,297	4,477	7,340	480	5,233
1942	33,304	11,607	17,607	4,653	11,772
1943	64,232	27,448	26,051	10,733	25,588
1944	72,726	41,961	17,060	13,705	36,100
1945	44,782	26,077	7,617	11,088	29,714
1946	30,035	17,186	6,297	6,552	19,301
1947	23,814	13,118	5,714	4,982	14,976
1948	20,068	8,888	6,177	5,003	14,894
1949	17,222	7,863	5,811	3,548	14,015
1950	17,337	7,854	5,961	3,522	13,412
1951	19,021	8,135	6,556	4,330	13,213
1952	20,436	8,501	7,099	4,836	13,694
1953	22,278	9,152	7,502	5,624	13,308
1954	23,998	10,368	7,626	6,004	13,285
1955	25,000[E]	N.A.	N.A.	N.A.	13,191
1956	25,000[E]	N.A.	N.A.	N.A.	12,434

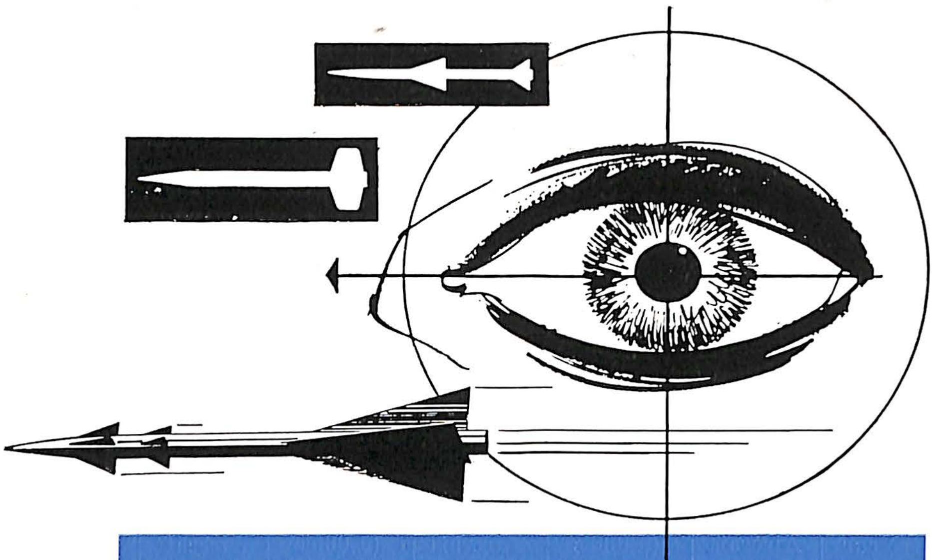
N.A.—Not available.
[a] As of December 31.
[b] As of June 30 from 1935-1939; as of December 31 from 1940 to 1952; as of June 30 from 1953-1955; as of January 1, 1956.
E Estimate.
Sources: 2, 4, 8, 12, 82, 83.

AIRCRAFT ACCEPTED BY THE USAF AND NAVY
1946 TO DATE

Calendar Year	TOTAL: Number of Aircraft	TOTAL: Airframe Weight, Excluding Spares (1,000's of Pounds)	USAF: Number of Aircraft	USAF: Airframe Weight, Excluding Spares (1,000's of Pounds)	Navy[a]: Number of Aircraft	Navy[a]: Airframe Weight, Excluding Spares (1,000's of Pounds)
1946	1,409	12,707	650[b]	7,799[b]	759	4,908
1947	2,117	11,441	1,197[b]	5,586[b]	920	5,855
1948	2,204	24,306	1,055	15,821	1,149	8,485
1949	2,290	29,604	1,475	23,149	815	6,455
1950	2,655	35,941	1,670	26,803	985	9,138
1951	5,521	51,659	4,148[b]	40,000[b]	1,373	11,659
1952	9,284	107,422	6,973[b]	88,000[b]	2,311	19,422
1953	10,630	138,396	8,204[b]	109,908[b]	2,426	28,488
1954	8,729	130,546	6,507[b]	104,653[b]	2,245	25,893
1955	8,000[E]	114,000[E]	6,000[E]	N.A.	2,000[E]	N.A.

N.A.—Not available.
E Estimate.
[a] Includes USAF acceptances for Navy, excludes Navy acceptances for USAF and Army.
[b] Includes USAF acceptances for other agencies. The duplication in acceptances accounts partly for the difference between this table and the table on page 9.

Sources: 8, 54, 82.



GUIDED MISSILES

Push button warfare has intrigued the public mind since the concept first entered the realm of possibility with the limited success of Germany's V-1 and V-2 missiles in World War II. But so far, remarked one realist a few years ago, all we have is the button.

Today, however, U. S. missile inventories are composed of more than buttons. There are nine missiles in operational status with the Air Force, Navy and Army, some of them based overseas. But push button warfare is still a long way off. Military experts estimate that manned aircraft will form the bulk of our strategic striking force for at least the next several years.

The progress of the aircraft industry in developing this new dimension of national defense—the guided missile—is incredible in the light of the problems in perfecting this weapon.

A guided missile is an unmanned craft capable of flying through space in a flight path that can be altered by a guidance system within or without the unit. Missiles are catalogued by their missions: surface-to-air, SAM; surface-to-surface, SSM; air-to-surface, ASM; and air-to-air, AAM.

The importance of missiles, even in their brief operational use during

World War II, is pointed up by General Dwight D. Eisenhower's assessment in his book, *Crusade In Europe:* "It seemed likely that, if the Germans had succeeded in perfecting and using these new weapons (V-1 and V-2 missiles) six months earlier than they did, our invasion of Europe would have proved exceedingly difficult, perhaps impossible."

Captured V-2 missiles were brought to the United States after Germany's surrender, and formed a hardware basis for the start of operations. The V-2 was far from a perfected weapon. Its behavior pattern after firing left much to be desired. Data on flight characteristics were laboriously assembled. It was only the substantial research and development efforts of industry and military that developed the knowledge to open the startling era of the missile which has produced such a profound effect on military and political thinking.

The problem of reliability is staggering. There is no opportunity to test a specific missile in the same manner that an aircraft is tested. It must work the first time; there are no repeat performances. And the very existence of our nation may well depend some day on the reliability of our missiles.

There are thousands of components involved in the operation of a missile. Engineers estimate that using only 100 components (a fraction of the actual number) each must have less than one chance in a thousand of failing if the missile is to have better than 90 per cent reliability.

A distinguished physicist, who was closely associated with such scientific achievements as proximity fuses, radar, atomic energy and rockets, made this observation about missiles: "In neither my civilian nor my military experience have I seen a problem which includes so many branches of physical science. Aerodynamics, radar, electronics, telemetering, servo-mechanisms, gyros, computers, thermodynamics, combustion, metallurgy, propulsion and chemistry must all contribute to a successful guided missile."

The aircraft industry's ability to build an object that flies through the air is not the main criterion on which its ability to build missiles is based. The prime reason is its ability in managing systems. An airplane is a system. The aircraft manufacturer is given a basic job and starts to work. He often does not produce the aluminum, manufacture the engine, make the landing gear, communications equipment or hundreds of other components that make up an airplane. Yet he manufactures the airplane. This is not merely an assembly job. The skill involved is in his ability to make all these intricate elements work together to accomplish a specific task. This is the unique qualification in missile production.

A top priority task in the missile field today is the development of an Intercontinental Ballistic Missile—the ICBM. Its mission is to deliver a thermonuclear warhead 5,000 miles, by leaving and re-entering the atmosphere in its flight. Long-range guided missiles have been under development for many years, but the warhead size imposed severe requirements in guidance, propulsion and re-entry which were beyond the state of the art. Development of light-weight, high-yield warheads simplified these technical problems and insured that thermonuclear explosives would be light and handy enough to be carried by long-range missiles of reasonable size.

Guidance Systems

The guided missile is, in light of other expendable weapons, very expensive. Measured in terms of "hits" the cost factor is largely academic. In terms of a "miss" it represents substantial loss. Probably the most expensive item in the fabrication of the weapon is its guidance system. Considering the fact that the value of the weapon, in final analysis, can only be measured in terms of its accuracy, guidance systems have become the object of most intensive research.

Guidance methods, under development and in operational use, are of two general categories—electronic and non-electronic. The non-electronic systems are, of course, far less susceptible to enemy intercept countermeasures. This type of guidance system falls into two general categories—celestial and inertial. Guidance systems of this type generally make use of several gyroscopes. As with the simple gyroscopes that may be purchased in any toy store, in physical operation, a guidance system gyroscope maintains a constant orientation on its axis in three-dimen-

FUNDS AVAILABLE FOR THE PROCUREMENT OF GUIDED MISSILES
DECEMBER 31, 1955
(Million Dollars)

	Unexpended Balance	Unpaid Obligations	Unobligated Balance
TOTAL — DEFENSE DEPARTMENT	$2,701	$1,494	$1,210
Air Force	1,363	591	772
Navy	495	298	199
Army	843	605	239

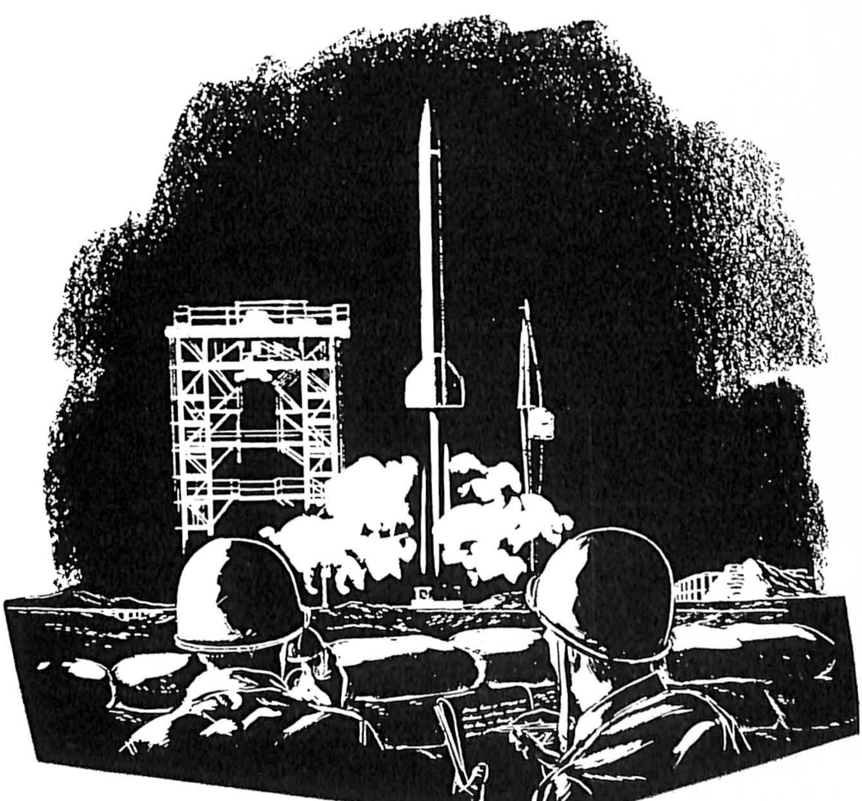
Sources: 40.

EXPENDITURES FOR THE PROCUREMENT OF GUIDED MISSILES
(Million Dollars)

Fiscal Year Ending June 30	TOTAL DEFENSE DEPARTMENT	Air Force	Navy	Army
1951	$ 21.0	$ 15.5	$ 5.1	$ .4
1952	168.9	66.4	56.1	46.4
1953	295.0	81.1	94.8	119.1
1954	503.5	175.9	141.1	186.6
1955	631.0	305.0	175.0	150.0
1956E	918.0	485.0	172.0	260.0
1957E	1,276.0	799.0	177.0	300.0

E Estimate.

Sources: 2, 41, 42.



sional space. This factor in guidance provides a reference system for guidance, and is the basis of the "inertial" system.

The system of devices enabling guidance to be controlled by automatic star tracking, eliminates any interference from surface countermeasures and is called "celestial."

The most obvious type of electronic guidance is "radar" homing on an enemy target. There are three primary types of this system. "Active" homing is accomplished by the missile's radar antennae which continually indicates the target. "Semi-active" homing is accomplished by a surface or airborne radar separate from the missile and transmitting

PLANNED OBLIGATIONS FOR RESEARCH AND DEVELOPMENT ON GUIDED MISSILES AND ON AIRCRAFT—DEPARTMENT OF DEFENSE
(Million Dollars)

Fiscal Year	Guided Missiles	Aircraft and Related Equipment
1954	$231.4	$269.8
1955	214.0	293.6
1956E	268.0	339.5
1957E	224.4	312.8

E Estimate.

Source: 49.

DEFENSE DEPARTMENT EXPENDITURES FOR THE PROCUREMENT OF GUIDED MISSILES AND AIRCRAFT
(Million Dollars)

Fiscal Year	Guided Missiles	Aircraft
1951	$ 21.0	$2,412.5
1952	168.9	4,888.4
1953	295.0	7,416.5
1954	503.5	8,937.0
1955	631.0	8,037.0
1956E	918.0	6,880.0
1957E	1,276.0	6,751.0

E Estimate.

Sources: 40, 41, 42, 49.

guidance instructions. "Passive" homing is accomplished by letting the missile home on any pre-selected electrical device that the enemy target may be operating.

Another type of guidance is the "command" system. This is a system involving both radar and radio. In one type, ground radars are pointed at the missile and at the target. A computer receives electrical information from the radars and transmits guidance to the missile. In another, the computer is built into the missile and radio contact between ground and missile is eliminated.

U. S. OPERATIONAL MISSILES

Missile	Manufacturer	Service
Air-to-Air		
Falcon	Hughes	USAF
Sparrow	Sperry	Navy
Air-to-Surface		
Petrel	Fairchild	Navy
Surface-to-Air		
Nike	Douglas & Western Electric	Army
Terrier	Convair.	Navy
Surface-to-Surface (air breathing)		
Matador	Martin	USAF
Regulus	Chance Vought	Navy
Surface-to-Surface (ballistic)		
Corporal	Firestone & Gilfillan	Army
Honest John	Douglas & Emerson Electric	Army

U. S. RESEARCH AND DEVELOPMENT MISSILE PROJECTS

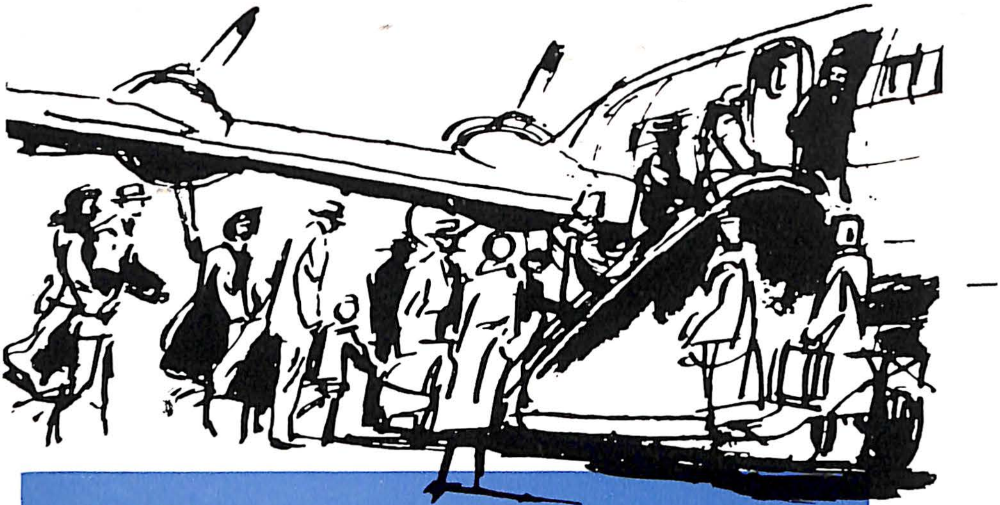
Missile	Manufacturer	Service
Atlas	Convair	USAF
Bomarc	Boeing	USAF
Jupiter	Chrysler	USA-USN
Navaho	North American	USAF
Nike B	Douglas & Western Electric	Army
Rascal	Bell	USAF
Redstone	Chrysler	Army
Snark	Northrop	USAF
Talos	Bendix	Navy
Thor	Douglas	USAF
Titan	Martin	USAF

U. S. RESEARCH MISSILE VEHICLES

Missile	Manufacturer	Service
Aerobee	Aerojet General	USN-USAF

Target Drones: Target Drones are made by Beech, Radioplane, and Ryan.

All of the above data has been officially released by USAF, Army, or Navy.



AIRLINES and TRANSPORTATION

Operations of U. S. scheduled domestic and international airlines achieved new records in every major category during 1955, and registered a significant reduction in subsidy requirement.

The domestic scheduled airlines in 1955 carried 38,026,000 passengers, an average of more than 104,180 a day. This compares with 32,343,000 passengers carried in 1954. The scheduled carriers flew 18,819,000,000 passenger miles, while the comparable railroad pullman travel amounted to 6,900,000,000 passenger miles. Public service revenues, or subsidy, dropped from $66,233,000 in 1954 to $38,407,000 in 1955, a decrease of about 42 per cent.

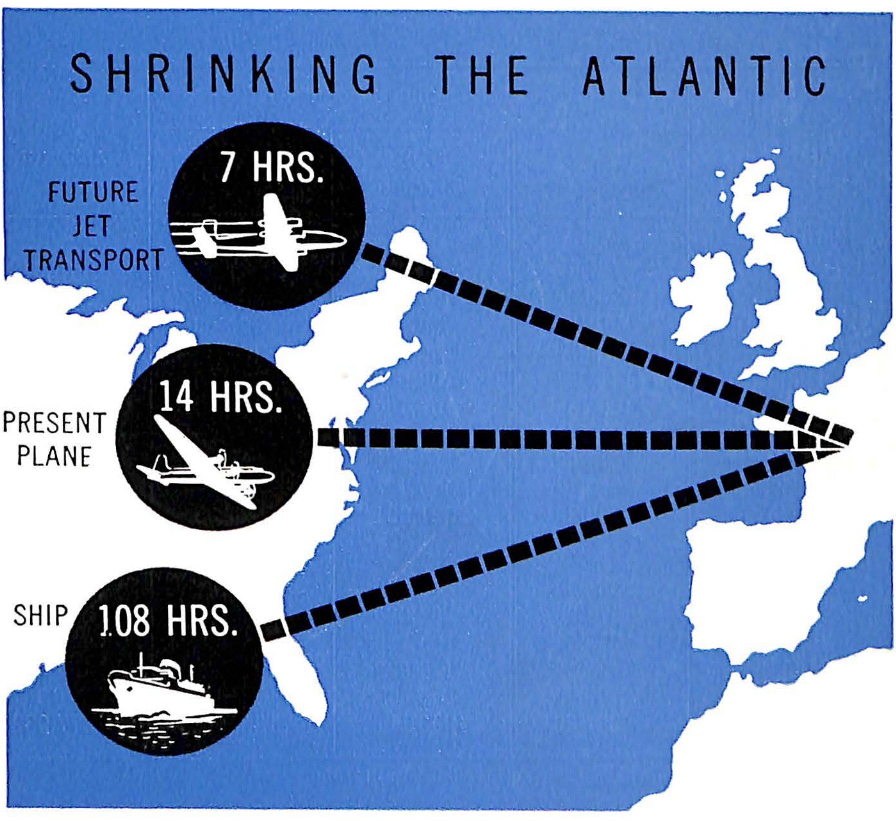
The high rate of airline activity is illustrated by the fact that between the hours of 5:00 and 6:00 p.m. during the summer months of 1955, the airlines had 665 planes in the air carrying approximately 25,000 passengers and 665,000 pounds of cargo which included mail, express and freight.

These substantial increases show that travelling Americans know a good bargain. Air fares remained at about the same rate as in 1938, when the Civil Aeronautics Act established the present system of regulated competition, but in terms of the purchasing power of 1938 dollars the fares have been reduced by 60 per cent.

Since 1938, the airlines have made great advances. The number of certificated airlines has increased from 22 to 56 and the number of employees from 13,300 to more than 111,655. Passenger miles flown by the scheduled carriers increased from 479,000,000 in 1938 to 18,819,000,000, an increase of 4,489 per cent. The number of daily schedules has increased seven times. The speed of aircraft has doubled from 180 miles per hour in 1938 to 360 miles per hour for today's aircraft.

Air Mail

Air Mail, which was a major source of revenue for the fledgling airlines when scheduled transportation was started, today accounts for only 4.2 per cent of the total revenues. The airlines, in fact, return substantial sums to the Post Office Department. The government col-



lected $142,571,000 on domestic air mail services in fiscal 1955. The airlines were paid $33,719,567 of that amount. The experiment of carrying three-cent mail by air on a space-available basis, which was started in October 1953, has expanded. Approximately 4 million pieces of first-class mail move every day by air on a space available basis. The Post Office Department estimates that delivery is 48 hours faster than when carried by surface transportation.

Equipment Program

During 1955, the air transport industry launched a $1,309,600,000 equipment program, the biggest in its history. Orders and statements of intentions to order included 135 pure turbojet transport planes at a cost of $761,300,000; 135 turboprop aircraft at a cost of $265,000,000; and 55 piston-engine planes at a total cost of $137,300,000. In addition, announced equipment-buying plans totaling another $146,000,000 will probably include orders for all three types of planes. The jet transports are scheduled for delivery in 1958. The $1,309,600,000 does not include an option for 30 additional turboprop planes.

TRANS-ATLANTIC PASSENGER TRAVEL BY AIR AND SEA, 1946 TO DATE

Year Ending June 30	By Air (Regular Scheduled)			By Sea, Passengers
	Total Passengers	U. S. Carriers	Other	
Westbound				
1946	46,475	43,953	2,522	112,943
1947	85,838	63,266	22,572	239,163
1948	126,138	89,780	36,358	314,714
1949	148,986	106,457	42,529	330,782
1950	161,091	106,908	54,183	427,113
1951	180,465	107,195	73,270	401,243
1952	194,914	114,659	80,255	458,427
1953	251,303	142,153	109,150	397,018
1954	309,648	177,124	132,524	419,559
1955	370,026	231,861	138,165	452,520
Eastbound[a]				
1950	135,804	88,020	47,784	296,996
1951	137,733	82,990	54,743	262,378
1952	177,432	100,768	76,664	308,[illegible]54
1953	245,718	143,928	101,790	354,494
1954	274,001	155,755	118,246	379,119
1955	338,163	206,111	132,052	377,932

[a] Figures for eastbound passengers not available until 1950.

Source: 65.

PASSENGER RATES,
Yield per Passenger-mile, in Cents

Type of Airline Travel	1954	1955
Domestic Trunk Line		
All classes	5.39	5.34[E]
Coach	4.26	4.36[E]
Family Plan	4.62	N.A.
All other	6.00	N.A.
Local Service	6.04	N.A.
International	6.83	6.69[E]
Territorial (excluding Alaska)	7.27	N.A.
Large Irregulars	3.20[E]	N.A.

N.A.—Not available.
E Estimate.

Sources: 2, 38.

SUMMARY OF U. S. AIR TRAFFIC TRENDS, 1948 TO DATE

Year Ending June 30	TOTAL[a]	Domestic Trunk Lines	Local Service Carriers	International Carriers	Territorial and Alaska	Other Carriers
Revenue Passenger-Miles (Millions)						
1948	7,913	5,931	64	1,868	N.A.	....
1953	18,481	13,398	371	3,261	115	1,336
1954	20,326	15,128	412	3,523	118	1,145
1955	23,836	17,770	500	4,108	124	1,334
Cargo Ton-Miles (Millions)						
1948	137	89	[b]	46	N.A.	....
1953	450	182	2	89	3	174
1954	436	190	2	97	4	143
1955	468	219	3	101	7	138
Mail Ton-Miles (Millions)						
1948	50	36	[b]	14	N.A.	....
1953	95	69	1	23	2	....
1954	107	76	1	29	1	....
1955	131	83	1	46	1	....

N.A.—Not available.
[a] "Total" may exceed the listed components because subtotals for "Not Available" items may be included.
[b] Less than one-half million.

Source: 37.

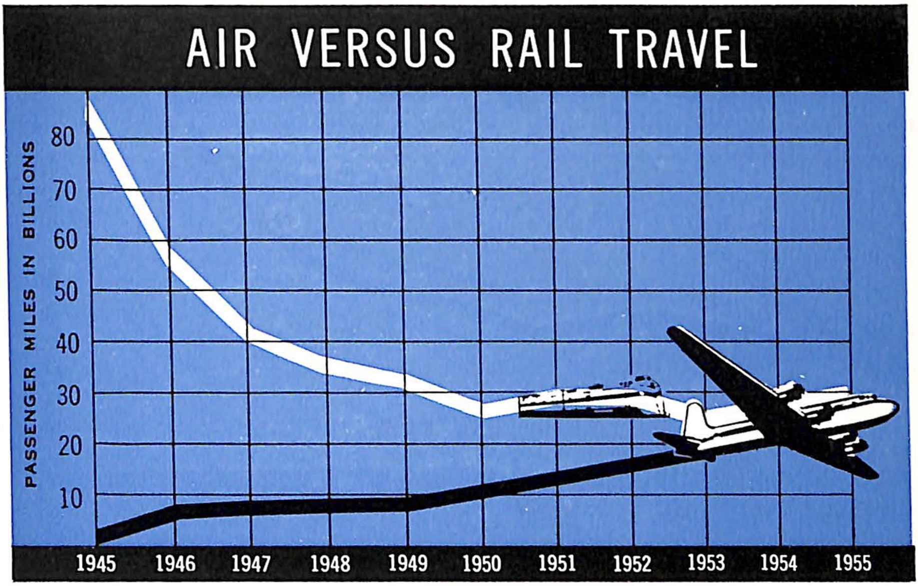
Freight and Express

Freight ton miles for the scheduled industry increased from 236,623,000 in 1954 to 280,938,000 in 1955, an increase of 18.7 per cent, while express ton miles gained from 41,175,000 in 1954 to 51,075,000 in 1955, an increase of 24 per cent. Mail ton miles went up from 118,293,000 in 1954 to 142,209,000 in 1955, an increase of about 19 per cent, and foreign mail ton miles rose nearly 7 per cent from 7,338,000 in 1954 to 7,842,000 in 1955.

EMPLOYMENT, WAGES, AND AVERAGE ANNUAL EARNINGS IN THE TRANSPORTATION INDUSTRY, 1954

	ALL INDUSTRY	ALL TRANSPORTATION	Air Transportation (Common Carrier)	Railroads	Highway Transportation	Water, Pipeline, and Other Transportation
Full-Time Equivalent Employees (Thousands)	53,311	2,562	110	1,209	926	317
Wages and Salaries (Million Dollars)	$196,244	$11,691	$562	$5,489	$4,109	$1,531
Average Annual Earnings per Full Time Employee	$3,681	$4,564	$5,109	$4,540	$4,437	$4,830

Source: 18.



DEVELOPMENT OF WORLD CIVIL AIR TRANSPORT
(Scheduled Services—International and Domestic, Excluding China and USSR)
1919 TO DATE

Year	Miles Flown (millions)	Passengers Carried (millions)	Passenger-Miles (millions)	Cargo Ton-Miles (millions)	Mail Ton-Miles (millions)	Average No. of Passengers Per Aircraft	Average Miles Flown Per Passenger
1919	1	N.A.	N.A.	N.A	N.A.	N.A.	N.A.
1929	57	N.A.	132	N.A.	N.A.	2.3	N.A.
1934	101	N.A.	405	N.A.	N.A.	4.0	N.A.
1939	185	N.A.	1,262	N.A.	N.A.	6.8	N.A.
1944	257	N.A.	3,412	N.A.	N.A.	13.3	N.A.
1949	836	26.5	14,478	390	128	17.3	546
1954	1,265	59.0	32,620	760	223	25.8	553
1955	1,407	69.0	38,530	907	257	27.4	559

N.A.—Not available.

Sources: 55, 59, 60, 96.

Air Traffic Control

A major problem facing the air transport industry is the vanishing air space for flight operations. Air space is becoming a critical problem as more and more aircraft, flying at greater speeds, use it. The government has completed a report on the subject and a Special Assistant for Aviation Facilities Planning, who reports to the President, was appointed to develop an air traffic control system suited for the nation's future needs.

AVERAGE PASSENGER LOADS, 1939 TO DATE
(Passenger-Miles per Vehicle-Mile)

Year	RR Coaches	Sleeping & Parlor Cars	All RR Passenger Cars	Class I Inter-City Busses	Scheduled Domestic Airliners
1939	**17.0**	**9.3**	**13.4**	**16.4**	**7.9**
1944	**41.0**	**20.3**	**31.9**	**24.9**	**15.2**
1949	**23.6**	**11.0**	**18.1**	**18.4**	**19.2**
1953	23.7	10.1	17.7	18.3	29.2
1954[E]	23.2	9.7	17.5	18.1	30.5

E Estimate.

Sources: 2, 62.

THE TEN LEADING PASSENGER TRANSPORT COMPANIES
(Millions of Revenue Passenger Miles[a])

1955		1954	
American Airlines	4,266	Pennsylvania Railroad	3,447
United Air Lines	3,754	American Airlines	3,372
Eastern Air Lines	3,342	United Air Lines	3,135
Pennsylvania Railroad	3,324	New York Central System	3,041
New York Central System	2,897	Eastern Air Lines	2,847
Trans World Airlines	2,866	Trans World Airlines	2,611
Atchison, Topeka & Santa Fe Railway System	1,943	Atchison, Topeka & Santa Fe Railway System	1,948
Union Pacific Railroad Company	1,437	Union Pacific Railroad Company	1,459
Southern Pacific Company	1,295	Southern Pacific Company	1,342
New York, New Haven & Hartford Railroad Company	1,208	New York, New Haven & Hartford Railroad Company	1,274

[a] Excludes commuters and multiple ride passengers.
Note: Data do not include foreign operations of the airlines.

Sources: 38, 61.

U. S. SCHEDULED AIRLINES—AIRCRAFT IN SERVICE BY MAKE AND MODEL
1941 TO DATE

Domestic

Aircraft Make & Model	1941	1952	1953	1954	1955
Bell					
B47D, G	..	6	6	6	7
Boeing					
247D	27	..	..	..	..
307	5	..	..	..	..
377	..	16	16	11	10
Convair					
240	..	99	90	92	93
340	..	25	103	121	123
Douglas					
DC-3, 3S	280	381	331	299	301
DC-4	..	124	126	109	100
DC-6, 6B	..	161	175	185	190
DC-7	..	..	10	61	77
Lockheed					
10	16	..	..	..	..
18	13	11	11	11	9
L49	..	37	37	37	44
649	..	5	5	3	..
749	..	59	62	62	58
1049	..	24	31	37	61
Martin					
2-0-2	..	21	25	25	19
4-0-4	..	96	100	100	100
Sikorsky					
S51	..	3	3	3	2
S55	..	5	8	11	10
Vickers					
744	..	..	..	..	8
TOTAL	341	1078	1139	1175	1212
Single Eng.	..	9	17	20	19
Twin Eng.	336	643	660	648	645
Four Eng.	3	426	462	507	548

International[a]

Aircraft Make & Model	1941	1952	1953	1954	1955
Boeing					
307	3	..	..	..	..
314	8	..	..	..	..
377	..	28	27	27	26
Convair					
240	..	14	14	10	5
Douglas					
DC-2	3	..	..	..	..
DC-3	45	21	24	22	18
DC-4	..	46	45	31	28
DC-6, 6A, 6B	..	25	42	62	60
DC-7	..	..	..	..	5
Lockheed					
10	2	..	..	..	..
18	3	..	..	..	..
L49	..	14	9	9	5
Martin					
130	1	..	..	..	..
Sikorsky					
S42B	4	..	..	..	..
S43	1	..	..	..	..
TOTAL	70	148	161	161	147
Twin Eng.	54	35	38	32	23
Four Eng.	16	113	123	129	124

[a] Excludes certain aircraft used in both domestic and international operations
Sources: 32, 35.

Military Air Travel

Movement of military personnel by scheduled carriers produced a net gain to the government of $9,800,000 in terms of per diem payable and the base pay of a private. The savings in man-hours of productive time amounted to 20,165,301. The airlines provided during 1955 more than 843,900,000 passenger miles of transportation to the various military agencies. In addition, the airlines through the Civil Reserve Air Fleet maintain a fleet of aircraft to aid in national emergencies. The fleet is composed of 45 per cent of the airlines' biggest and fastest airliners now flying in scheduled service. The fleet has an airlift capacity estimated at 566,000 available ton-miles an hour.

AIRCRAFT IN SERVICE ON WORLD AIRLINES
(Members of International Air Transport Association—Dec. 31, 1954)

Aircraft by Country in Which Manufactured	Number of Aircraft		Percent of Total
GRAND TOTAL	2,476		100.0
Made in the United States	2,143		86.6
DC-7		59	
DC-6		335	
DC-4		223	
DC-3		727	
Constellation		265	
Convair 340		141	
Convair 240		136	
Stratocruiser and Stratoliner		56	
Martin 4-0-4 and 2-0-2		118	
All other		83	
Made in Great Britain	252		10.2
Viking		39	
Viscount		43	
Bristol 170-171		31	
DH Dragon Rapide		25	
DH Heron		27	
All other		87	
Made in Canada	53		2.1
Made in other countries	28		1.1

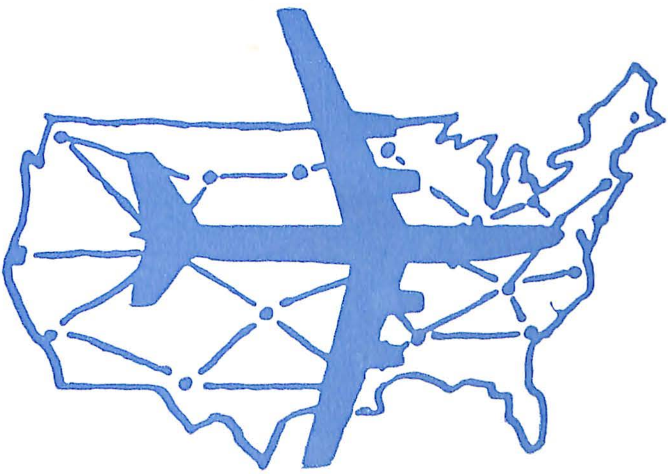
Source: 58.

ESTIMATED INTERCITY PASSENGER TRAFFIC, BY TYPE, 1916 TO DATE

Year	TOTAL	Domestic Air Carriers	Railroads[a]	Highways	Inland Waterways
Billions of Passenger-Miles					
1916	36.0	[b]	35.2	[b]	.8
1939	270.7	.7	22.7	245.9	1.5
1941	310.6	1.4	29.4	278.0	1.8
1944	233.9	2.2	95.7	134.1	1.9
1947	351.3	6.1	46.0	297.4	1.8
1951	449.2	11.7	35.3	400.8	1.4
1954	591.2	17.9	29.4	542.2	1.7
1955	640.0[E]	19.8	28.5	590.0[E]	1.7[E]
Percent					
1916	100.0	[b]	97.8	[b]	2.2
1939	100.0	.3	8.4	90.8	.5
1941	100.0	.4	9.5	89.5	.6
1944	100.0	1.0	40.9	57.3	.8
1947	100.0	1.7	13.1	84.7	.5
1951	100.0	2.6	7.9	89.2	.3
1954	100.0	3.0	5.0	91.7	.3
1955	100.0	3.1	4.4	92.2	.3

[a] Includes commutation and electrified divisions of steam railway companies, but excludes electric railways.
[b] Negligible.

Sources: 13, 15, 29, 32, 61.



Domestic Airmail Rates, Since 1918

Effective Date	Rate	Note
1918, May 15	24¢ per ounce or fraction	10¢ of this for special delivery
July 15	16¢ for first ounce or fraction	10¢ of this for special delivery
Dec. 15	6¢ per ounce or fraction	
1919, July 18	2¢ per ounce	
1924, July 1	8¢ per ounce or fraction per zone	3 zones established
1925, July 1	10¢ per ounce or fraction	Overnight airmail New York-Chicago
1926, Jan. 19	10¢ per ounce for fraction up to 1,000 miles	More for greater distances
Sep. 4-11	Special rates for special services	Varying from 8 to 32¢
1927, Feb. 1	10¢ per half ounce or fraction	Zoning abandoned
1928, Aug. 1	5¢ for first ounce or fraction	
1932, July 6	8¢ for first ounce or fraction	
1934, July 1	6¢ per ounce or fraction	
1944, Mar. 26	8¢ per ounce or fraction	Overseas mail to servicemen 6¢ per half ounce
1946, Oct. 1	5¢ per ounce or fraction	
1949, Jan. 1	6¢ per ounce or fraction 4¢ per postal card or post card	
1953, Oct. 6		Starting October 6, 1953 experimental airlift of 3c mail on a "space available" on aircraft basis between Washington-New York-Chicago.

Sources: 63, 88.

Transportation Accident Death Rates 1954

Kind of Transportation	Passenger Miles (Millions)	Deaths	Death Rate per 100,000,000 Passenger Miles
Passenger Deaths in—			
passenger automobiles and taxis	850,000	22,500	2.6
busses	55,000	60	0.11
railroad passenger trains	29,320	23	0.08
scheduled air transport planes	17,390	16	0.09
All Deaths connected with the operation of			
passenger automobiles and taxis	850,000	31,000	3.6
busses	55,000	480	0.9
railroad passenger trains	29,320	998	3.4
scheduled air transport planes	17,390	25	0.14

Source: 79.

DOMESTIC SCHEDULED AIRLINES—OPERATORS, EQUIPMENT, AND SPEED
1926 TO DATE

As of December 31	Operators	Aircraft in Service	Average Available Seats	Route Mileage Operated	Average Speed, M.P.H.	Passenger Fatalities per Million Passenger-Miles Flown
1926	13	N.A.	N.A.	N.A.	N.A.	N.A.
1927	18	N.A.	N.A.	N.A.	N.A.	N.A.
1928	34	268	N.A.	N.A.	N.A.	N.A.
1929	38	442	N.A.	N.A.	N.A.	N.A.
1930	43	497	N.A.	30,293	N.A.	N.A.
1931	39	490	N.A.	30,857	N.A.	N.A.
1932	32	456	6.61	28,956	N.A.	N.A.
1933	25	418	7.59	28,283	N.A.	N.A.
1934	24	423	8.86	28,609	N.A.	N.A.
1935	26	363	10.33	29,190	N.A.	N.A.
1936	24	280	10.67	29,797	N.A.	N.A.
1937	22	291	12.52	32,006	N.A.	N.A.
1938	16	260	13.91	34,879	N.A.	4.5
1939	18	276	14.66	36,654	N.A.	1.2
1940	19	369	16.54	42,757	N.A.	3.0
1941	19	370	17.54	45,163	N.A.	2.3
1942	19	186	17.91	41,596	N.A.	3.7
1943	19	204	18.34	42,537	N.A.	1.3
1944	19	288	19.05	47,384	155.6	2.2
1945	20	421	19.68	48,516	155.4	2.2
1946	24	674	25.25	53,981	160.2	1.2
1947	28	810	29.93	62,215	168.2	3.2
1948	31	878	32.37	67,702	171.9	1.3
1949	37	913	35.03	72,667	179.0	1.3
1950	38	960	37.47	77,440	181.2	1.1
1951	38	981	39.55	78,913	184.6	1.3
1952	35	1,078	42.71	77,894	190.8	0.4
1953	32	1,139	46.07	78,384	197.8	0.6
1954	32	1,175	50.06	78,294	205.8	0.1
1955	31	1,212	51.62	78,992	209.0	0.8[E]

E Estimate.
N.A.—Not available.
Sources: 32, 38.

AIR VS. RAILROAD PASSENGER TRAVEL
1937 TO DATE
(Passenger-Miles in Billions)

Year	Domestic Air Carriers			Railroads (excluding Commutation)			Air as Percent of Railroad
	TOTAL	Scheduled	Irregular	TOTAL	Pullman	Coach	
1937	.4	.4	—	21.6	9.2	12.4	1.9
1938	.5	.5	—	18.5	8.3	10.2	2.7
1939	.7	.7	—	19.6	8.5	11.1	3.6
1940	1.1	1.1	—	20.7	8.2	12.5	5.3
1941	1.4	1.4	—	26.2	10.1	16.1	5.3
1942	1.4	1.4	—	50.0	19.1	30.9	2.8
1943	1.6	1.6	—	83.8	25.9	57.9	1.9
1944	2.2	2.2	—	91.7	28.3	63.4	2.4
1945	3.4	3.4	—	86.7	27.3	59.4	3.9
1946	6.0	5.9	N.A.	59.7	20.7	39.0	10.1
1947	6.3	6.1	N.A.	41.2	13.5	27.7	15.3
1948	6.3	6.0	N.A.	36.5	12.2	24.3	17.3
1949	7.4	6.8	.6	30.8	10.5	20.3	24.0
1950	8.8	8.0	.8	26.6	9.2	17.4	33.1
1951	11.7	10.6	1.1	29.4	9.9	19.5	39.8
1952	13.8	12.5	1.3	29.1	9.3	19.8	47.4
1953	16.1	14.8	1.3	27.2	8.2	19.0	59.2
1954	17.9[E]	16.8	1.1[E]	25.0	7.3	17.7	70.4
1955	20.9[E]	19.8	1.1[E]	24.2	6.9	17.3	86.4

E Estimate.
N.A.—Not available.
Sources: 2, 32, 38, 61.

AMERICA'S TRANSPORTATION NETWORK
(Thousands of Miles)

Medium of Transportation	1930	1954
Airways — Domestic	30	78
Railroads — Road Owned	249	221
Total Rural Roads	3,009	3,030
Surfaced	649	1,906
Federal-Aid Primary Highways	193	234
Petroleum Pipelines	89	139
Waterways and Great Lakes	28	23

Sources: 2, 13, 29, 30, 32, 39, 64.

AVERAGE REVENUE PER PASSENGER-MILE, 1926 TO DATE
(Cents)

Year	AIRLINES		RAILROAD		INTER-CITY BUS
	Domestic Scheduled	Domestic Non-Scheduled	Coach (Excluding Commuter)	Pullman (Total)	
1926	12.0	—	3.35	N.A.	2.96
1937	5.6	—	1.80	3.08	1.73
1947	5.1	—	2.02	3.53	1.70
1952	5.55	3.20	2.53	4.60	2.02
1953	5.45	3.20	2.53	4.68	2.06
1954	5.39	3.20[E]	2.50	4.66	2.06
1955	5.34[E]	3.20[E]	2.47	4.62	2.07

N.A.—Not available.
E Estimate.
Sources: 2, 4, 38, 62, 77.

U. S. INTERNATIONAL SCHEDULED AIRLINES—OPERATORS, EQUIPMENT, SPEED, 1928 TO DATE

As of December 31	Operators	Aircraft in Service	Average Available Seats	Route Miles Operated (thousands)	Average Speed M.P.H.	Passenger Fatalities per Million Passenger-Miles Flown
1928	1	57	N.A.	N.A.	N.A.	N.A.
1929	4	83	N.A.	N.A.	N.A.	N.A.
1930	3	103	N.A.	19.2	N.A.	N.A.
1931	3	100	N.A.	19.5	N.A.	N.A.
1932	3	108	N.A.	19.6	N.A.	N.A.
1933	3	86	N.A.	19.4	N.A.	N.A.
1934	2	99	N.A.	22.2	N.A.	N.A.
1935	2	101	N.A.	31.3	N.A.	N.A.
1936	2	94	N.A.	32.0	N.A.	N.A.
1937	2	92	N.A.	32.0	N.A.	N.A.
1938	2	73	16.9	35.0	N.A.	13.0
1939	2	84	17.7	43.5	N.A.	12.8
1940	3	68	18.3	52.3	N.A.	N.A.
1941	3	83	18.0	N.A.	N.A.	1.2
1942	3	68	17.7	N.A.	N.A.	N.A.
1943	3	70	17.5	27.2	N.A.	3.9
1944	3	70	18.5	29.7	149.2	5.3
1945	4	97	18.9	38.9	150.7	3.7
1946	9	147	27.2	66.4	166.3	3.5
1947	12	154	35.2	95.5	191.1	1.1
1948	13	175	35.1	105.9	198.5	1.0
1949	13	177	36.6	109.0	207.1	N.A.
1950	12	160	41.0	106.4	218.4	2.1
1951	12	140	46.4	108.8	223.5	1.1
1952	13	148	49.1	110.5	226.8	3.0
1953	14	161	52.3	112.3	229.9	0.1
1954	15	161	56.9	111.8	N.A.	N.A.
1955	15	147	57.03	114.0	245.4	0.04[E]

E Estimate.
N.A.—Not available.
Sources: 32, 38.

U. S. INTERNATIONAL SCHEDULED AIRLINES—PASSENGER SERVICE
1929 TO DATE

Year	Passengers Carried[a] (Thousands)	Passenger Seat-Miles Flown (Millions)	Revenue Passenger-Miles Flown[b] (Millions)	Revenue Passenger Load Factor (Percent)	Average Passenger Revenue per Passenger Mile (Cents)	Average Length of Trip (Miles)
1929	11.5	N.A.	N.A.	N.A.	N.A.	N.A.
1930	33.0	N.A.	18.6	N.A.	N.A.	464
1931	59.2	N.A.	14.2	N.A.	N.A.	238
1932	71.5	N.A.	20.8	N.A.	N.A.	289
1933	74.4	N.A.	25.0	N.A.	N.A.	315
1934	96.8	N.A.	36.8	N.A.	N.A.	351
1935	111.3	N.A.	46.0	N.A.	N.A.	381
1936	87.7	N.A.	41.8	N.A.	N.A.	414
1937	112.3	N.A.	53.7	N.A.	N.A.	416
1938	N.A.	116.1	53.2	45.83	8.33	487
1939	136.1	134.4	71.8	53.46	8.57	557
1940	170.2	175.5	99.8	56.88	8.83	614
1941	235.8	248.3	162.8	65.57	8.61	713
1942	276.2	313.1	237.0	75.68	8.85	880
1943	292.9	307.5	244.2	79.42	7.92	874
1944	356.7	391.3	310.6	79.37	7.82	910
1945	493.5	583.4	448.0	76.78	8.67	942
1946	1,066.4	1,553.7	1,100.7	70.85	8.31	1,057
1947	1,359.7	2,924.3	1,810.0	61.90	7.77	1,332
1948	1,372.9	3,292.3	1,889.0	57.38	8.01	1,376
1949	1,520.1	3,624.7	2,054.0	56.67	7.72	1,351
1950	1,675.5	3,695.4	2,206.4	59.71	7.28	1,316
1951	2,041.8	4,327.7	2,599.8	60.08	7.10	1,273
1952	2,365.5	4,850.9	3,021.0	62.28	7.04	1,277
1953	2,700.4	5,472.5	3,385.6	61.87	6.87	1,254
1954	2,875.0	6,288.0	3,750.0	59.63	6.79	1,314
1955	3,415.0	7,029.0	4,419.0	62.87	6.69[E]	1,294

[E] Estimate.
N.A.—Not available.
[a] 1929-1946: Total passengers; 1947 to date: Revenue passengers only.
[b] 1930-1937: Total passenger-miles; 1938 to date: Revenue passenger-miles.

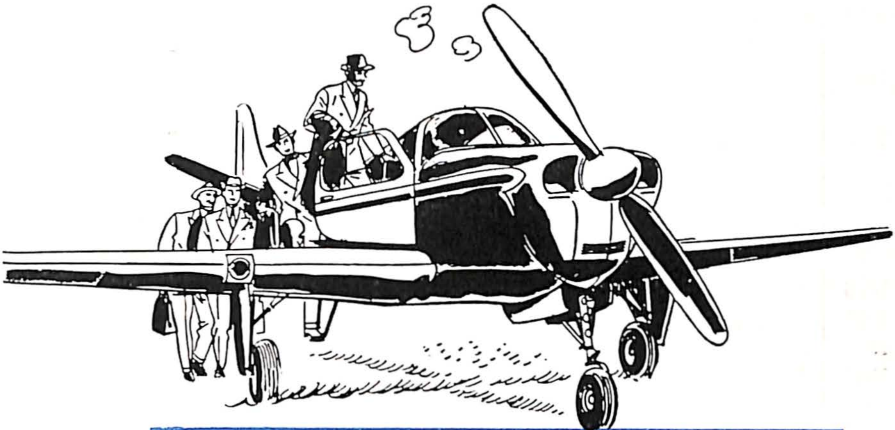
Sources: 32, 38.

DOMESTIC SCHEDULED AIRLINES—PASSENGER SERVICE, 1926 TO DATE

Year	Passengers Carried[a] (Thousands)	Passenger Seat-Miles Flown (Millions)	Revenue Passenger-Miles Flown[b] (Millions)	Revenue Passenger Load Factor (Percent)	Average Passenger Revenue per Passenger-Mile (Cents)	Average Length of Trip (Miles)
1926	5.8	N.A.	1.0	N.A.	N.A.	N.A.
1927	8.7	N.A.	3.0	N.A.	N.A.	N.A.
1928	48.3	N.A.	13.0	N.A.	11.0	N.A.
1929	161.9	N.A.	41.0	N.A.	12.0	N.A.
1930	384.5	N.A.	85.1	N.A.	8.3	221
1931	472.4	N.A.	107.0	N.A.	6.7	226
1932	476.0	303.6	127.4	N.A.	6.1	268
1933	502.2	373.8	174.8	N.A.	6.1	348
1934	475.5	367.8	189.9	N.A.	5.9	399
1935	678.5	577.7	316.3	N.A.	5.7	415
1936	931.7	686.2	439.0	N.A.	5.7	421
1937	985.1	836.2	411.5	49.22	5.6	418
1938	1,197.1	951.5	479.8	50.43	5.2	401
1939	1,734.8	1,215.2	682.9	56.20	5.1	394
1940	2,802.8	1,817.1	1,052.2	57.90	5.1	375
1941	3,848.9	2,341.9	1,384.7	59.13	5.0	360
1942	3,136.8	1,963.6	1,418.0	72.22	5.3	452
1943	3,019.7	1,857.0	1,634.1	88.00	5.3	541
1944	4,046.0	2,436.8	2,178.2	89.39	5.4	538
1945	6,476.3	3,815.6	3,362.5	88.12	5.0	511
1946	12,213.4	7,556.5	5,948.0	78.71	4.6	487
1947	12,890.2	9,373.8	6,109.5	65.12	5.1	474
1948	13,168.1	10,385.1	5,981.0	57.59	5.8	454
1949	15,080.7	11,672.9	6,752.6	57.85	5.8	448
1950	17,343.7	13,064.5	8,002.8	61.26	5.6	461
1951	22,652.2	15,565.7	10,566.2	67.88	5.6	466
1952	25,009.8	19,098.0	12,528.3	65.60	5.6	501
1953	28,721.0	23,263.2	14,760.3	63.45	5.5	514
1954	32,343.0	26,851.4	16,768.7	62.45	5.4	518
1955	38,026.0	31,299.0	18,819.0	62.29	5.3[E]	521

E Estimate.
N.A.—Not available.
[a] 1926-1934: Duplicated revenue and nonrevenue passengers. 1935-1941: Duplicated revenue passengers. 1942 to date: Unduplicated revenue passengers.
[b] 1926-1936: Includes nonrevenue passenger-miles.

Sources: 32, 38.



GENERAL UTILITY AVIATION

General utility aviation, once considered only an interesting sidelight to airline operations, has made spectacular strides since the end of World War II. For example, general aviation flies three times as many hours as the commercial airlines and of the total U. S. active civil air fleet of 60,400 planes, it accounts for all but 1,500 aircraft used by airlines. The domestic airlines flew an estimated 3,200,000 hours in 1955; Civil Aeronautics Administration estimates that general utility aviation flew 9,500,000 hours.

During recent years there has been a dramatic increase in the production and use of single and multi-engine aircraft for business, industry and agriculture. The utility aircraft industry shipped 4,434 units valued at $68,258,000 in 1955, compared with deliveries of 3,071 units valued at $43,461,000 in 1954. This is a 44 per cent increase in units and a 57 per cent increase in dollar value.

The six principal areas covered by general utility aviation are: business, industry, agriculture, aerial taxis and pleasure or sport. The executive aircraft, which is widely used by businessmen, has had a profound effect on American business. Before World War II, most U. S. industries operated centralized organizations. During the last two decades, how-

AIDS TO AIR NAVIGATION, 1926 TO DATE

Year	Civil Airways Mileage		Radio Range Stations		Non-directional Radio Beacons	Federally Operated Traffic Control Facilities		Interstate Airways Communication Stations	Combined Station Towers
	Controlled Airways	Direct VOR Airways	Low and Medium Frequency	Very High Frequency		Airport Towers	Airway Centers		
1926	2,041	—	—	—	—	—	—	—	—
1931	17,152	—	47	—	46	—	—	—	—
1936	22,245	—	146	—	57	—	—	203	—
1941	36,062	—	323	8	48	—	14	415	—
1946	44,145	—	364	50	74	115	29	397	—
1951	74,424	—	375	385	152	157	31	427	34
1953	72,097	54,490	368	392	181	115	31	395	53
1954	69,359	64,995	346	403	170	104	31	376	70
1955	67,770	81,209	344	424	175	100	31	364	75

Sources: 32, 35.

ever, there has been a strong trend toward decentralized operations. This trend has generated a demand for faster means of travel. Today's businessman cannot spend three or four days travelling to do one or two days of productive work. Through use of the executive aircraft, he can double and often quadruple his productivity.

General aviation also has brought about a revolution in agriculture. The Department of Agriculture and the Civil Aeronautics Administration estimate that aerial application of insecticides and fungicides and fertilizers adds about $3,000,000,000 annually to the farm income and protects millions of potential board feet of lumber in our national forests.

Business flying alone accounted for 4,300,000 hours in 1955 compared with 1,068,000 hours in 1946, a four-fold increase. The wide and growing

LANDING AIDS TO AIR NAVIGATION, 1941 TO DATE

Calendar Year	Instrument Landing Systems	Precision Approach Radar	Airport Surveillance Radar
1941	1	—	—
1946	31	—	—
1951	97	10	10
1952	120	10	10
1953	143	10	17
1954	153	10	28
1955	157	10	31

Sources: 32, 35.

use of business aircraft demonstrates that industry is able to justify their operation economically.

This steady growth is due to three principal factors:

1. Its worth as a profitable tool of business.
2. Improvement of the aircraft.
3. Ability of the user to obtain greater utilization.

CERTIFICATED CIVIL PILOTS AND STUDENT PILOTS, 1927 TO DATE

As of December 31	Certificated Airplane Pilots				Student Pilot Approvals During Year	Glider Pilots
	TOTAL PILOTS	Airline Transport	Commercial	Private		
1927	1,572	[a]	N.A.	N.A.	545	—
1928	4,887	[a]	N.A.	N.A.	9,717	—
1929	10,287	[a]	6,053	4,162	20,400	—
1930	15,280	[a]	7,847	7,433	18,398	178
1931	17,739	[a]	8,513	9,226	16,061	267
1932	18,594	330	7,967	10,297	11,325	209
1933	13,960	554	7,635	5,771	12,752	149
1934	13,949	676	7,484	5,789	11,994	109
1935	14,805	736	7,362	6,707	14,572	145
1936	15,952	842	7,288	7,822	17,675	138
1937	17,681	1,064	6,411	10,206	21,770	161
1938	22,983	1,159	7,839	13,985	15,556	172
1939	33,706	1,197	11,677	20,832	29,839	170
1940	69,829	1,431	18,791	49,607	110,938	138
1941	129,947	1,587	34,578	93,782	93,366	160
1942	166,626	2,177	55,760	108,689	93,777	211
1943	173,206	2,315	63,940	106,951	36,802	1,435
1944	183,383	3,046	68,449	111,888	51,276	2,412
1945	296,895	5,815	162,873	128,207	77,188	2,438
1946	400,061	7,654	203,251	189,156	173,432	N.A.
1947	433,241[b]	7,059[b]	181,912[b]	244,270[b]	192,924	2,995[b]
1948	491,306[c]	7,762[c]	176,845[c]	306,699[c]	117,725	3,143[c]
1949	525,174	9,025	187,769	328,380	49,575	3,291
1950	[d]	[d]	[d]	[d]	44,591	[d]
1951	580,574	10,813	197,900	371,861	45,003	3,300
1952	581,218	11,357	193,575	376,286	30,537	3,365
1953	585,974	12,757	195,363	377,854	37,397	3,402
1954	613,695	13,341	201,441	398,913	43,393	3,512

N.A.—Not available.
[a] Airline Transport Rating became effective May 5, 1932.
[b] As of April 1, 1948.
[c] As of May 1, 1949.
[d] No survey made.
Sources: 32, 35.

There are four main types of aircraft used in general aviation:

1. Small one- and two-place aircraft with 65 to 150 horsepower engines, and speeds of from 70 to 125 miles per hour. They are used for instruction, light agricultural use and sport flying.
2. Three- and four-place aircraft powered with engines from 125 to 200 horsepower. They have cruising speeds of 120 miles per hour or more, an endurance of three to four hours without refueling,

HOURS FLOWN BY UTILITY AIRCRAFT, 1931 TO DATE

Calendar Year	TOTAL (Thousands of Hours)	Instructional		Commercial[a]		Business[b]		Pleasure, etc.	
		Hours 000's	Percent	Hours 000's	Percent	Hours 000's	Percent	Hours 000's	Percent
1931	1,083	307	28.3	281	25.9	152	14.1	343	31.7
1941	4,460	2,816	63.1	511	11.5	250	5.6	883	19.8
1951	8,451	1,902	22.5	1,584	18.8	2,950	34.9	2,015	23.8
1952	8,186	1,503	18.4	1,727	21.1	3,124[c]	38.2	1,832	22.3
1953	8,527	1,248	15.0	1,649	19.0	3,626	42.0	2,004	24.0
1954	8,963	1,292	14.4	1,829	20.4	3,875	43.2	1,967	22.0
1955	9,500[E]	NA	NA	NA	NA	4,300[E]	NA	NA	NA

[a] Includes contract, industrial, and commercial agricultural flying.
[b] Includes flying for corporate or executive purposes as well as flying on personal business
[c] Company Business 2.1 million hours; Individual Business 1.0 million hours.
E Estimate.
Sources: 2, 31.

PUBLIC AIRPORTS BY LENGTH OF RUNWAY AND REGION, JANUARY 1, 1956

Region	TOTAL	Airports by Length of Runway (in feet)						
		0-2,999	3,000-3,499	3,500-4,199	4,200-4,999	5,000-5,899	5,900-6,999	7,000-& over
TOTAL	2,713	1,196	342	377	209	337	85	167
New England	119	62	4	21	11	12	2	7
Middle Atlantic	293	192	33	26	14	20	2	6
East North Central	510	285	89	70	18	30	6	12
West North Central	424	216	62	62	24	28	8	24
South Atlantic	321	112	36	40	33	73	5	22
East South Central	111	37	18	20	13	14	1	8
West South Central	323	109	41	61	34	43	16	19
Mountain	294	50	23	46	35	69	28	43
Pacific	318	133	36	31	27	48	17	26

Source: 32.

and are extensively used in all categories of general aviation.

3. Four- to five-place aircraft, with from 175 to 300 horsepower. They cruise at speeds ranging from 125 to 200 miles per hour and are used as executive aircraft.
4. Four- to ten-place, multi-engine aircraft with 150 to 500 horsepower engines. They have a cross-country speed of from 150 to 250 miles per hour, four to seven hours endurance, and are able to duplicate airline type performance and operate in marginal weather.

Apart from the daily use of the general aviation fleet in routine business, industry, and agriculture, this fleet of thousands of light aircraft provides a reserve of transportation which could be vital. Under the conditions which would result from atom bombing, it is reasonable to assume that the usual surface transportation would be either at a stand-still or badly disrupted for many hours following such an attack. But the air lanes would still be open. Light aircraft capable of landing in small areas under emergency conditions could become the chief link between life and death, bringing the supplies and providing the communications necessary to re-establish devastated areas.

CIVIL AIRPLANE PRODUCTION

1937–1945, by Number of Engines and Places

Year	Total Production	By Number of Engines		Landplanes, by Place		
		Single	Multi	1–2	3–5	Over 5
1937	2,289[a]	2,171	118	1,668	460	105
1938	1,823	1,770	53	1,487	258	42
1940	6,785	6,562	167	5,527	1,031	140
1945	2,047	1,946	101	1,929	17	73

1946 to Date, by Type of Use and Number of Places

Year	Total Production	By Type of Use		By Place		
		General	Transports	1–2	3–5	Over 5
1946	35,001	34,568	433	30,766	3,802	433
1948	7,302	7,039	263	3,302	3,737	263
1950	3,520	3,391	129	1,029	2,362	129
1951	2,477	2,279	198	614	1,661	202
1952	3,509	3,057	452	3,056		453
1953	4,134	3,825	309	3,822		312
1954	3,389	3,098	291	2,982		407
1955	4,820	4,575	245	3,586		448

N.A.—Not available.

[a] Civil airplane production shown here differs from that on pp 8 & 9. Recent CAA revision of total civil airplane production not yet carried through all breakdowns.

Sources: 23, 32.

Total Civil Aircraft, 1928 to Date

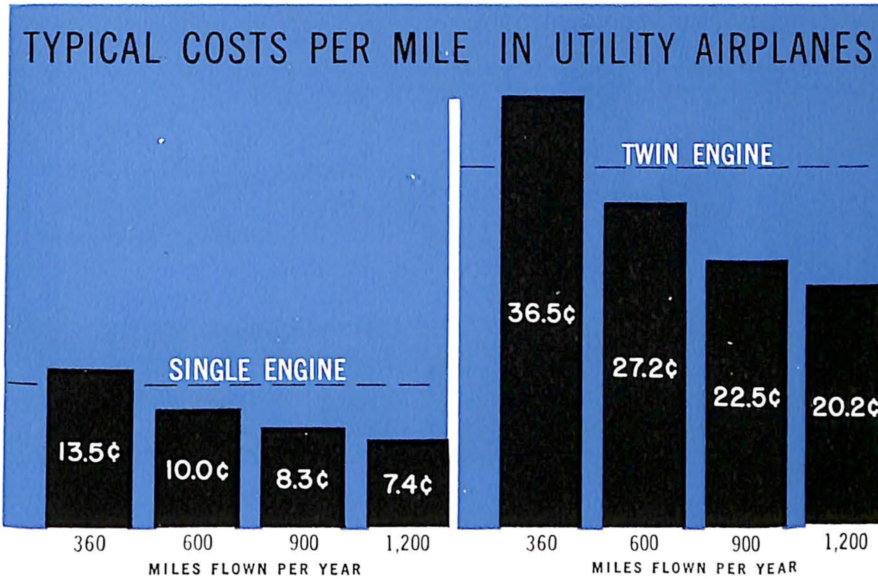
As of January 1	Total	Active	Inactive
1928	2,740	N.A.	N.A.
1932	10,680	N.A.	N.A.
1935	8,322	N.A.	N.A.
1941	26,013	N.A.	N.A.
1951	92,809	60,921	31,888
1952	88,545	54,039	34,506
1955	92,067	58,994	33,073
1956	85,320	60,432	24,888

N.A.—Not available.
E Estimate.
Sources: 32, 35.

Civil Aircraft by States, January 1, 1955

State	Total	Active	Inactive	State	Total	Active	Inactive
Total	92,067	58,994	33,073				
Alabama	718	445	273	Nebraska	1,737	1,287	450
Arizona	1,258	707	552	Nevada	476	288	188
Arkansas	1,104	636	468	New Hampshire	221	127	94
California	10,635	6,311	4,324	New Jersey	1,960	1,158	802
Colorado	1,250	816	434	New Mexico	830	551	279
Connecticut	685	428	257	New York	4,598	2,926	1,672
Delaware	210	135	75	North Carolina	1,615	1,032	583
District of Columbia	512	310	202	North Dakota	1,148	682	466
				Ohio	4,436	2,836	1,600
Florida	2,743	1,359	1,384	Oklahoma	1,958	1,313	645
Georgia	1,255	752	503	Oregon	1,723	1,121	602
Idaho	855	624	231	Pennsylvania	3,830	2,430	1,400
Illinois	5,152	3,487	1,365	Rhode Island	203	120	83
Indiana	2,786	1,843	943	South Carolina	567	356	211
Iowa	2,066	1,634	432	South Dakota	1,075	807	268
Kansas	2,433	1,664	769	Tennessee	928	600	328
Kentucky	721	459	262	Texas	6,829	4,487	2,342
Louisiana	1,338	821	517	Utah	503	318	185
Maine	515	320	195	Vermont	158	101	57
Maryland	913	537	376	Virginia	1,244	697	547
Massachusetts	1,406	866	540	Washington	2,297	1,559	738
Michigan	3,940	2,452	1,488	West Virginia	[illegible]4	354	220
Minnesota	2,242	1,568	674	Wisconsin	1,908	1,257	651
Mississippi	936	584	352	Wyoming	514	364	150
Missouri	2,123	1,522	601	Territories and Foreign	1,770	1,055	715
Montana	1,168	888	280				

Source: 32.

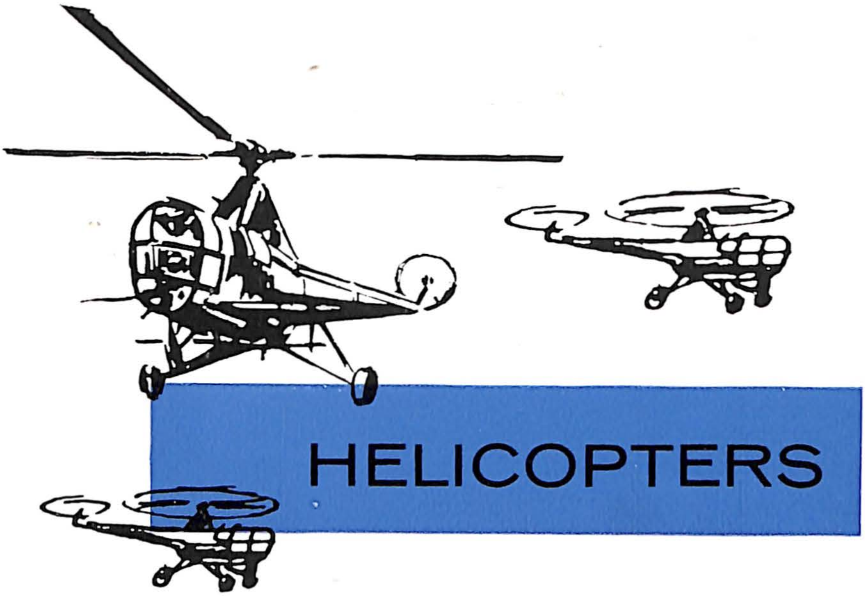


CIVIL AIRCRAFT[a], BY YEAR OF MANUFACTURE
AS OF JANUARY 1, 1955

Year of Manufacture	Number	Percent of Total
	92,067	100.0
Prior to 1943	23,919	26.0
1943	5,930	6.4
1944	1,515	1.6
1945	1,819	2.0
1946	26,587	28.9
1947	10,885	11.8
1948	5,387	5.9
1949	2,667	2.9
1950	2,838	3.1
1951	1,851	2.0
1952	2,805	3.0
1953	3,316	3.6
1954	2,548	2.8

[a] Number of civil aircraft, active and inactive, commercial transport and utility, recorded with Civil Aeronautics Administration.

Source: 33.



HELICOPTERS

Through the ages man tried mightily to unlock the secret of winged flight. But it wasn't until the invention of the internal combustion engine that he was able to achieve that ambition.

In 1903, when the Wright Brothers succeeded in bringing powered flight into reality, "fixed-wing" and "rotary-winged" (helicopter)* principles of flight were generating about the same degree of interest in aeronautical circles both here and abroad.

The achievement of powered flight, although it caused a ripple of excitement across the world, was largely of significance only to the military mind. The military services were quick, of course, to realize the tactical advantage of aircraft in its addition of a third dimensional aspect to the conduct of war.

It was inevitable because of this factor that aircraft development would pace the demands placed upon it by the military necessity. Because of the promise of the fixed-wing aircraft in flying *high, fast* and *far,* the complete significance of the potential utility of the helicopter was largely ignored by the military and the public for many years.

In 1907, Louis Breguet in France flew a helicopter that weighed half a ton and was driven by four rotors. In the '20's, Juan de la Cierva, in Spain, experimented with rotary wing flight (non-powered autogiro rotor principle). His development of the hinged rotor blades, rather than the rigid type, proved an important contribution to the design of practical

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*Pronunciation of the name *helicopter* is derived from the Greek—*helix*—meaning "spiral" and *pteron*—meaning "wing"—the accepted pronunciation is *hell-i-copter.*

helicopters. The first real distance flight by helicopter was made by Dr. Heinrich Focke from Bremen to Berlin in 1937.

In 1939, the first successful helicopter flight in the Western hemisphere was made by Dr. Igor Sikorsky at Bridgeport, Connecticut.

During World War II, the Army, Navy and Coast Guard began limited use of helicopters in military combat operations. In this period, however, their use was restricted almost completely to light emergency transport and rescue.

Once again, it was in the minds of the military strategists that the great potential of the helicopter was realized and that its development, as a result, was stepped up. The Coast Guard had pioneered during the war years in proving the utility of the helicopter as a rescue vehicle. Then, in 1947, the Marine Corps formed the first helicopter squadron to test proposed "vertical" combat assault landings in establishment of

Helicopters in Production
April 1956

Producer	No. of Places	No. of Engines	HP	Commercial Design	Military Designations				
					USAF	USA	USCG	USMC	USN
Bell	3	1	200	47G	H-13G	H-13G	HTL-6	HTL-6	HTL-6
	3	1	250	47G2		H-13H			
	3	1	200	47H1					
	4	1	250	47-J				HUL	HUL
	4	1	1900	61					HSL
	2	1	450	200	XV-3	XV-3			
	6	1	825	204	XH-40	XH-40			
Doman	8	1	400	LZ-5		YH-31			
Hiller	3	1	200	12-C	H-23-C	H-23-C			
	2	2	96	HJ-1	H-32				
	1	1	40	HJ-1				XROE	XROE
Kaman	5	1	600	KC-600				HOK-1	HOK-1
Sikorsky	10-12	1	600	S-55	H-19A	H-19C	H04S-2G	HRS-1	H04S-1
	10-12	1	700	S-55A	H-19B	H-19D		HRS-3	H04S-3
	—	2	3800	S56		H-37		HR2S	
	14	1	1525	S-58B & C		H-34		HUS	HSS
Vertol	22	1	1425	H-21	H-21B	H-21C			

Source: 2.

airheads. A year later the helicopter became an integral unit in air rescue operations of the Air Force.

On March 8, 1946, the first commercial helicopter was certificated for public use. In the ten short years since, the helicopter industry has achieved an enviable record of growth with increasing public enthusiasm for its application across the entire field of transportation.

Rescue Role

The great versatility of the helicopter as a rescue vehicle received worldwide attention during the Korean War with the dramatic vertical evacuation of more than 23,000 United Nations personnel—most of whom would have been lost to the enemy, had their rescue depended upon any other method of delivery.

In 1955, thousands of civilians trapped in the floods of Tampico, Mexico, and in the disaster areas of New England and the West Coast, owed their lives to 'copters and their ingenious crews. In the Tampico area alone, in 6½ days of operation, 12 helicopters made 1,121 flights, evacuated 7,661 persons, and distributed 114,957 pounds of food.

As a direct result of the rescue record performed by industry-owned and military helicopters, the Federal Civil Defense Administration in November, 1955, issued a memorandum to all state and local governments whereby the FCDA would provide matching funds on a 50-50 basis with any state or city to assist in the purchase of a helicopter. In explaining this program, FCDA Administrator, Governor Val Peterson, pointed out that since 1953, there have been 100 disasters in our country and the helicopter has proved invaluable in each. Therefore, he said, each state should maintain a civilian helicopter fleet, to be used for routine transport, police work, traffic control and aerial survey and as standby rescue vehicles in time of disaster.

Today, the 11 companies comprising the helicopter industry employ more than 18,000 persons in the manufacture of helicopters for both civil and military application. Sales are averaging in excess of $333.5 millions a year, and the industry's backlog by the end of 1955 totaled more than $540 millions. There are 17 models in production, 14 in prototype stage and 7 in the design and development process.

Helicopter Problems

New uses for the helicopter in business and by the military are constantly being developed. But along with the explosive growth in acceptance of the helicopter by the public has come a new obstacle in the delivery of the helicopter's complete utility. It is obvious that, with its

design and operational characteristics, the helicopter is markedly different from the fixed-wing type of aircraft.

For example, regulations defining fixed-wing aircraft rules governing altitude and visibility limitations and approach zone requirements for landings and takeoffs obviously curtail helicopter operations. Helicopters can and do slow down in the air and travel at reduced speed as the visibility conditions existing at a particular time require. Furthermore, it is necessary to relieve helicopters from altitude requirements drafted for fixed-wing aircraft in order to permit effective utilization of their operational characteristics as short-haul, intra-city, air-bus, and air-trucks. It is also in the interest of safety to permit helicopters to operate at air traffic levels which are below those at which faster, fixed-wing aircraft operate, particularly over congested areas to avoid the hazards of flight obstacles and collisions.

Nevertheless, only four of the 48 states of the nation recognize the helicopter in their statutes as a separate and distinct form of aircraft. To remedy this deficiency, the Helicopter Council of the Aircraft Industries Association, in cooperation with the National Association of State Aviation Officials, is striving to bring to the attention of state legislatures the needed revisions in existing laws to assure the full utility of the helicopter.

Through dramatic evacuations performed in wartime, as well as peacetime emergencies, everyone is familiar with rescue capabilities of the helicopter. But more important, the helicopter, as a transport vehicle, is performing magnificently in round-the-clock scheduled service in Los Angeles, Chicago, New York.

Certainly indicative of the complete air worthiness of the helicopter in civil transport is the fact that, in the six years of scheduled helicopter passenger service in the U. S. and in Europe, *there has never been a passenger fatality.* And by way of well deserved tribute to the quality of research, design and engineering teams of the U. S. helicopter industry—*all helicopters* flown by the world's airlines are of U. S. design and manufacture, or are built abroad under U. S. license.

There is mounting public pressure to integrate the helicopter into community and inter-city transportation systems.

Commercial Operations

New York Airways has reported a 300 per cent increase in its scheduled passenger service. Los Angeles Airways began operating passenger service in November 1954, between Long Beach and Los Angeles Airport and now serves communities as far south as Newport Beach, stopping at the Disneyland heliport en route, west to San Bernardino and north to San Fernando Valley. Helicopter Air Service in Chicago has applied for passenger service in the Chicago area. Today, helicopter service is also available between airports, and airports and cities, in Pittsburgh, Cleveland, Denver and Dallas, and this year will be inaugurated in Duluth. In Europe, the world's first international helicopter service will expand its present service between Holland, Belgium, North France and Germany to include regular service between Brussels and Paris.

The helicopter airlines in the five years ending with 1955 have more than doubled the available ton miles of service offered. They increased their revenue passenger miles almost 3½ times in 1955, compared with 1954. Their freight ton miles in this same period showed an increase of 26 per cent and their express ton miles rose more than 167 per cent. Total revenues were up 12.3 per cent.

In addition to the New York Police Department and The Port of New York Authority, which use the helicopter in solution of official transportation problems, operating off waterfront, roof-top and airport heliports, the State of Connecticut and Los Angeles Police Department have now added helicopters to their transportation fleet.

Full utilization of the helicopter as a short-haul, city-center to city-center transport is only limited by lack of "downtown" heliports. The establishment of the proposed waterfront heliport in mid-town Manhattan will prove an important step in the realization of city-center to city-center helicopter service.

In 1954 about 438 million passengers in the U. S. travelled by common carriers on short-haul trips of less than 250 miles. The airlines carried only 2½ per cent of these short-haul passengers—but 75 per cent of the passengers who travelled more than 1,000 miles. Railroads and buses carried 14 times as many passengers in short-haul transportation alone as the airlines carried in short-haul and long-haul put together. The market for the helicopter short-haul transport is great—and still virtually untapped.

In this connection, the Helicopter Council is distributing a special printing of The Port of New York Authority's study "Heliport Location and Design" to aid state and local governments in planning their heliport requirements.

U. S. EXPORTS OF CIVIL ROTARY-WING AIRCRAFT
1948 TO DATE

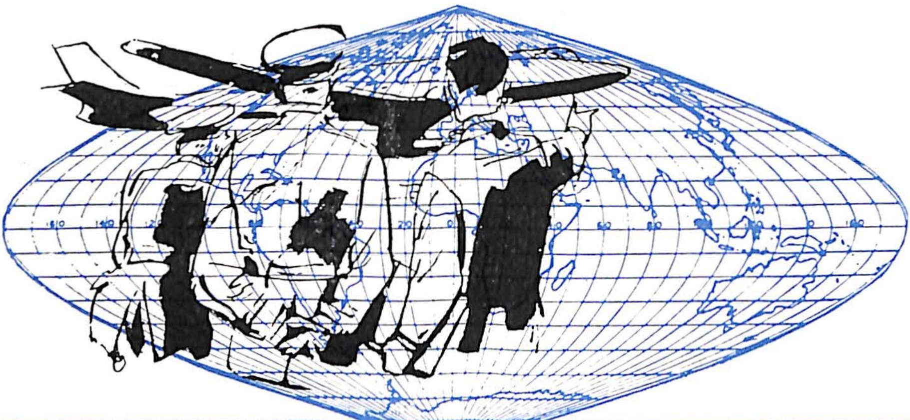
Year	Number	Value in Thousands
1948	47	$1,933
1949	31	1,181
1950	38	984
1951	28	899
1952	37	1,411
1953	98	4,873
1954	74	4,044
1955	66	4,165

Source: 23.

SALES AND BACKLOG OF SELECTED HELICOPTER MANUFACTURERS
(In Millions of Dollars)

	1954	1955
Total Sales during the Year	$307.4	$333.5
To Military Agencies	202.6	260.1
Civilian Sales	104.8	73.4
Total Backlog at End of Year	$677.8	$540.1
Military Orders	584.3	469.0
Civilian Orders	93.5	71.1

Source: 2.



AIRCRAFT EXPORTS

International trade is the basis of developing understanding among nations. Acquiring and retaining allies has been largely based on the success of economic relations. The presence of American products in foreign nations, and their high rate of acceptability, has played a major role in strengthening the alliance of the free world.

Free nations during 1955 continued to show a marked preference for all classes of American aircraft and related equipment, with exports registering a 17.7 per cent gain from $619,000,000 in 1954 to $728,300,000 in 1955. The U. S. aircraft industry ranked fifth in 1955 with respect to value of exports among all American industry.

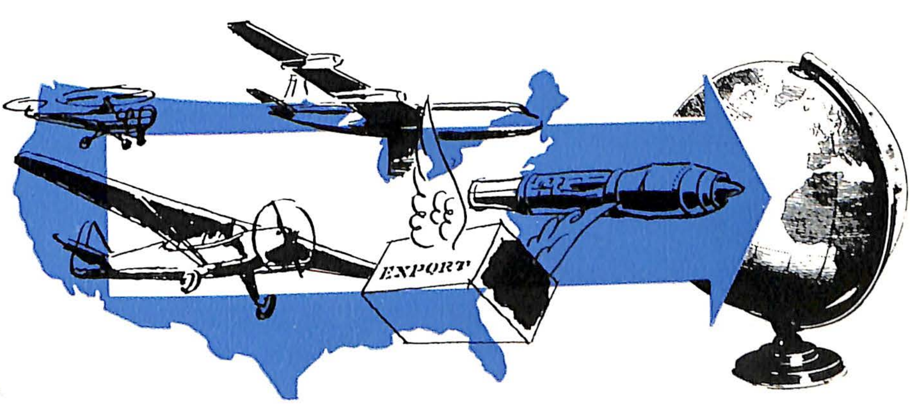
This overseas business accounted for 8.6 per cent of the industry's total production compared with 7.5 per cent in 1954. The export business is estimated to have maintained approximately 65,000 workers on the payrolls of the aircraft industry, a gain of 12 per cent over 1954.

MUTUAL SECURITY PROGRAM, SHIPMENTS OF MILITARY AIRCRAFT
OCTOBER 6, 1949—DECEMBER 31, 1955

Period	Total Aircraft Shipped	Air Force Aircraft	Navy Aircraft
TOTAL	7,909[a]	6,519[a]	1,390[a]
October 6, 1949—March 31, 1950	28		
April 1, 1950—September 30, 1950	223		
October 1, 1950—March 31, 1951	474	818[b]	283[b]
April 1, 1951—September 30, 1951	376		
October 1, 1951—March 31, 1952	656	512	144
April 1, 1952—September 30, 1952	661	612	49
October 1, 1952—March 31, 1953	1,366	1,202	164
April 1, 1953—September 30, 1953	1,323	1,072	251
October 1, 1953—March 31, 1954	641	478	163
April 1, 1954—September 30, 1954	529	445	84
October 1, 1954—March 31, 1955	617	478	139
April 1, 1955—September 30, 1955	745	660	85
October 1, 1955—December 31, 1955	377	342	35

[a] Revised. Since revision of previously reported monthly shipments is not available "Total" does not agree with total shipments reported above.
[b] Total shipments October 6, 1949 to September 30, 1951.

Sources: 44, 45.



UNITED KINGDOM: EMPLOYMENT AND PRODUCTION IN THE AIRCRAFT MANUFACTURING INDUSTRY

Year	Employment	Value of Production (Million Dollars)
1918	347,112	N.A.
1935	35,890	69.1
1939	355,000	N.A.
1944	1,821,000	N.A.
1948	134,219	455.2
1950	153,600	423.1
1954	238,200[a]	624.0[E]
1955	249,000[a]	N.A.

N.A.—Not available.
E Estimate by official British sources.
[a] As of end of November.

Sources: 56, 57.

However, the problems confronting the industry in increasing its export business are numerous. The most troublesome is the limited availability of dollar exchange throughout the Free World. Various aid programs of the government tended to alleviate this situation, but many countries that greatly preferred American products were forced to purchase from other sources because of dollar shortages.

The U. S. aircraft industry maintained its leadership in all categories. Aircraft production in the United States exceeds by a substantial margin the total production in the rest of the free world.

Russia's aircraft production is a matter of speculation, and its ex-

UNITED KINGDOM: AERONAUTIC EXPORTS

Annual Average	Million Dollars	Annual	Million Dollars
1924–1928	$ 5.6	1949	$125.2
1929–1933	7.1	1950	95.2
1934–1938	16.3	1951	116.5
1939–1943	33.9	1952	121.6
1944–1948	57.7	1953	182.0
		1954	156.9
		1955	185.3

Sources: 11, 56.

port to satellite nations for the most part is military. Even among the "borderline" nations where the consumer of aviation products has a free choice, the preference is predominately for American equipment. Five of the leading American manufacturers of aircraft and engines exported directly approximately 44 per cent of their commercial production in 1955, and it is estimated that their export business in 1956 will be about the same.

In addition to the substantial export of new production aircraft, engines and related equipment, there was a 133 per cent increase in shipments abroad of used and rebuilt aircraft. These exports amounted to 340 aircraft with a value of more than $1,178,000 in 1954. During 1955 the market soared with 800 aircraft valued at $37,185,000 being exported. This increase in one class of aircraft exports is due to the large,

new equipment program of U. S. air carriers. These carriers, accepting delivery of new, faster, more luxurious aircraft, sold many of their older models to airlines abroad.

The British aircraft industry was assisted in its export efforts by the British government through financing support and delivery against payment in "soft" currencies. The turboprop Vickers Viscount transport was sold abroad extensively, including the United States, but American manufacturers have begun production of turboprop and turbojet transports that will find wide acceptance. Several foreign flag airlines have already ordered American turbojet transports.

EXPORTS OF CIVIL AIRCRAFT, 1948 TO DATE

NEW PASSENGER TRANSPORTS

Year	TOTAL		3,000–14,999 lbs airframe weight		15,000–29,999 lbs airframe weight		30,000 lbs & over airframe weight	
	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)
1948	91	$37.4	34	$2.4	14	$4.2	43	$30.8
1949	51	22.2	16	1.3	25	7.6	10	13.4
1950	48	40.4	4	.4	15	6.6	29	33.4
1951	26	13.2	13	1.1	1	a	12	12.1
1952	25	18.2	9	.6	1	.6	15	17.0
1953	87	79.2	17	1.3	13	7.5	57	87.0
1954	110	93.0	29	2.0	7	4.0	74	70.4
1955	95	81.2	39	2.5	5	2.4	51	76.3

NEW UTILITY, PERSONAL AND LIAISON PLANES

Year	TOTAL		3-Places or less		4-Places and over	
	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)
1948	935	$4.2	552	$1.5	383	$2.7
1949	510	2.8	235	.7	275	2.1
1950	408	2.2	173	.5	235	1.7
1951	540	3.7	237	1.0	303	2.7
1952	815	5.6	551	3.1	264	2.5
1953	776	5.4	370	1.5	406	3.9
1954	529	4.5	223	1.1	306	3.4
1955	749	7.4	296	1.9	453	5.5

Despite the aids offered to the British aircraft industry in selling their wares, the aviation export records of both nations speak for themselves. During 1955, Great Britain exported $185,300,000 worth of aircraft, engines, parts, electrical equipment, tires and instruments (including both military and civil sales export).

During the same 12-month reporting period of 1955, according to figures compiled by the U. S. Census Bureau, United States aviation ex-

OTHER

Year	Rotary Wing Aircraft		Used Aircraft		Other	
	Number	Value (Millions)	Number	Value (Millions)	Number	Value (Millions)
1948	47	$1.9	202	$ .7	.....	.....
1949	31	1.2	252	.6	.....	.....
1950	38	.9	262	.9	.....	.....
1951	28	.9	300	.9	.....	.....
1952	37	1.4	303	1.5	.....	.....
1953	98	4.9	416	1.5	.....	.....
1954	74	4.0	340	1.2	.....	.....
1955	66	4.2	800	37.1	4	.01

[a] Less than $500,000.

Source: 23.

U. S. EXPORTS OF AIRCRAFT ENGINES[a] FOR CIVILIAN AIRCRAFT, 1948 TO DATE

Year	Number	Value (Thousands of dollars)
1948[b]	660	$326
1949[b]	107	112
1950	247	285
1951	304	509
1952	551	941
1953	347	708
1954	728	1,516
1955	897	2,016

[a] Under 400 h.p.; data for exports of engines of 400 h.p. and over withheld for "security reasons."

[b] Under 250 hp.

Source: 23.

ports amounted to 728,300,000—*more than three times the British aviation export for the entire year.*

The virtual destruction of the German, Italian, French and Japanese aircraft production capacity and the heavy damage done to the British aircraft industry during World War II has been largely overcome. The U. S. furnished substantial help in the rehabilitation of these industries, most notably in the "off-shore" procurement program. Under this program, the U. S. allocated during recent years large sums for the development and production of military aircraft which were delivered to our Allies. The progress has been remarkable and in the future U. S. manufacturers expect increasing competition in aircraft sales.

CANADA: AIRCRAFT AND PARTS INDUSTRY, 1935 TO DATE

Year	Number of Plants	Average Number of Employees	Gross Selling Value of Products (Millions of U. S. Dollars)
1935	7	294	$ .9
1936	7	416	1.3
1937	8	606	1.7
1938	13	1,617	6.9
1939	13	3,596	12.6
1940	19	10,348	24.2
1941	24	26,661	74.0
1942	42	44,886	137.8
1943	45	69,529	223.7
1944	45	79,572	388.2
1945	38	37,812	253.3
1946	16	11,405	36.2
1947	12	9,374	44.3
1948	11	8,049	45.6
1949	14	10,695	59.7
1950	15	10,549	50.2
1951	23	19,198	111.3
1953	43	38,048	398.7
1954	47	35,089	346.0

Sources: 10, 48.

U. S. TOTAL EXPORTS AND EXPORTS OF AERONAUTIC PRODUCTS
1912 TO DATE
(Millions of Dollars)

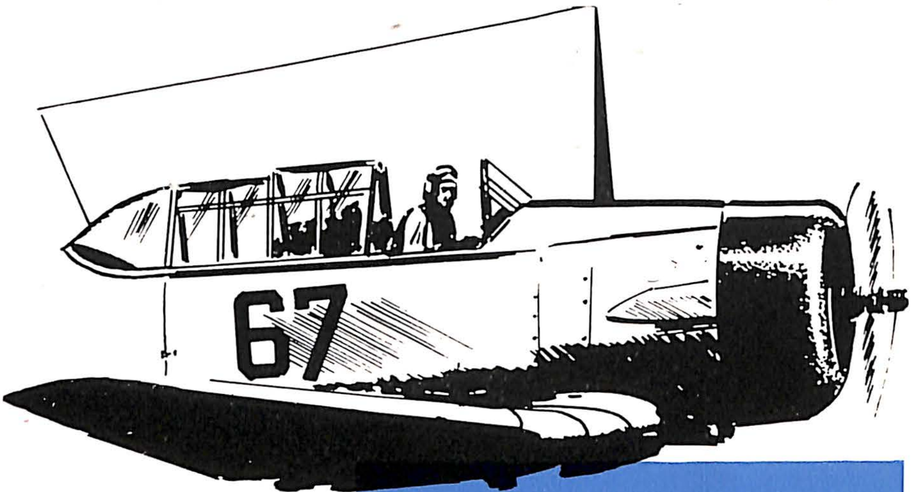
Year	Total United States Merchandise	Total Aeronautic Products	Percent of total
1912	$ 2,170.3	$ .1	[a]
1915–1918	22,176.7	31.5	.14
1921	4,378.9	.5	[a]
1929	5,157.1	9.1	.18
1939	3,123.3	117.8	3.8
1946	9,500.2	115.3	1.2
1952	15,025.7	603.2	4.0
1953	15,649.0	880.6	5.6
1954	14,948.1	618.9	4.1
1955	15,389.7	728.3	4.7

[a] Less than .05 percent.
Sources: 26, 27, 28, 29, 30.

UNITED KINGDOM: ORDERS FOR GAS TURBINE AIRLINERS
UP TO APRIL 1, 1956
Number of Units

Name	Total	For British Use	For Export
Comet 1 & 1a (all delivered) ...	19	10	9
Comet II	18	18	..
Comet III	1	1	..
Comet IV	19	19	..
Viscount 700	225	39	186
Viscount 800	75	38	37
Britannia 100	15	15	..
Britannia 250	9	9	..
Britannia 300	27	20	7
Total	408	169	239

Source: 56.



TRAINING

Aircraft and missiles being produced or in development by the United States aircraft industry represent the synthesis of coordinated effort at every level of human endeavor. From the thought of the creative genius to the skill of the production line worker, the lowest common denominator of American aerial supremacy is training and/or education.

As a result, the most critical capital resource of the aircraft industry today is its skilled *people.* They are in short supply, and because of the composition of the work force in the industry the problem of recruiting and holding competent technical, professional and management personnel is acute.

Examination of any big city newspaper will disclose great numbers of opportunities in all facets of the aircraft industry for pilots, engineers, research scientists, electronic experts, production workers and management experts.

New weapons; such as, supersonic aircraft and missiles, with their emphasis on electronics, coupled with new developments in atomic power, have placed a heavy burden on American technology and industrial management. The complexes of systems and components of the modern aerial weapon are so inter-related and the skills needed to produce and integrate these, so specialized, that only a highly educated and trained individual can perform adequately.

The aircraft manufacturing industry, which has been repeatedly faced with shortages of skilled personnel, undertakes apprentice and in-plant training programs. Some of the larger companies offer advanced courses in various technical aspects of aviation research, development, and production. These companies, hard pressed for qualified technical personnel in most cases, will take qualified engineers in any field and train them to their aeronautical need.

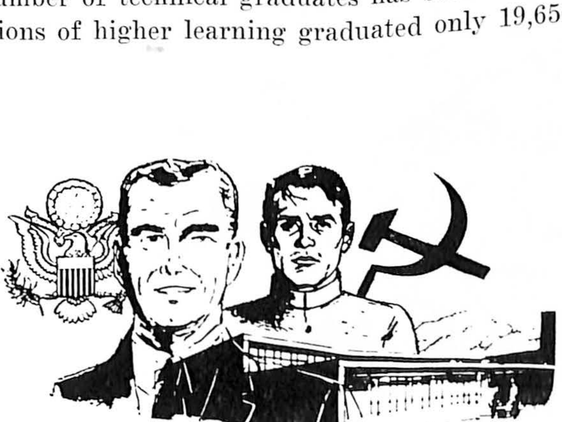
The nation's airlines operate flight and ground schools for the orientation and training of new employees, and for maintaining a high level of personnel efficiency.

Today, it is conservatively estimated that some 5,000 industrial organizations, including those of the aircraft industry, have immediate openings for 50,000 engineer and science graduates. There are job openings for very nearly twice the number that the nation's universities and colleges will graduate in 1956.

In 1953, the aircraft industry employed 48,500 of the 553,800 professional research engineers and scientists in the United States.

The aircraft industry in 1953 also employed 10.1 per cent of all engineering personnel employed by American industry; 1.7 per cent of all chemists; 6.2 per cent of all metallurgists; 16.0 per cent of all physicists; 14.1 per cent of all mathematicians; and a considerable number of research personnel covering virtually all other of the physical sciences.

Of greatest concern to the aircraft industry—indeed to the nation and all its industry—is the increasing shortage of scientific and technical personnel graduating from our colleges and universities. Since 1949, the annual number of technical graduates has been dropping. In 1954, U. S. institutions of higher learning graduated only 19,650 engineers—



nearly two-thirds less than the number required by industry. Russia, with whom this nation is engaged in a tremendous and vital race for technological supremacy, graduated two-and-one-half times this number in 1955.

Training in higher mathematics and the sciences should begin in the high school; yet in the last 50 years the proportion of high school students studying algebra has dropped from 50 per cent to 20 per cent; physics from 20 per cent to 4 per cent.

In contrast, the Russian high school graduate is 17 years old, and has compressed 12 years work into ten years by going to school six days a week and taking fewer holidays than their American counterparts. That decade of education includes a full ten years of mathematics, seven years of languages and a combined nine years for the sciences of physics, biology, chemistry and astronomy.

While our educational prowess has, until recently, presented a bleak picture for the future, public spirited Americans in industry, government, and in our great educational institutions are aroused and are forthrightly propounding and taking remedial action.

The high schools and colleges of the nation, more and more, are increasing their curricula to cover many fields of aviation. Colleges are, in many cases, offering pre-flight aviation training, and some offer flight training. Texas A & M College, for example, with the assistance of the Civil Aeronautics Administration is establishing a special six-weeks flight training school to train pilots in "aerial applicator" flight. This

Civil Flying Schools, Students and Certificated Pilots
1927 to Date

Year	Certified Civil Flying Schools	Student Pilot Certificates Issued As of December 31
1927	—	545
1928	—	9,717
1929	24	20,400
1930	39	18,398
1931	29	16,061
1932	21	11,325
1933	19	12,752
1934	21	11,994
1935	24	14,572
1936	27	17,675
1937	30	21,770
1938	24	15,556
1939	46	29,839
1940	749	110,938
1941	1,054	93,366
1942	843	93,777
1943	693	36,802
1944	N.A.	51,618
1945	964	77,188
1946	1,557	173,432
1947	3,078	192,924
1948	3,058	117,725
1949	2,430	49,575
1950	2,086	44,591
1951	1,625	45,003
1952	1,280	30,537
1953	1,093	37,397
1954	1,035	43,393
1955	902	42,554

N.A.—Not available.

Sources: 32, 35.

particular adjunct of agriculture is assuming tremendous proportions as America strives to increase her productivity to meet domestic and international food needs.

During World War II, more than 160 civilian aviation schools were under Army Air Force contract to train flying and technical personnel. To a lesser degree, the Air Force employed this system of contracting with civilian schools during the early days of the Korean War.

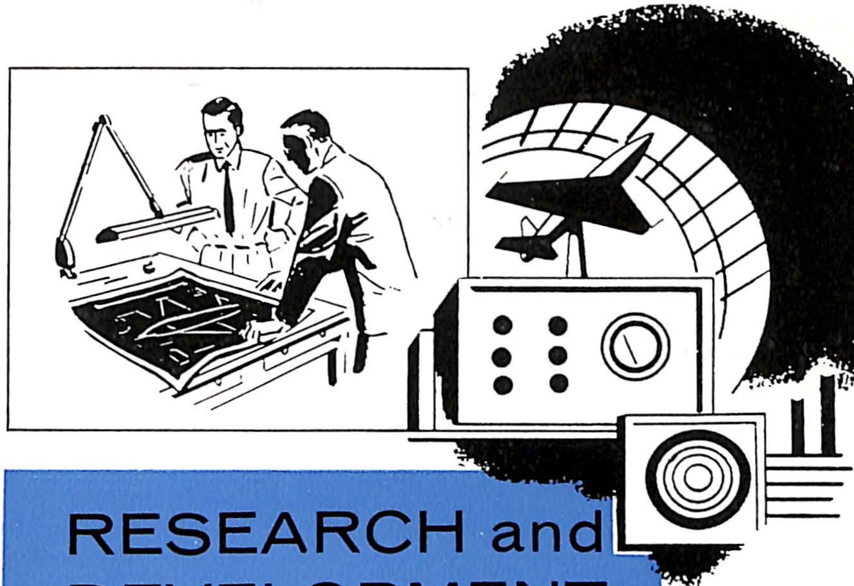
The Air Force has since discontinued its use of civilian schools for other than primary flying instruction, and as a result most training schools have been faced with serious economic problems during the last eighteen months. The picture is brightening generally, however, as the significance of the civil aviation industry to the nation's economy in peacetime emerges.

In 1950, pilots were being trained for the Air Force at an annual rate of 3,000. With the advent of the Korean War, this rate was increased to 4,000 per year, then to 7,200 per year. Pilot output during 1951 through 1953 remained at approximately 7,200 per year. In 1954, however, Air Force pilot output once again began to drop. In fiscal 1956 (July 1955-July1956) pilot output is pegged at approximately 6,300 annually.

CIVIL PILOT AND OTHER RATINGS CERTIFICATES ISSUED
1953-1955

Type of Certificate	1953		1954		1955	
	Original Issuances	Additional Ratings	Original Issuances	Additional Ratings	Original Issuances	Additional Ratings
Pilot Ratings						
Student	37,397	—	43,393	—	42,554	—
Private	13,362	836	15,523	923	15,866	1,082
Commercial	4,784	5,956	5,192	4,685	7,031	5,519
Air Transport	825	2,141	627	1,588	719	1,659
Flight Instructor	—	798	—	738	—	802
Instrument	—	3,019	—	1,928	—	2,781
Other	57	8	80	3	118	4
Other Ratings						
Mechanic	4,425	1,712	3,867	1,606	4,315	1,813
Navigator	124	—	77	—	37	—
Radio Operator	2	—	2	—	2	—

Sources: 32, 35.



RESEARCH and DEVELOPMENT

The bedrock of U. S. air supremacy is its quality; numerical superiority was long ago conceded to Russia and her satellites.

Qualitative air superiority can only come through a dynamic program of research and development. The air power that the military will require to increase our deterrent capacity, which is the surest means of preserving peace in a restive world, requires vigorous and emphatic attention today. The battle of the laboratories has the same significance as armed battles had in the past.

Research and development programs of the aircraft industry all but vanished at the end of World War II—smothered in a landslide of cancelled contracts and virtually destroyed by the heavy slashes of the military budget. Even at the peak of World War II, aircraft industry research and development was not as extensive as today's vast assault on scientific frontiers. The industry was able to hold together a nucleus of scientific and engineering teams that formed the basis for expansion of the research and development program at the outbreak of the Korean War when the nation rushed to re-arm with modern weapons. The U. S. today is approaching the goals of air strength set by our military leaders, and the emphasis has shifted to keeping these force levels modern. This requires an accelerated research and development effort.

Since 1950, the aircraft industry has produced a revolution in U. S. air power. There has been a complete change from forces built around the piston engine to forces powered by the turbojet engine, and a new potent weapon has been added to the air arsenal—the missile. The basis for this metamorphosis in arms was research and development.

The overall characteristic of research and initial development is its concern with the unknown. There is no method of determining the outcome of any segment of a research effort. It may well prove to have been unproductive. Many avenues must be explored. The process is costly, and the results of research are not apparent in actual hardware for as long as five to ten years.

Research is primarily concerned with uncovering new facts about nature, and developing principles for their practical application. Re-

MAJOR RESEARCH AND DEVELOPMENT PROGRAMS OF THE FEDERAL GOVERNMENT
1954-1957
(In Millions of Dollars)
Department of Defense
(including Air Force, Army, and Navy)
Obligations[a]

Year	Aircraft	Guided Missiles	Operation of Research Facilities	Expenditures for Increase of Research and Development Plant
1954	269.8	231.4	266.3	145.2
1955	293.6	214.0	249.0	110.5
1956[E]	339.5	268.0	284.6	125.0
1957[E]	312.8	224.4	347.4	150.0

ATOMIC ENERGY COMMISSION EXPENDITURES

	Production & Weapons	Reactor Development	Biology, Medicine, & Physical	Increase in R & D Plant
1954	96.0	70.6	62.9	44.8
1955	92.1	95.4	65.9	36.4
1956[E]	101.9	144.4	73.6	83.6
1957[E]	95.1	211.1	87.3	136.3

E Estimate.

[a] Obligations may exceed expenditures; for total DOD obligation the difference is less than 3%, but may be more in any one program.

Source: 49.

EXPENDITURES FOR RESEARCH AND DEVELOPMENT BY THE FEDERAL GOVERNMENT AND SELECTED AGENCIES
(In Millions of Dollars)

	Total for all Federal Agencies	Air Force[a]	Army	Navy	AEC[a]	NACA
1940-1944 Av. for 5 yrs.	520.4	83.7	80.9	80.2	403.5[b]	7.6
1945-1949 Av. for 5 yrs.	1,083.9	164.9	265.5	118.2	353.4	33.5
By Fiscal Yrs.						
1950	1,143.1	218.4	120.8	310.8	221.4	54.5
1951	1,342.3	297.9	159.3	363.8	242.6	61.6
1952	1,839.0	523.0	316.0	476.0	249.6	67.4
1953	2,118.8	618.4	415.0	535.7	261.8	78.6
1954	2,102.5	598.0	428.4	505.8	274.3	89.5
1955[E]	2,084.0	604.0	408.8	446.0	288.7	72.0
1956[E]	2,229.1	655.0	408.5	451.9	344.0	76.0

E Estimate.
[a] and predecessor agencies.
[b] 2-year average—1943 and 1944.

Source: 81.

search sets the pace for technological achievements. But research findings alone have no value without extensive development activities to prove their usefulness.

The paradox of research and development progress is that each breakthrough in a specific field, such as development of engines of more powerful thrust, in turn increases the difficulty of problems in other fields and creates new ones.

The combination of greater engine thrust, thinner wings and new configurations opened the way to astonishing jumps in performance. But the speed, in turn, generated a host of problems; such as, disintegration of aircraft skins due to high temperatures, much greater difficulty in stabilizing the aircraft in flight and preventing breakup while maneuvering at very high speeds.

The advent of missiles brought with it a new group of problems, made more difficult because there was practically no backlog of information to draw upon. Research and development has moved rapidly in this field and today there are missiles with operational units deployed at overseas bases. The Intercontinental Ballistic Missile (ICBM) program, one of the most ambitious scientific and engineering projects attempted by man, is utilizing an array of talents literally ranging from "a" to "z"—aerodynamics to zoology. The elusive clues to the solutions of the ICBM problems can only be found through continuing research.

The aircraft industry in 1953, the most recent year for which statistics are available, spent $758,000,000 on research and development, about one-fifth of the entire research and development expenditure by all U. S. industries. This expenditure is equivalent to 12 per cent of the aircraft industry's total sales dollar. The all-industry average amounted to only 2 per cent of the total sales dollar.

Expenditures for research and development by the federal government in fiscal year 1956 was $2,229,100,000—almost double the amount expended in fiscal year 1950. This amount includes expenditures by Air Force, Army, Navy, Atomic Energy Commission and National Advisory Committee for Aeronautics.

The aircraft industry in 1953 employed 48,500 scientists and engineers out of a total of 553,800 working in all industries.

RESEARCH AND DEVELOPMENT COSTS AND EMPLOYMENT IN INDUSTRY IN 1953

Industry	Cost of Conducting Research & Development		Scientists & Engineers in Research & Development	
	Millions of Dollars	Percent	Number of Scientists and Engineers	Percent
All Industry	$3,699.4	100.0	553,800	100.0
Manufacturing Industries				
Aircraft	758.0	20.5	48,500	8.8
Electrical Equipment	778.3	21.0	61,000	11.0
Machinery	318.9	8.6	60,300	10.9
Chemicals	361.1	9.8	62,700	11.3
Petroleum	145.9	3.9	38,500	6.9
Scientific Instruments	171.7	4.6	18,800	3.4
Other Manufacturing (including automobiles)	968.9	26.2	148,900	26.9
Non-Manufacturing	196.6	5.4	115,100	20.8

Source: 72.

TYPES OF SCIENTISTS AND ENGINEERS CONDUCTING RESEARCH AND DEVELOPMENT IN SELECTED INDUSTRIES, 1953

Number Employed

Type of Scientist and Engineer	All Industries	Aircraft	Electrical Equipment	Machinery	All Other
Total	553,800	48,500	61,000	60,300	384,000
Engineers	408,800	41,100	51,100	53,400	263,200
Metallurgists	11,300	700	900	1,200	8,500
Chemists	60,000	1,000	3,000	1,000	55,000
Physicists	7,500	1,200	2,200	400	3,700
Mathematicians	6,400	900	700	300	4,500
Other	59,800	3,600	3,100	4,000	49,100

Source: 72.

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