REPORT OF THE COMMITTEE ON AVIATION

AVIATION STATISTICS

This report is supplementary to the comprehensive report made by the Committee on Aviation of the Actuarial Society of America in May 1940 in *TASA* XLI, the supplementary reports of that Committee in *TASA* XLII, XLIII, XLV, XLVII, XLVIII, XLIX and L, and the supplementary reports made by this Committee in *TSA* I and II.

SCHEDULED FLYING

United States

Table 1 shows the recent trend of fatality rates on United States scheduled airlines. Although the rates fluctuate somewhat from year to year, a steady improvement is seen when they are grouped into four-year periods. There is no present indication of a greater hazard in international than in domestic flying of these airlines.

Since pilots engaged full time in scheduled flying approximate 1,000 hours a year the death rates per 1,000 hours are indicative of the annual death rate of such pilots. The columns headed "Death Rate of All Pilots Employed in Scheduled Flying" and "Death Rate of Other Crew Members Employed in Scheduled Flying" include, on the one hand, those who do less than the normal amount of flying on account of having some supervisory duties or for other reasons and include, on the other hand, the deaths in non-scheduled flights operated by scheduled airlines, such as test or charter flights. The "Death Rate of First Pilots in Scheduled Flights," therefore, might be said to indicate the hazard of the normal airline pilot, while the "Death Rate of All Pilots Employed in Scheduled Flying" represents that of the average pilot. The difference in recent years is not great.

If the hazard in scheduled cargo flying were for any reason greater on the average than in passenger flying, the passenger death rate per 1,000 passenger hours would be expected to be less than the pilot death rate per 1,000 airplane hours. This has not been the case in recent years, however.

Outside of United States

The International Air Transport Association has furnished to the Committee the experience of most of its member companies for the period 1946 to 1949. Deducting the experience of United States scheduled airlines and making reasonable assumption as to average speed for the purpose of translating reported miles into hours, a passenger fatality rate of .005 per

1,000 hours for the year 1949 and .006 for the period 1946 to 1949 is deduced for reporting airlines of countries other than the United States. This compares with the rate of .007 for 1946 to 1948 given in *TSA* I, 625. It also compares with the rate of .0018 for United States airlines for 1949 and of .0028 for the period 1946 to 1949.

NON-SCHEDULED FLYING

Table 2 shows the fatality rates in the years 1946 to 1949 of first pilots per 1,000 airplane hours by kind of non-scheduled civil flying. The ex-

TABLE 1

UNITED STATES SCHEDULED AIRLINES

Period	Passenger Death Rate per 1,000 Passenger Hours	Death Rate of First Pilots in Scheduled Flights per 1,000 Airplane Hours	Death Rate of All Pilots Employed in Scheduled Flying, per Year of Exposure	Death Rate of Other Crew Members Employed in Scheduled Flying, per Year of Exposure
	Domestic			
1948	.0023	.0020	.0015	.0021
1949	.0022	.0029	.0021	.0017
1950	.0020	.0019	.0018	.0015
1945–1948	.0032	.0033	.0031	.0033
1946–1949	.0029	.0032	.0030	.0029
1947–1950	.0029	.0026	.0023	.0023
	International			
1948	.0020	.0020	.0050	.0049
1949	.....	.....	.....	.....
1950	.0041	.0021	.0013	.0031
1945–1948	.0033	.0026	.0031	.0051
1946–1949	.0021	.0022	.0025	.0033
1947–1950	.0021	.0021	.0024	.0029
	Total			
1948	.0022	.0020	.0024	.0033
1949	.0018	.0023	.0016	.0010
1950	.0024	.0019	.0017	.0020
1945–1948	.0033	.0032	.0031	.0040
1946–1949	.0028	.0030	.0029	.0031
1947–1950	.0027	.0025	.0023	.0025

TABLE 2

NON-SCHEDULED FLYING BY KINDS
FIRST PILOT FATALITY RATE PER 1,000 HOURS

PERIOD	COMMERCIAL AND MISCELLANEOUS			NON-COMMERCIAL BUSINESS			PERSONAL			INSTRUCTION			NON-SCHEDULED CARRIERS		
	Hours*	Deaths	Rate	Hours*	Deaths	Rate	Hours*	Deaths	Rate	Hours*	Deaths	Rate	Hours*	Deaths	Rate
1946	1,256	120	.10 Low												
	663	123	.19 High	1,037	29	.03	1,602	308	.19	5,749	157	.027	375	9	.024
1947	1,166	82	.07	1,966	68	.03	2,616	412	.16	10,353	244	.024	233	8	.035
1948	896	99	.11	2,576	85	.03	2,606	403	.15	8,701	182	.021	351	6	.017
1949	1,330	85	.06	2,615	55	.02	2,732	286	.10	4,187	86	.021	167	10	.060
1946–49	4,648	386	.08 Low	8,194	237	.03	9,556	1,409	.15	28,990	669	.023	1,126	33	.029
	4,055	389	.10 High												
1947–49	3,392	266	.08	7,157	208	.03	7,954	1,101	.14	23,241	512	.022	751	24	.032

* 000 omitted.

posures are an estimate of airplane hours by the Civil Aeronautics Administration, based on a sampling survey of aircraft owners. If there is any systematic error in the underlying data it probably is in the direction of understatement of the usage of individual aircraft, with consequent overstatement of the death rates. In 1946 several widely different estimates of the exposure of commercial and miscellaneous flying were made. The range of the resulting death rates is shown in the table.

The table indicates a general though irregular improvement in death rates over the period covered.

The class of non-scheduled air carriers is not homogeneous but the bulk

TABLE 3

NON-SCHEDULED CARRIERS
PASSENGER DEATH RATE PER 100,000,000 PASSENGER MILES

Year	Passenger Miles (000 Omitted)	Deaths	Deaths per 100,000,000 Passenger Miles	Exposure Included
1946	400,000	60	15.0	All carriers
1948 (1st 9 mos.)	181,000	46	25.4	All domestic carriers
1949	570,958	104	18.2	"Large" domestic and international carriers
1950	766,507	29	3.8	"Large" domestic and international carriers

of the exposure comes from a relatively small number of these carriers who operate aircraft of types similar to those used by scheduled airlines, some carrying passengers and some only cargo. Passenger exposures have been compiled only irregularly in the past, and not always on comparable bases. Such figures as are available are assembled in Table 3. The 1950 passenger death rate shows a marked improvement, which may be due to closer Federal regulation and to self-regulation by associations of non-scheduled airlines.

The death rate per 100,000,000 passenger miles on United States scheduled airlines for the period 1946 to 1950 was 1.6.

CANADIAN CIVIL PILOTS

The data on Canadian civil pilots by class of license for 1947 to 1950, furnished by the Dominion Department of Transport, are shown in Table 4.

It is not unlikely that the class of private pilots includes a considerable

number whose flying is small or nonexistent, and that the rate shown is not applicable to pilots with substantial annual flying time. The Committee has no definite information on this point, however.

TABLE 4

Class of License	Years of Exposure	Aviation Fatalities	Fatality Rate per 1,000
Transport*	3,218	21	7
Commercial†	3,929	29	7
Private	9,060	32	4

* Includes airline transport.
† Includes limited commercial and senior commercial.

UNITED STATES AIR FORCE

Government Statistics

The addition of the 1949 and 1950 figures for the United States Air Force to those for 1946 to 1948 given in *TASA* L, 59, generally results in a slight reduction in fatality rates at the higher ages, and for pilots other than those of the regular services a slight increase at the youngest ages. Fatality rates for 1950 and for the period 1946 to1950 are given in Table 5 (for non-pilot rated personnel—*i.e.*, navigators, bombers, gunners, flight surgeons, etc.—the second figures are for 1947 to 1950).

The 1950 figures exclude deaths on combat missions whether resulting from battle or from other causes. The figures for "All Rated Pilots" are divided between the two halves of the year 1950. A comparison of the two six-month periods indicates the effect of more intensive training, increased amount of flying, etc., since the beginning of the Korean war. The average number of *aircraft* hours per pilot on flying status in the first six months of 1950 was 66, and in the second six months was 79. These are the average numbers of hours per six-month period. The average *flying* hours per pilot would be somewhat greater on account of flights by rated pilots as copilots or in some other capacity.

An analysis of the age-specific fatality rates for all rated pilots between overseas and the continental United States similar to that given in *TASA* L, 100, for the period 1946 to 1948, is not available for 1949 and 1950, but for all ages combined in 1950 the overseas noncombat rate for pilots was 14.7 and the continental rate 6.3, and the rates for non-pilot rated personnel were 24.7 and 4.6.

Student Pilots

For the years 1949 and 1950 combined the fatality rate in basic pilot training was 4.6 per 1,000 years of exposure and for advanced training was 17.0.

TABLE 5

UNITED STATES AIR FORCE
AVIATION FATALITY RATES PER
1,000 PER ANNUM

AGE GROUP	ALL RATED PILOTS		
	1950		1946–1950
	1st 6 Mos.	2d 6 Mos.	
Under 25	24.1	26.9	15.2
25–29	10.0	11.8	9.7
30–34	3.5	5.6	6.0
35 and over	5.6	3.0	5.5
All	7.4	9.0	9.3
	Regular Air Force Pilots (Included Above)		
	1950		1946–1950
Under 25	14.1		23.9
25–29	9.8		10.8
30–34	4.7		5.3
35 and over	3.9		4.7
All	6.0		8.1
	Non-pilot Rated Personnel		
	1950		1947–1950
Under 25	.....		12.9
25–29	8.9		9.2
30–34	7.3		7.0
35 and over	1.7		6.4
All	7.3		8.6

Military Air Transport Service

Passenger fatality rates for the former Air Transport Command and Naval Air Transport Service for the years 1943 to 1946 were given in *TASA* XLIX, 548. For the period 1947 to 1950 the passenger fatality rate in the successor Military Air Transport Service was 1.2 per one hundred million passenger miles, all the deaths having occurred in a single crash. This compares with a rate of 1.6 for all United States scheduled commercial airlines for the same period. The Department of the Air Force states that the fatality rate is likely to be higher in 1951 although no definite figures are yet available.

TABLE 6

UNITED STATES AIR FORCE (INCLUDING FORMER UNITED STATES ARMY AIR FORCES)—INTERCOMPANY EXPERIENCE

Attained Insurance Age at Beginning of Calendar Year of Exposure	January 1, 1946 to June 30, 1950			July 1, 1950 to June 30, 1951				
				Years of Exposure	Excluding Deaths on Combat Missions but Not the Corresponding Exposures		Including All Deaths While in Flight	
	Years of Exposure	Aviation Fatalities	Fatality Rate per 1,000		Aviation Fatalities	Fatality Rate per 1,000	Aviation Fatalities	Fatality Rate per 1,000
	Issued with Aviation Extra Premium							
Under 25	1,545	31	20.1	330	6	18.2	13	39.4
25–29	10,614	79	7.4	3,416	35	10.2	41	12.0
30–34	9,539	45	4.7	5,520	19	3.4	31	5.6
35 and over	2,450	1	.....	1,823	4	.....	6	3.3
All	24,148	156	6.5	11,089	64	5.8	91	8.2
	Issued with Aviation Exclusion Provision							
Under 25	1,096	19	17.3	114	2	.....	2	.....
25–29	3,185	18	5.7	670	5	7.5	6	9.0
30–34	1,281	4	.....	604	.....	.....	.....	.....
35 and over	130	.....	.....	93	.....	.....	.....	.....
All	5,692	41	7.2	1,481	7	4.7	8	5.4

Intercompany Experience

Twenty-eight companies contributed their experience on military pilots for issues since January 1, 1946, observed in the case of some companies through December 31, 1950 and in the case of others through June 30, 1951. Only those lives who were active as military pilots or student pilots at time of issue were included. Policies issued with aviation rider because the insured was a former or potential pilot were not included. Since these statistics are on insured lives, the results are more relevant to underwriting problems than the government statistics except to the extent that the

TABLE 7

UNITED STATES NAVY
AVIATION FATALITY RATE PER 1,000 PER ANNUM
Naval Aviators—Excluding Students
(Includes Marine Corps 1948–1950)

Age Group	1950	1947–1950
Under 25	19.7	16.0
25–29	10.1	7.5
30–34	5.6	4.4
35 and over	2.6	2.3
All	8.5	7.2

Student Naval Aviators
(Includes Marine Corps)

Stage of Training	1950	1946–1950
Basic	6.9	5.0
Advanced	39.6	28.3

insurance figures have lower credibility on account of smaller exposure.

The principal results are shown in Table 6 for the United States Air Force, and in Table 8 for the United States Navy (see later section), with fatality rates omitted in classes having less than 5 deaths. Figures are shown for the periods January 1, 1946 to June 30, 1950 and July 1, 1950 to June 30, 1951, approximately representing periods without and with active hostilities. For the latter period, deaths and death rates are shown with deaths on combat missions both excluded and included as far as they could be identified from the reports of deaths. It is possible that some of the pilots counted as killed on combat missions were actually killed while not in flight. The denominator of the fatality rates in each case is the total number of years of exposure as it was impossible to separate the amount

of exposure to combat hazards. The fatalities which were treated as deaths on combat missions include not only those which clearly belonged in this class but also those who were merely identified as killed in action and those where the nature of the flight was uncertain but probably combat. The fatality rate from hazards of aviation, as distinguished from enemy action, lies between the two sets of fatality rates shown.

The intercompany figures include lives who were student military pilots at the time of issue, while the government statistics on pilots relate only to those who had received their rating. In the extra premium class there were 10 deaths among those insured as students, of whom 3 were students at the time of death. In the ridered class the respective numbers were 4 and 1.

TABLE 8

UNITED STATES NAVY (INCLUDING MARINE CORPS)

INTERCOMPANY EXPERIENCE

Attained Insurance Age at Beginning of Calendar Year of Exposure	January 1, 1946 to June 30, 1950			July 1, 1950 to June 30, 1951				
				Years of Exposure	Excluding Deaths on Combat Missions but Not the Corresponding Exposures		Including All Deaths While in Flight	
	Years of Exposure	Aviation Fatalities	Fatality Rate per 1,000		Aviation Fatalities	Fatality Rate per 1,000	Aviation Fatalities	Fatality Rate per 1,000
	Issued with Aviation Extra Premium							
Under 25	1,566	19	12.1	262	4	15.3	11	42.0
25–29	6,735	52	7.7	2,130	18	8.5	31	14.6
30–34	4,170	18	4.3	2,492	17	6.8	30	12.0
35 and over	1,381	2	.....	984	1	.....	4	.....
All	13,852	91	6.6	5,868	40	6.8	76	13.0
	Issued with Aviation Exclusion Provision							
Under 25	1,372	22	16.0	183	1	.....	1	.....
25–29	2,087	10	4.8	530	5	9.4	7	13.2
30–34	687	3	.....	317	7	22.1	8	25.2
35 and over	176	.....	.....	115	.....	.....	.....	.....
All	4,322	35	8.1	1,145	13	11.4	16	14.0

UNITED STATES NAVY

Government Statistics

The addition of a year's experience to that given in *TSA* II, 515, produces little change except for a slight increase in the rate for naval aviators at the youngest ages and in the rate for student naval aviators in advanced training (see Table 7). The 1950 figures exclude deaths on combat missions. The Committee is informed, however, by the Department of the Navy that the 1950 fatality rate for all ages combined would be in-

TABLE 9

ROYAL CANADIAN AIR FORCE PILOTS—1947–1950

Age Group	Aviation Fatality Rate per 1,000 per Annum
Under 25	7.7
25–29	6.0
30–39	5.8
40 and over	....
All	5.8
Rank	
Pilot Officer and Junior Ranks	....
Flying Officer	6.0
Flight Lieutenant	5.8
Squadron Leader	11.2
Wing Commander and Higher Ranks	1.6
All	5.8

creased about one-third by the inclusion of known fatalities in combat operations, subject to further increase if some of those missing in action are not found to have survived. The over-all noncombat aviation fatality rate for the second half of 1950 was lower than for the first half of the year but the actual figures have not been released for publication.

Intercompany Experience

The principal figures are shown in Table 8 in the same form as the Air Force figures in Table 6. In the extra premium class there were 9 deaths among those insured as students, of whom 1 was a student at the time of death. In the ridered class the respective numbers were 1 and 0.

ROYAL CANADIAN AIR FORCE

The fatality rates shown in Table 9, furnished by the Canadian Department of National Defence for pilots of the RCAF for the period 1947–

1950, are believed to be more accurate than the rates shown in *TSA* II, 516. As compared with the United States services the lower fatality rate at the youngest ages may be explained in part by the fact that no newly enlisted Flight Cadets were given basic pilot training during 1946 and 1947. The rates have also been affected by the fact that after the end of World War II and until about 1950 the RCAF concentrated on transport and photographic work. Relatively few newly graduated pilots went directly to units where they would fly single pilot aircraft. Whether the somewhat greater variation by rank is an accidental fluctuation cannot be determined since the exposures and number of fatalities were not released to the Committee. Some Squadron Leaders have, however, been employed at experimental and testing units. The number so employed will not increase in proportion to the over-all increase in Squadron Leader pilot strength which will occur over several years subsequent to 1950. It is felt that the rate for Squadron Leaders cannot be considered significant due to the relatively small number of fatalities which are said to be involved.