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Pilot Interviews - Composite Pirep of 7500 Trips Through the Equatorial Front

(None)

(Not known)
U.S. Army Air Forces, 6th Weather Region, (Caribbean and Panama* (None)
U.S. Air Force, Air Weather Service, Washington, D. C. TR-105-52

Nov' 44 Unclass. U.S. English 104 (None)

A questionnaire was submitted to a number of pilots and navigators who had been flying the equatorial front. This questionnaire was to furnish a detailed structural description of the front. Data from approximately 7500 flights through the front are given in the answers. Some of the questions covered include experience of the individual flier in flying through the front; comparison of the equatorial front with cold fronts in temperate climates; preference of sea or land route; favorite time of day or night for flying through the front; the front at different seasons; special phenomena encountered during flight; relationship between the width of the front and its intensity; the state of the sea in the area of the front; suggestions for improving forecasts, and general weather comments for this area.

*Areas) Fort Sherman, Panama

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Meteorology (30)
Climatology (7)

Meteorologic data - Tropical regions (61717.3)
Weather reports (98443)

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AIR WEATHER SERVICE
TECHNICAL REPORT 105-52

PILOT INTERVIEWS: COMPOSITE PIREP OF 7500 TRIPS THROUGH THE EQUATORIAL FRONT

NOVEMBER 1944

HEADQUARTERS
AIR WEATHER SERVICE
WASHINGTON, D.C.

U. S. ARMY AIR FORCES
TECHNICAL DIVISION

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AWS Tech Rept 105-52

PILOT INTERVIEWS

COMPOSITE PIREP OF 7500 TRIPS THROUGH THE EQUATORIAL FRONT

Classification canceled (or changed) to Rel
by authority of Chief Air Weather Service
by Maj Ed Cleveland date 20 Sept 46

6TH WEATHER REGION

Aug. 1944

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P I L O T I N T E R V I E W S

A COMPOSITE PIREP OF 7500 TRIPS THROUGH THE EQUATORIAL FRONT

Compiled and Published

by

Research Section
6th Weather Region

November
1944

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Classification canceled (or changed) to_____
by authority of_____
by_____date_____

The 6th Weather Region expresses its sincere appreciation to each of the pilots and navigators of the Army and Navy whose experience is included in this weather summary. Their cooperation in answering our questions has greatly increased our knowledge of the equatorial front and given us a better understanding of the airman's problems in flying through this front.

Lloyd H. Magar
LLOYD H. MAGAR,
Lt. Col., A.C.,
Regional Control Officer,
6th Weather Region.

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INTRODUCTION

The Research Section of the 6th Weather Region submitted questionnaires concerning the equatorial front to the pilots and navigators of the Army and Navy who have been flying in this area. The purpose was to furnish the forecasting personnel of the 6th Weather Region and other interested organizations with a detailed structural description of the front in the hope that a better understanding of its physical composition will lead to more accurate forecasting of its movement and intensity.

These answers represent each man's individual experience in flying the equatorial front. Data from approximately 7500 flights through the front are included in this paper and therefore present a more detailed description of the front in this area than has even been compiled.

Some of the answers contradict the opinion expressed by a majority of the airmen, but this may be attributed to a difference in experience, type of aircraft, the inconsistency of frontal weather, and various other factors.

PILOT INTERVIEWS

Army and Navy personnel who contributed this information concerning the equatorial front.

Col. R. M. Bristol
Col. E. M. Day
Col. P. B. Griffith
Col. J. E. Roberts

Lt. Col. J. G. O'Brien
Lt. Col. A. F. Tucker

Maj. D. W. Bailey
Maj. A. H. Carver, Jr.
Maj. C. M. Cramer
Lt. Cmdr. R. K. Hendorson, USNR
Maj. J. A. Irwin
Maj. D. L. Roberts
Maj. F. A. Sanders
Maj. O. G. Stephens

Capt. J. W. Adair
Capt. L. H. Agard
Capt. W. F. Bond
Capt. R. M. Brown
Capt. L. W. Cunningham
Lt. H. Dickerson, USNR
Capt. J. H. Eichler
Capt. C. V. Eld
Capt. C. P. Felice
Capt. C. E. Glassmeyer, Jr.
Capt. W. R. Hansen
Capt. J. M. Huffman, Jr.
Capt. W. H. Hunt
Capt. W. R. Knight
Capt. S. E. Nast
Capt. C. A. Neel
Capt. T. T. Ott
Capt. R. W. Scheller
Lt. I. J. Scott, USNR
Capt. E. L. Stevens
Capt. M. W. Williams

Lt. (jg) H. W. Burradale, USNR
1st Lt. B. L. Bergesen
1st Lt. W. E. Christensen
1st Lt. J. L. Curleo
1st Lt. J. T. Dowling, Jr.
1st Lt. S. P. Easley
1st Lt. E. H. Gibb, Jr.
1st Lt. C. E. Hel[illegible]
1st Lt. W. J. Ha[illegible]e
Lt. (jg) T. L. Healey, USNR
1st Lt. R. E. Henderson
1st Lt. F. W. Holer
1st Lt. J. R. Irwin
1st Lt. E. E. Koken
1st Lt. J. C. Kline
1st Lt. V. W. Lange
1st Lt. A. W. Luce
1st Lt. H. B. McMillon
1st Lt. G. L. Newkirk
1st Lt. G. F. Piker
1st Lt. T. L. Rudoy
1st Lt. H. C. Sacks
1st Lt. T. V. Sawyer
1st Lt. H. R. Schlesinger
1st Lt. J. E. Shelton, Jr.
1st Lt. T. B. Small
1st Lt. H. B. Stone
1st Lt. K. C. Summicht
1st Lt. S. K. Thompson
1st Lt. D. E. Whittenberg
1st Lt. J. F. Wilcoxson, Jr.

2nd Lt. I. A. Allaire
2nd Lt. F. B. Allen
2nd Lt. L. M. Asbury
2nd Lt. W. M. Baldridge
2nd Lt. C. G. Beard
2nd Lt. D. H. Binder

Army and Navy Personnel who contributed this information concerning the equatorial front. (cont'd)

2nd Lt. K. J. Bogert
2nd Lt. R. J. Cherkauer
2nd Lt. G. M. Dann
2nd Lt. R. I. Fleming
2nd Lt. D. S. Gurman
2nd Lt. R. A. Klussendorf
2nd Lt. J. L. Lindenmuth
2nd Lt. A. P. Lundberg
2nd Lt. A. M. Mason
2nd Lt. J. O. Meeks
2nd Lt. R. M. Richberger
2nd Lt. J. E. Qink

2nd Lt. P. W. Scott
2nd Lt. G. P. Sheen
2nd Lt. P. H. Smith
2nd Lt. W. C. Touchton, Jr.
2nd Lt. H. D. Vincent
2nd Lt. R. L. Walker
2nd Lt. W. B. Walling
2nd Lt. W. R. Williams
2nd Lt. L. C. Wright

CWO L. M. Sympson

I N D E X

		Page
1	How much experience have you had in flying through the equatorial front?	1
2	What is your general impression of the equatorial front as compared with cold fronts in temperate climates?	7
3	Do you prefer the sea or land route and why?	14
4	What is your favorite time of day for flying through the front?	21
5	What is your opinion of the front during different seasons? (Weather, turbulence, etc.)	27
6	When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?	36
7	What special phenomena have you encountered in flights in the area of the front?	
	a. Is there usually much lightning?	
	b. Have you ever encountered hail?	
	c. What are the prevailing winds at flight levels north and south of the front?	42
8	Is there any relationship between the width of the front and its intensity?	66
9	What is usually the state of the sea in the area of the front?	71
10	What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?	76
11	Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?	87
12	What suggestions can you make for improving forecasts?	92
13	Are there any general comments you would care to make regarding weather in this area?	99

1. How much experience have you had in flying through the equatorial front?

Col. R. M. Bristol: "Have flown through the front about 10 times."

Col. E. M. Day: "Approximately 15 times through the front."

Col. P. B. Griffith: "About 25 trips."

Col. J. E. Roberts: "I have flown through the equatorial front quite a number of times during the past 13 months."

Lt. Col. J. G. O'Brien: "18 separate trips."

Lt. Col. A. F. Tucker: "Twice through the front west of South America and six times through the front east of South America. Note — I have practically no experience through the front west of South America."

Maj. D. W. Bailey: "Have been in this area about 17 months. Flew through it about 5 days a week for the first 5 months and only a few times a month since then."

Maj. A. H. Carver, Jr.: "Approximately 16 months — 8 or 10 months of this period was employed flying in the patrol lanes."

Maj. C. M. Cramer: "554 hours patrol time over a period of one year, and approximately 100 hours administrative flying over a period of 21 months."

Lt. Cmdr. R. K. Henderson, USNR: "In this area (north from Galapagos) 20 times."

Maj. J. A. Irwin: "14 or 15 times through the front."

Maj. D. L. Roberts: "28 months."

Maj. F. A. Sanders: "35 months in this area. Most weather encountered on south trips flown by this organization."

Maj. O. G. Stephens: "Since May 1942."

Capt. J. W. Adair: "800 hours."

Capt. L. H. Agard: "I have flown through the front approximately twelve times."

Capt. W. F. Bond: "Regularly while flying patrols out of Guatemala City; occasionally since that time. Total 22 months."

1. How much experience have you had in flying through the equatorial front?

Capt. R. M. Brown: "Approximately 30 to 50 penetrations."

Capt. L. W. Cunningham: "23 months of patrols and cross-country flying through it — 1300 hours."

Lt. H. Dickerson, USNR: "4 months — about 35 times through the front."

Capt. J. H. Eichler: "Have flown through it 150 times and tried to fly through it about 5 additional times."

Capt. C. V. Eld: "About 2 years."

Capt. C. P. Felice: "For the past 2 years, since I have been stationed here, I have been flying through the front quite regularly."

Capt. C. E. Glassmeyer, Jr.: "This information was compiled from actual navigational logs over a period of 18 months, 11 months participating in patrol flights, based at Galapagos Islands. NOTE: Greatest number of patrol flights from which this information was derived were flown at 10,000 ft. to 15,000 ft."

Capt. W. R. Hansen: "Frequent flights through for the past 18 months, 6 months of which was patrolling through the front."

Capt. J. M. Huffman, Jr.: "18 months."

Capt. W. H. Hunt: "I have been in this area for 18 months during which time I have flown through the front about 50 times."

Capt. W. R. Knight: "A year and a half. For first 4 active months, passage through the front were made almost daily on patrols from Galapagos to Guatemala City."

Capt. S. E. Nast: "From June to November 1942, about 80 trips were made through the front on the normal patrol lanes of that period between Galapagos and Guatemala City. Since November 1942, approximately thirty passages through the equatorial front have been made, spread equally over the routes Albrook to Salinas, Albrook to Galapagos, and Galapagos to Guatemala City. These latter thirty trips have been made, at all seasons of the year. Non of the trips were made at night. The patrols were made along prescribed tracks with no digressions allowed, except in case of extreme weather. In my own experience the weather was never found so extreme as to necessitate altering course. On the other 30 flights changes in course have been permissible, but rarely necessary, and even when necessary they have been slight — to avoid a small region of rain, or, when flying above bases of clouds, to skirt towering cumulus."

1. How much experience have you had in flying through the equatorial front?

Capt. C. A. Neel: "Approximately 800 hours over water in the Pacific over a period of 20 months."

Capt. T. T. Ott: "Approximately 2 years."

Capt. R. W. Scheller: "Have flown through front approximately 12 times."

Lt. I. J. Scott, USNR: "6 times — from May to October."

Capt. M. W. Williams: "Started flying the equatorial front in January 1943. For the past 8 months flights through the front have been occasional."

Lt. (jg) H. W. Barradale, USNR: "2 months of actual flying during 18 month period."

1st Lt. B. L. Bergesen: "Have flown through the equatorial front over an 18 month period which includes both the wet and dry seasons."

1st Lt. W. E. Christensen: "Flown through it often the last 18 months."

1st Lt. J. L. Cuneo: "8 months."

1st Lt. J. T. Dowling, Jr.: "During a period of nearly 2 years, I have approximately 100 hours of actual logged instruments through the front."

1st Lt. S. P. Easley: "800 hours."

1st Lt. E. H. Gibb, Jr.: "Some experience over a period of 17 months."

1st Lt. G. E. Hall: "Approximately 18 months in area."

1st Lt. W. J. Hastie: "15 months."

Lt. (jg) T. L. Healey: "6 months."

1st Lt. R. E. Henderson: "About 3 trips both ways."

1st Lt. F. W. Holer: "20 trips."

1st Lt. J. R. Irwin: "8 months."

1st Lt. E. E. Koken: "1 year — security patrol Guatemala City to Galapagos."

1st Lt. J. C. Kline: "Not much."

1. How much experience have you had in flying through the equatorial front?

1st Lt. V. W. Lange: "Approximately 50 crossings between Galapagos and Guatemala, Galapagos and the Canal Zone, and Salinas and the Canal Zone."

1st Lt. A. W. Luce: "About 16 months. Local flying at Galapagos with numerous patrols to Guatemala and circuit patrols from Galapagos to as far north as 6° N. Many flights into the Zone."

1st Lt. H. B. McMullen: "In the past year and a half I have made about 50 trips through the front and back."

1st Lt. G. L. Newkirk: "Flew patrols from Guatemala City to Galapagos Islands from January 1943 to November 1943 and intermittently since."

1st Lt. G. F. Piker: "18 months."

1st Lt. T. L. Ruddy: "About 18 months."

1st Lt. Harry C. Sachs: "18 months in this area. 11 months flying in front."

1st Lt. T. V. Sawyer: "17 months approximately. 15 trips through front."

1st Lt. H. R. Schlesinger: "I have had considerable experience in flying through the front and most of it in the past 10 months."

1st Lt. J. E. Shelton, Jr.: "About 19 months."

1st Lt. T. B. Small: "I have been stationed in this area since May 1943, however did not fly through the frontal area, but a few times, until April 1944. Since April of this year being stationed at Galapagos I have averaged several trips through the frontal area a month."

1st Lt. H. Stone: "Regular patrols from January 1943 to January 1944."

1st Lt. K. C. Summicht: "12 months patrol, 10 months periodical cross country."

1st Lt. S. K. Thompson: "I have been flying regularly through the front for about 16 months."

1st Lt. J. F. Wilcoxson, Jr.: "Approximately 17 months."

1st Lt. D. E. Whittenberg: "40 or more flights including patrol and cross-country flights."

2nd Lt. I. A. Allara: "5 months."

1. How much experience have you had in flying through the equatorial front?

2nd Lt. F. B. Allen: "12 times."

2nd Lt. L. M. Asbury: "17 months — approximately 50 trips through the front."

2nd Lt. W. M. Baldridge: "Have been in area about 5 months, going through the front about 3 times a month."

2nd Lt. C. G. Beard: "Several times."

2nd Lt. D. H. Binder: "Very little."

2nd Lt. K. J. Bogert: "16 times."

2nd Lt. R. J. Cherkauer: "Have been flying in the area of front about 5 months."

2nd Lt. G. M. Dann: "3 flights through the front."

2nd Lt. R. L. Fleming: "4 cross-country flights to Salinas, Ecuador."

2nd Lt. D. S. Gurman: "4 to 5 times Galapagos to Panama and back. 6 to 7 times Galapagos to San Jose, Guatemala and back."

2nd Lt. R. A. Klussendorf: "16 months — 11 months out of Galapagos on patrol."

2nd Lt. J. H. Lindenmuth: "2 flights."

2nd Lt. A. P. Lundberg: "I have made approximately 10 trips through the equatorial front."

2nd Lt. A. M. Mason: "30 to 50 crossings of the front."

2nd Lt. J. O. Meeks: "6 months continuous operations and 21 months flying in the area."

2nd Lt. R. M. Richberger: "20 months."

2nd Lt. J. E. Rinks: "Galapagos to Panama about 20 times. Galapagos to San Jose, Guatemala about 20 times."

2nd Lt. P. W. Scott: "About 12 trips through it."

2nd Lt. G. P. Sheen: "2 trips."

2nd Lt. P. H. Smith: "I have penetrated the front at least 30 or 40

1. *How much experience have you had in flying through the equatorial front?*

times."

2nd Lt. W. C. Touchton, Jr.: "Quite a bit of experience in the past few months."

2nd Lt. H. D. Vincent: "5 months. During wet season."

2nd Lt. R. L. Walker: "4 trips."

2nd Lt. W. B. Walling: "About a dozen times."

2nd Lt. W. R. Williams: "Very little. 5 times."

2nd Lt. L. C. Wright: "6 months."

CWO L. M. Sympson: "I have been flying through and near the equatorial front since January 1942. Prior to that I made occasional trips as a civilian pilot through the area in 1937."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

Col. R. M. Bristol: "Considerably more turbulence and rain."

Col. E. M. Day: "Rainfall is much heavier; front is more spotty and ragged. Not as well defined."

Col. P. B. Griffith: "The equatorial front is more turbulent with more rain, but generally not as extensive."

Col. J. E. Roberts: "In all the times I have flown through the equatorial front I have never encountered anything that will compare to a cold front in a temperate climate. By this I mean turbulence, ice, etc."

Lt. Col. J. G. O'Brien: "Heavier rain and much more turbulent when front is in the same status as cold fronts in temperate climates."

Lt. Col. A. F. Tucker: "Considerably less of a problem than temperate fronts. Bad features are intense rain, lack of knowledge of its position and intensity due to few reports. Believe the turbulence is seldom of the extreme nature possible farther north."

Maj. D. W. Bailey: "I have had very little experience with cold fronts in temperate climates. I am not qualified to answer this question."

Maj. A. H. Carver, Jr.: "The equatorial front is not as severe as the cold fronts of the temperate climates, and very rarely does one get the turbulence experienced in cold fronts. Rain is extremely heavy in the equatorial front, but icing, snow, and the like are never experienced. The equatorial front is much less hazardous."

Maj. C. M. Cramer: "I believe the equatorial front, although it has greater convectional development, does not have the hazards to flying of a cold front, such as ice, hail, lightning, or extreme convectional currents in mountainous country."

Lt. Cmdr. R. K. Henderson, USNR: "A great deal less turbulence, lighter rain, and is much safer to fly through than a cold front in the temperate zone."

Maj. J. A. Irwin: "Not nearly as severe as cold front in temperate climate."

Maj. D. L. Roberts: "I believe this front, when fully developed, is as intense as fronts in any other region."

Maj. F. A. Sanders: "My belief is that the equatorial front, as compared with the cold fronts of temperate climates, is generally much more severe."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

Maj. O. G. Stephens: "My flying experience in temperate climates has been limited; therefore I can make no comparison."

Capt. J. W. Adair: "Never flew through a cold front."

Capt. L. H. Agard: "I don't know very much about cold fronts in temperate climates. But it is my belief that the equatorial front is not nearly as severe."

Capt. W. F. Bond: "Much milder."

Capt. R. M. Brown: "It can be penetrated at low altitudes with a minimum of turbulence and with a minimum of fear of icing or ground obstructions."

Capt. L. W. Cunningham: "Haven't had much experience in temperate cold fronts."

Lt. H. Dickerson, USNR: "Equatorial front down low (50 ft. to 1000 ft.) is a lot less violent as compared to a cold front in temperate climates."

Capt. J. H. Eichler: "Equatorial front is easier to handle because of good visibility right up to cumulonimbus clouds, but wide variations in course and altitude are necessary to stay semi-contact. I have not had much experience with cold fronts, about 3 encounters."

Capt. C. V. Eld: "Rather moderate."

Capt. C. P. Felice: "Since all of my time on actual missions has been spent down here, I cannot make the comparison with the cold fronts in the temperate climates."

Capt. C. E. Glassmeyer, Jr.: "Not having flown in cold fronts in temperate climates my comparison would have no basis of evaluation; however, from all information and instructions covering the subject, with which I have become acquainted, I would say the equatorial front is generally less severe."

Capt. W. R. Hansen: "As I have not flown through many fronts in temperate climates I am not prepared to answer this. Equatorial front is much thicker."

Capt. W. H. Hunt: "I have had no experience flying through cold fronts."

Capt. W. R. Knight: "Am not acquainted with frontal conditions in temperate climates."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

Capt. S. E. Nast: "Never having flown in temperate climates I can make no comparison between the equatorial front and the cold fronts of other regions. From a purely academic knowledge of cold fronts, and from discussions with those who have had experience in them, I should judge that the equatorial front is much milder, resembling a semi-stationary front. On more than one occasion I have observed it to be nothing more than two different air masses, that is, with different temperatures and air densities (as indicated by a change in indicated air speed without a change in true air speed for the same flight level), but without weather phenomena."

Capt. C. A. Neel: "The equatorial front seems much less severe than fronts in the States."

Capt. T. T. Ott: "Cold fronts in temperate climates are, on the average, less intense. They cover a much smaller area, are more clearly defined at the beginning, middle, and end."

Capt. R. W. Scheller: "Have had little experience with cold fronts in temperate climates on which to base an opinion."

Lt. I. J. Scott, USNR: "The equatorial front has less turbulence, but more rain and is wider."

Capt. E. L. Stevens: "Cold front — less turbulence. Equatorial front — no ice."

Capt. M. W. Williams: "I have no knowledge of cold fronts, therefore cannot voice an opinion."

Lt. (jg) H. W. Barradale, USNR: "Very mild."

1st Lt. B. L. Bergesen: "My impression is the equatorial front is more severe than a cold front in temperate climates."

1st Lt. J. L. Cuneo: "More turbulent."

1st Lt. J. T. Dowling, Jr.: "The equatorial front is ordinarily milder than the usual cold front as to turbulence, except during the tropical hurricane weather."

1st Lt. E. H. Gibb, Jr.: "Not as intense and turbulence is not as bad."

1st Lt. C. E. Hall: "Equatorial front has no icing conditions and not as solid -- generally you can zigzag your way through."

1st Lt. W. J. Hastie: "It can be equally severe."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

Lt. (jg) T. L. Healey, USNR: "Equatorial front has much more rain in it, and wind shifts, while the cold front has more turbulence and cumulonimbus clouds."

1st Lt. R. E. Henderson: "It is more severe in turbulence and has lower ceilings."

1st Lt. F. W. Holer: "I have never flown in cold fronts, but I assume that the equatorial front is more severe."

1st Lt. J. R. Irwin: "Worse."

1st Lt. E. E. Koken: "Both fronts can be violent in accordance with cloud formations. The equatorial front more so than cold fronts."

1st Lt. J. C. Kline: "No impression."

1st Lt. V. W. Lange: "I have never flown through a cold front in a temperate climate."

1st Lt. A. W. Luce: "The equatorial front is not as severe as cold fronts except possibly at 10,000 ft. to 20,000 ft. The equatorial front is wider, has more rain, and more variable winds. Turbulence can be very severe at low altitudes in the equatorial front. There is no icing or hail in the equatorial front from 0 - 15,000 ft."

1st Lt. H. B. McMullon: "The equatorial front has several advantages over temperate climate fronts. The icing level in the equatorial front is about 15,000 ft., thus eliminating the use of icing equipment on wings props, etc. Carburetor ice, however, is present at any time or altitude. Where temperate fronts usually have a definite movement, the equatorial front just hangs, or for all intents and purposes, is stationary."

1st Lt. G. L. Newkirk: "Very little icing conditions in the equatorial front."

1st Lt. G. F. Piker: "I have had no experience flying through fronts in temperate climates."

1st Lt. T. L. Ruddy: "Normally it is not as rough as a cold front."

1st Lt. H. C. Sachs: "The equatorial front is the only one that I have flown through. From written material on cold fronts, the equatorial front must be less severe."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

1st Lt. T. V. Sawyer: "The equatorial front is much more moderate."

1st Lt. H. R. Schlesinger: "I have never flown through fronts in temperate climates, but would think the equatorial front to be less severe in intensity."

1st Lt. J. E. Shelton, Jr.: "No experience with temperate climates."

1st Lt. T. B. Small: "I have flown very little in weather other than in this area."

1st Lt. K. C. Sumnicht: "I have limited experience in temperate climate fronts, but believe the equatorial front less severe."

1st Lt. S. K. Thompson: "I don't know too much about cold fronts, but I do know that the equatorial front can be plenty rugged at times."

1st Lt. J. F. Wilcoxson, Jr.: "The equatorial front is less predictable in flight. Turbulence is usually greater. Violent storm areas are more difficult to avoid."

1st Lt. D. E. Whittenberg: "No experience with cold fronts."

2nd Lt. I. A. Ailara: "The equatorial front consists of scattered turbulence and rain, and is somewhat mild as compared to temperate climate fronts."

2nd Lt. F. B. Allen: "No experience in temperate climates."

2nd Lt. L. M. Asbury: "No cross-country flying experience except in this area."

2nd Lt. W. M. Baldridge: "No experience with temperate climate cold fronts."

2nd Lt. D. H. Binder: "The cold front has less turbulence but more hail, icing, and other adverse weather conditions."

2nd Lt. K. J. Bogert: "Never flew in a cold front."

2nd Lt. R. J. Cherkauer: "The equatorial front is far less turbulent and lacks true characteristics of a front formed by two definite air masses."

2nd Lt. G. M. Oann: "I have never flown in a front in temperate climates."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

2nd Lt. R. L. Fleming: "The equatorial front is more persistent."

2nd Lt. D. S. Gurman: "Temperate climate cold fronts are more severe, having turbulence, hail, icing, lightning, as compared to rain and turbulence of the equatorial front."

2nd Lt. R. A. Klussendorf: "Having never flown through cold front, I do not know from experience. From information I have studied, I gather that cold fronts are more severe."

2nd Lt. J. H. Lindenmuth: "The equatorial front has heavier rain, and clouds not as high, and there is less turbulence (over water)."

2nd Lt. A. P. Lundberg: "I have encountered weather in temperate climates only twice, therefore, I am not qualified to voice an opinion."

2nd Lt. A. M. Mason: "I believe the equatorial front is milder if you can fly low - 1000 ft."

2nd Lt. J. O. Meeks: "Have never flown in the United States enough to make a comparison."

2nd Lt. R. M. Richberger: "The equatorial front is more turbulent, but there is less danger of icing."

2nd Lt. J. E. Rinks: "Usually not as rough as cold fronts in temperate climates."

2nd Lt. P. W. Scott: "The equatorial front is much more turbulent than temperate climate cold fronts."

2nd Lt. G. P. Sheen: "Much rougher."

2nd Lt. P. H. Smith: "The equatorial front is always the same, varying only in the intensity of rain and turbulence; while the cold front varies with rain, sleet, ice, and snow. I have not had much experience in cold fronts."

2nd Lt. W. C. Touchton, Jr.: "Milder."

2nd Lt. H. D. Vincent: "It is neither worse nor better."

2nd Lt. R. L. Walker: "Not as rough, but more extensive."

2nd Lt. W. B. Walling: "Milder, especially at times."

2. *What is your general impression of the equatorial front as compared with cold fronts in temperate climates?*

2nd Lt. W. R. Williams: "No experience with fronts in temperate climates."

2nd Lt. L. C. Wright: "Less predictable."

CWO L. M. Sympson: "Generally speaking, cold fronts in temperate climates are marked by a sudden change in cloud conditions and a marked change of wind direction and force, whereas the equatorial front has gradual cloud changes from either south or north to the center. Temperature changes through the equatorial front are quite small, although considerable changes in air density are common."

3. Do you prefer the sea or land route and why?

Col. R. M. Bristol: "Sea route in heavy ships; land route in lighter ships."

Col. E. M. Day: "Sea route. Turbulence is less, terrain features are not a concern, and weather as a general rule is less intense."

Col. P. B. Griffith: "Sea route. You can go through on instruments without fear of getting into the mountains. The land sometimes necessitates flying quite high on instruments."

Col. J. E. Roberts: "Prefer the sea route. Turbulence does not seem to be so severe as over land. Also the sea route affords better choice of altitude in which to fly through the front. Normally, I prefer to penetrate the front at about 7000 ft."

Lt. Col. J. G. O'Brien: "Sea route with multi-engine aircraft. Offers a more direct route, and also eliminates terrain hazards."

Lt. Col. A. F. Tucker: "Sea. Nothing to hit if you desire to fly low."

Maj. D. W. Bailey: "I prefer the sea route as you can fly low, 1000 ft. to 1500 ft. and the front is not as rough at this altitude. The thunderheads and cumulus are usually high and more violent over land than over water in this area."

Maj. A. H. Carver, Jr.: "Sea by day and land by night. Flying over water eliminates worry about hidden obstructions. Minimum altitude may be flown safely, therefore, whenever preferred."

Maj. C. M. Cramer: "Sea route. No obstructions at any altitude and it is usually the shortest route."

Lt. Cmdr. R. K. Henderson, USNR: "Sea route, because we can fly on instruments for hours at a time without worrying about mountains."

Maj. J. A. Irwin: "Sea route. Less turbulence and better choice of altitudes."

Maj. D. L. Roberts: "The sea route is favored; if necessary flying can be done at low altitudes on instruments."

Maj. F. A. Sanders: "Sea route because of safety from mountains. Turbulence and rain can be flown through at any desired altitude with no fear of crashing into mountains."

Maj. O. G. Stephens: "I prefer the sea route because of the distance saved and lack of rock-filled clouds."

3. Do you prefer the sea or land route and why?

Capt. J. W. Adair: "Sea. Generally less turbulence and no problem of altitude."

Capt. L. H. Agard: "I prefer the sea route because it has less cloud build-ups and turbulence."

Capt. W. F. Bond: "Sea. Can penetrate the equatorial front at low altitudes without danger of flying into the ground. Seems more severe over land."

Capt. W. M. Brown: "I prefer the sea route. At times it is advisable to fly as low as 500 ft. This could not be done safely over the land route."

Capt. L. W. Cunningham: "Sea. Can choose altitudes at will and not worry about mountains - smooth flying on the deck."

Lt. H. Dickerson, USNR: "Sea, because the higher you go into a front, the worse it is, while over water you can usually go under."

Capt. J. H. Eichler: "The sea route is safe from terrain obstacles when weather is generally bad. The land route is sometimes better before 1400Z, but the weather must be definitely contact, for instruments can not be flown in mountains."

Capt. C. V. Eld: "Sea."

Capt. C. P. Felice: "For navigational purposes and because of the element of time saving, the sea route is preferable. However, when at times it has appeared impassable on a direct sea course, the land routes usually afforded easy passage."

Capt. C. E. Glassmeyer, Jr.: "From a navigational standpoint I prefer the sea route mainly because turbulent weather can generally be avoided by flying at minimum altitudes. This can be done with no fear of flying into mountains, obstructions, etc."

Capt. W. R. Hansen: "Sea. There is no danger of down drafts taking you clear in; you are always stopped at three or four hundred feet. No mountains to worry about."

Capt. J. M. Huffman, Jr.: "Sea - less turbulent."

Capt. W. H. Hunt: "I prefer the sea route because it is then possible to fly at 1000 ft. or less and avoid most of the severe turbulence."

3. Do you prefer the sea or land route and why?

Capt. W. R. Knight: "Sea routes. Altitudes shown on maps in this area are often as much as 2000 ft. off and cannot be relied upon. Over water flying can be done at any altitude with safety."

Capt. S. E. Nast: "I prefer a sea route, by all means. Rock-center clouds are automatically eliminated, so let-downs and climbs can be made without fear of obstacles. For the same reason, the surface, with its minimum turbulence, can be flown safely. In connection with surface flying the obviation of icing hazards should be considered an advantage (this applies to passing through the front, only), as should the avoidance of vertical circulation of upper altitudes.

"From a navigator's standpoint the sea route is preferable because the winds are not subject to all the modifications encountered over land or in mountainous regions. Here again, flying through the front at the surface is an advantage. The sometimes frequent wind shifts can be estimated accurately enough for practical purposes.

"It should be noted, for the benefit of those not familiar with the region, that estimates of surface winds in the region of the equatorial front should not be relied upon, except at the surface. In some 500 hours of navigating over the waters of the West Indies, I found it justifiable to assume the surface wind to hold good up to 2000 ft. altitude. Generally, I should say, that in or near the equatorial front, except in perfectly calm regions, surface winds do not prevail above 500 ft. On several occasions, after disappointing and embarrassing experiences, I have measured by wind stars, the wind from 600 to 800 ft. In winds as strong as 12 to 16 knots the direction between surface and flight level was from 90° to 180° different, quite enough to cause a great difference in accuracy of navigation. This occurred without a cloud layer between flight level and surface."

Capt. C. A. Neel: "I prefer sea routes because of less turbulence and no danger of mountains at lower levels."

Capt. T. T. Ott: "The sea route is preferable, because there is freedom of action in choosing flight altitude and path. The water build-up during the day is usually less severe than that over land."

Capt. R. W. Scheller: "Sea route, better choice of altitude to avoid turbulence and precipitation and also freedom from the mental strain of flying over unknown terrain."

Lt. I. J. Scott, USNR: "I prefer the sea route because I can fly low over the water with safety."

3. Do you prefer the sea or land route and why?

Capt. E. L. Stevens: "Sea, because there are no mountains to run into."

Capt. M. W. Williams: "The sea route always. Turbulence over land is usually more severe than over the sea, and you can always be sure there are no terrain hazards."

Lt. (jg) H. W. Barradale, USNR: "Sea."

1st Lt. B. L. Bergosen: "The sea route because at low altitude (500 ft.) the front is confined to light turbulence and rain showers."

1st Lt. W. E. Christensen: "Sea. I can fly under the front if need be."

1st Lt. J. L. Cunso: "Sea."

1st Lt. J. T. Dowling, Jr.: "The sea route is always much less turbulent."

1st Lt. S. P. Easley: "Sea, less turbulence when flying under 2500 ft."

1st Lt. E. H. Gibb, Jr.: "The sea route. Regardless of the intensity of any weather encountered you can usually get below it if need be. Also the mental hazard of mountains is eliminated."

1st Lt. C. E. Hall: "You can always fly under the front if at sea."

1st Lt. W. J. Hastie: "It is impossible to prejudge; you have to simply pick your way through."

Lt. (jg) T. L. Healey, USNR: "Land. Navigation is easier."

1st Lt. R. E. Henderson: "Sea route, because it is possible to go underneath the front."

1st Lt. F. W. Holer: "I prefer the sea route because I can fly at low altitudes when conditions are severe."

1st Lt. J. R. Irwin: "Sea -- no mountains to worry about."

1st Lt. E. E. Koken: "Sea route, it is possible to fly low because of no land obstructions."

1st Lt. J. C. Kline: "No preference."

1st Lt. V. W. Lange: "Definitely the sea route. I believe the sea route to be somewhat less intense, and also because I like to fly through at low altitude."

3. Do you prefer the sea or land route and why?

1st Lt. A. W. Luce: "Sea route preferred because lower altitude can always be used when high cumulonimbus is encountered. Land route requires high flying and possible turbulent conditions."

1st Lt. H. B. McMullon: "The sea route is preferable because it is direct and there is no terrain to worry about. The icing level is lower over land."

1st Lt. G. L. Newkirk: "Sea. Much smoother and safer under instrument conditions."

1st Lt. G. F. Piker: "The sea, because there is less turbulence and no obstacles."

1st Lt. T. L. Ruddy: "I have never flown anything but the sea route."

1st Lt. H. C. Sachs: "Sea route. When the turbulence becomes great, one may fly as low as desired without fear of obstacles. Also surface winds benefit the navigator while flying at 2000 ft. or less."

1st Lt. T. V. Sawyer: "Sea -- air is smoother, no obstructions."

1st Lt. H. R. Schlesinger: "I prefer the sea route because of the wider choice of altitudes, less turbulence, and the freedom to deviate from course to penetrate the front at a more desirable point, which cannot always be done over land because of mountains and terrain."

1st Lt. J. E. Shelton, Jr.: "Sea -- no worry about mountains."

1st Lt. T. B. Small: "The sea route. There is usually considerable weather built up with turbulence over Cape Mala in afternoon. The Bay of Panama is usually fairly open or with only scattered rain; and there is no danger of obstructions at low altitudes by this route."

1st Lt. H. B. Stone: "Sea. Allows for passage at lower altitude."

1st Lt. K. C. Sumnicht: "I prefer the sea route, because most severe turbulence may be avoided by minimum altitude flight without fear of obstructions."

1st Lt. S. K. Thompson: "I prefer the sea route. My reason is that it is the shortest path to destination, usually the shortest route through the front, and best of all there are no mountains under you. With the amount of turbulence sometimes encountered in the front while on instruments, it is nice to know that there are no hills to run into."

3. Do you prefer the sea or land route and why?

1st Lt. J. F. Wilcoxson, Jr.: "Depends on position of front. If clouds are over water route, 90% of the time the land route will be fairly clear and vice versa."

1st Lt. D. E. Whittenberg: "The sea route is safer and smoother. The front and bad cloud formations can be more easily dodged."

2nd Lt. I. A. Ailara: "Sea route. A lesser degree of turbulence in the from which is not as concentrated as over land."

2nd Lt. F. B. Allen: "Sea route, less turbulent, no obstacles."

2nd Lt. L. M. Asbury: "The sea route is usually a smoother trip."

2nd Lt. W. M. Baldridge: "Have flown sea route only, but would prefer sea route to land. Less turbulent and intense and you know how low you can go."

2nd Lt. C. G. Beard: "Sea route, you can go under the front."

2nd Lt. D. H. Binder: "The sea route because weather conditions are not as turbulent over sea as over land."

2nd Lt. K. J. Bogert: "Sea route - you can go under the front."

2nd Lt. R. J. Cherkauer: "Have only flown thru equatorial front over the sea."

2nd Lt. G. M. Dann: "Sea. The front is less active and less dangerous."

2nd Lt. R. L. Fleming: "The sea route. Better flying conditions exist and there are no obstructions to flight. Any desired altitude may be flown."

2nd Lt. D. S. Gurman: "I prefer sea routes because the fronts seem to be less intense."

2nd Lt. R. A. Klussendorf: "Sea route. I prefer to fly low through weather and knowing there are no obstructions rising above sea level is very satisfying."

2nd Lt. J. H. Lindenmuth: "Sea route, flying is possible at low altitude without danger of obstacles."

2nd Lt. A. P. Lundberg: "I prefer the sea route as flying under the front is quite easy."

3. Do you prefer the sea or land route and why?

2nd Lt. A. M. Mason: "Sea route, because it is smoother air and has no obstructions to clear or fly around."

2nd Lt. J. O. Meeks: "Sea route is preferable; less turbulence makes it possible to fly at a low altitude under the extreme turbulence."

2nd Lt. R. M. Richberger: "Sea route — possible to fly under the front without danger of hitting mountains."

2nd Lt. J. E. Rinks: "Sea route. No danger of hitting obstructions."

2nd Lt. P. W. Scott: "Sea. No terrain to worry about."

2nd Lt. G. P. Sheen: "Sea route, go underneath weather without danger of obstacles."

2nd Lt. P. H. Smith: "I prefer the sea route for it is always possible to drop to a minimum altitude below the turbulence."

2nd Lt. W. C. Touchton, Jr.: "Land. Navigational standpoint."

2nd Lt. H. D. Vincent: "Sea route. The front isn't usually as high or rough as over land."

2nd Lt. R. L. Walker: "Sea because you can always fly under the clouds and no high ground endangers a let down.

2nd Lt. W. B. Walling: "Sea — less danger of running into overcast at low altitudes."

2nd Lt. W. R. Williams: "Sea. No other route."

2nd Lt. L. C. Wright: "Sea—better possibilities of flying under front."

CWO L. M. Sympson: "Purely as a means of safety, the sea route is best. The front seems to have a slight east-west motion so it is possible to have less cloud formations over land than over the ocean. However, there are no mountains over the water and instrument flying at low levels is much safer. There also appears to be less turbulence over the water."

4. What is your favorite time of day for flying through the front?

Col. R. M. Bristol: "From 1200Z to 1600Z. Have never tried it at night."

Col. E. M. Day: "From 1400Z to 1700Z. Night activity has dissipated front and afternoon build-up has not yet begun."

Col. P. B. Griffith: "Early morning."

Col. J. E. Roberts: "Depends on its location. If I am flying well out to sea, I have no particular choice as to time of day. However, in all probability you will encounter heavier rain during the afternoon period and at night."

Lt. Col. J. G. O'Brien: "1300Z to 1700Z."

Lt. Col. A. F. Tucker: "Night time in order to make arrival one hour after dawn, which is usually the best arrival time in the tropics. Daytime if terminal weather is no problem."

Maj. D. W. Bailey: "From my observation it seems the time of day makes little difference over water but over land it is less violent in the morning."

Maj. A. H. Carver, Jr.: "Early morning is perhaps the best time for flying through the front. It usually has not built up to proportions existing later in the day."

Maj. C. M. Cramer: "Makes no difference because of the type of aircraft we fly (B-24), however it is believed early morning is best."

Lt. Cmdr. R. K. Henderson, USNR: "Morning. There are fewer thunderheads built up."

Maj. J. A. Irwin: "Early in the morning."

Maj. D. L. Roberts: "Generally, I don't think the time of the day has much to do with the intensity of the front. I have found it bad at all times of the day."

Maj. F. A. Sanders: "The front can change too rapidly for me to have any favorite time. Our planes usually fly through at mid-morning or mid-afternoon to late afternoon."

Maj. O. G. Stephens: "I have found that afternoons are slighly more favorable."

Capt. J. W. Adair: "Morning."

4. What is your favorite time of day for flying through the front?

Capt. L. H. Agard: "As early in the morning as possible; it is built up very little then."

Capt. W. F. Bond: "Morning."

Capt. R. M. Brown: "Immaterial."

Capt. L. W. Cunningham: "Not much difference as far as I'm concerned."

Lt. H. Dickerson, USNR: "In the morning, because in the afternoon it has had time to build up."

Capt. J. H. Eichler: "Over sea later than 1900Z."

Capt. C. V. Eld: "1400Z to 2000Z."

Capt. C. P. Felice: "As far as I am concerned, there is no special time for flying thru the front that I would call my favorite time. I have flown thru it at all times during the day, but never at night. I could not say that the front is more suitable for flying at one particular time during the day than any other time; change in intensity of the front is a matter of hours, rather than days, and it can build up or decrease at any time during the day."

Capt. C. E. Glassmeyer, Jr.: "From my experience, between the hours of 1100Z until 1700Z or 1800Z was found the most favorable time to fly through the front."

Capt. W. R. Hansen: "Early morning is usually best, before the front gets built up."

Capt. J. M. Huffman, Jr.: "Immaterial."

Capt. W. H. Hunt: "I prefer flying through the front in the afternoon."

Capt. W. R. Knight: "Morning. The build-up seems to increase during the day. However, most flights to Panama were completed early because of terminal and not frontal conditions. There is actually very little change over the ocean thru the day."

Capt. S. E. Nast: "Where flight schedules have been left to the determination of the pilot, the choice of time for passing through the front has been influenced not so much by frontal activity as by terminal weather. Because flying conditions at Albrook, Salinas, and Guatemala City are generally better in the morning than in the afternoon, take-offs for flights in which I have participated have been scheduled for earliest practical landing time at destination, without regard for frontal activity.

4. What is your favorite time of day for flying through the front?

"On numerous patrols out of Galapagos I have had opportunity to fly through the front both in the morning and afternoon of the same day. In that area I should judge the time of day to be not too important a factor, I believe, however, that for the most part it does not have the violence which develops closer to land, as in the Bay of Panama. In this latter region, my experience with afternoon flights through the front is almost nil."

Capt. C. A. Neel: "Early mornings."

Capt. T. T. Ott: "Early afternoon, from 1800Z to 2100Z."

Capt. R. W. Scheller: "Early in the day."

Lt. I. J. Scott, USNR: "Over land in the early morning, 1100Z to 1400Z, over water, no preference."

Capt. E. L. Stevens: "About ten o'clock in the morning."

Capt. M. W. Williams: "It seems to me that the morning hours are best for flying through the frontal areas. In the afternoon more thunderstorm activity is usually encountered."

Lt. (jg) H. W. Barradale, USNR: "No choice."

1st Lt. B. L. Bergesen: "The early morning before the front builds up."

1st Lt. W. E. Christensen: "Early morning."

1st Lt. J. L. Cuneo: "Afternoon."

1st Lt. J. T. Dowling, Jr.: "During the day before noon."

1st Lt. S. P. Easley: "Mornings - usually less build-up in cumulonimbus clouds."

1st Lt. E. H. Gibb, Jr.: "Early morning when the sun first comes up."

1st Lt. G. E. Hall: "From sunup to noon."

1st Lt. W. J. Hastie: "None. It can be severe at anytime of day."

Lt. (jg) T. L. Healey, USNR: "As early in the morning as possible, as long as it is daylight."

1st Lt. R. E. Henderson: "Early morning, about 1100Z."

4. What is your favorite time of day for flying through the front?

1st Lt. F. W. Holer: "I think the best time is just before sunset. Many times, coming in late, I have encountered good weather."

1st Lt. E. E. Koken: "Morning."

1st Lt. J. C. Kline: "Day."

1st Lt. V. W. Lange: "Between 0500Z and 1400Z, when the turbulence is lightest on most days."

1st Lt. A. W. Luce: "Very early morning before the front can build up. Higher altitude can be used in morning with possibility of very clear weather from 6000 ft. to 10,000 ft., hence greater speed."

1st Lt. H. B. McMullen: "About mid-day or slightly thereafter, but not later than two in the afternoon. If the front is building up it makes little difference when you go through it. But at nearly mid-day the lighting effect of the sun is vertical and the light spots are really light spots."

1st Lt. G. L. Newkirk: "Morning from 1000Z to 1700Z."

1st Lt. G. F. Piker: "Early in the morning."

1st Lt. T. L. Ruddy: "In the morning."

1st Lt. H. C. Sachs: "Generally in the early morning; as a rule the build-up seems to be less than later in the day."

1st Lt. T. V. Sawyer: "Early morning or before noon."

1st Lt. H. R. Schlesinger: "Early in the morning until noon or during the night. It seems to build up rapidly in the afternoons and forms towering cumulus which are sometimes hidden by overcast and other clouds. Unfortunately I ran into some of these about 2000Z with sad experiences of turbulence, lightning, and very heavy rain. At night or early morning it seems to be lower and less severe, possibly no rain and slight turbulence."

1st Lt. J. E. Shelton, Jr.: "Morning."

1st Lt. T. B. Small: "About noon."

1st Lt. H. Stone: "Morning - 0900Z to 1700Z."

1st Lt. K. C. Sumnicht: "Dawn to 1600Z."

4. What is your favorite time of day for flying through the front?

1st Lt. S. K. Thompson: "In the afternoon."

1st Lt. J. F. Wilcoxson, Jr.: "Early in the morning. Clouds are thinner, less turbulence."

1st Lt. D. E. Whittenberg: "The morning is best for the sun has not added to the turbulence already present."

2nd Lt. I. A. Ailara: "1300Z to 1700Z."

2nd Lt. F. B. Allen: "Noon or late morning."

2nd Lt. L. M. Asbury: "In the mornings."

2nd Lt. W. M. Baldridge: "Mid-day."

2nd Lt. C. G. Beard: "Early morning."

2nd Lt. D. H. Binder: "Early morning."

2nd Lt. K. J. Bogert: "Early morning."

2nd Lt. R. J. Cherkauer: "No particular time."

2nd Lt. G. M. Dann: "Early morning."

2nd Lt. R. L. Fleming: "From daybreak up until noon."

2nd Lt. D. S. Gurman: "Morning seems most favorable because the front hasn't developed and is therefore less violent."

2nd Lt. R. A. Klussendorf: "Early morning. It seems less turbulent and built up, although there is more haze."

2nd Lt. J. H. Lindenmuth: "Early morning, 1000Z to 1400Z."

2nd Lt. A. P. Lundberg: "Daylight until noon."

2nd Lt. A. M. Mason: "Before noon."

2nd Lt. J. O. Meeks: "I prefer to fly the front from daylight until noon."

2nd Lt. R. M. Richberger: "Morning - the front is less active."

2nd Lt. J. E. Rinks: "Morning."

4. What is your favorite time of day for flying through the front?

2nd Lt. P. W. Scott: "Early in th morning."

2nd Lt. G. P. Sheen: "Early morning."

2nd Lt. P. H. Smith: "In the morning when flying over water. At night - the front usually dissipates over land."

2nd Lt. W. C. Touchton, Jr.: "Morning - after sunup."

2nd Lt. H. D. Vincent: "Early morning before it has built up."

2nd Lt. R. L. Walker: "Early morning."

2nd Lt. W. B. Walling: "Early morning."

2nd Lt. W. R. Williams: "Early morning."

2nd Lt. L. C. Wright: "Early hours of morning."

CWO L. M. Sympson: "Due to the fact that abrupt changes can and do take place within an exceptionally short period, it becomes more of a question of terminal weather conditions rather than frontal conditions. The front can always be passed through on instruments if contact conditions do not occur, but safe landings require contact conditions."

5. What is your opinion of the front during different seasons? (Weather, turbulence, etc.)

Col. R. M. Bristol: "Appears more widespread in the rainy season, with perhaps slightly less turbulence."

Col. E. M. Day: "I believe it intensifies with the rainy season's progress having frequent scattered to general rain. I have never encountered anything but light turbulence. (Always penetrated at lower altitudes)."

Col. P. B. Griffith: "I have found little difference in the front during seasons, except it is perhaps a little worse during August and September."

Col. J. E. Roberts: "I believe it is more intense and more easily defined during the wet season, varying from showers to heavy rain; however, the average turbulence in both wet and dry seasons is generally moderate."

Lt. Col. J. G. O'Brien: "The front is of stronger intensity during the rainy season. The average turbulence is light or moderate."

Lt. Col. A. F. Tucker: "Light turbulence, little lightning, no ice, and lots of static."

Maj. D. W. Bailey: "I noticed little difference except that it moved north and south with the seasons. In my opinion the weather varies more by days than by seasons. It will be very strong for a few days and then be weak for awhile. Most of my experience was from May to October and this was my observation during that period."

Maj. A. H. Carver, Jr.: "The front only changes position with seasons, whereas it changes intensity at any time, usually running in a weakly cycle, weak to strong. Turbulence changes with the weather, not with the season. Turbulence is usually moderate; sometimes fairly severe turbulence is felt at 2000 ft., the next day at 10,000 ft., and it is always much less when below 500 ft."

Maj. C. M. Cramer: "Believe it had greater development and was a lot rougher during the summer months when it moved to its northern position. The weather depends a great deal on the altitude of penetration. At low altitudes there is always lots of rain; above 6000 ft. it is usually fairly dry but rougher. Turbulence is almost directly proportional to the development of the front. There is always lots of rain. During the summer months when the front is furthest north, the turbulence is worst."

Lt. Cmdr. R. K. Henderson, USNR: "It changes in intensity very little

although the geographical position changes."

Maj. J. A. Irwin: "The front is more severe during the wet season with slightly more turbulence."

Maj. D. L. Roberts: "There is no seasonal variation in intensity; turbulence is moderate to severe and there will be from 30 to 60 minutes instrument. However, during the dry season the front is not as wide and does not occur as often as during the wet season."

Maj. F. A. Sanders: "Wet season varies from good to bad, bad weather can be expected 65% to 75% of the time. Dry season is good weather about 70% of the time. Turbulence during either season will be moderate to severe depending on the build-up."

Maj. O. G. Stephens: "There is little change in frontal intensity with season. Turbulence is moderate when the front is active."

Capt. L. H. Agard: "During the wet season the front is more severe, especially close to land. It consists of rain, turbulence, and high build-ups and the clouds usually have bases as low as 100 ft. There is little or no turbulence in the dry season, always more in the wet season."

Capt. R. M. Brown: "The intensity of the front seems to change very little with the seasons, however its position is constantly changing. There is usually heavy precipitation and moderate turbulence at 1500 ft. and lower."

Capt. L. W. Cunningham: "The front is weakest during February, March, April, and May. The turbulence depends on the altitude the front is flown through."

Lt. H. Dickerson, USNR: "The front moves north or south with the seasons having about the same amount of turbulence."

Capt. J. H. Eichler: "The front follows the sun in its north and south movement with a three month lag. It weakens as it goes south, however I have seen precipitation on all but three trips and have avoided instruments on about half of all trips. Most convergence indicated by turbulence in June, July, October, and November."

Capt. C. V. Eld: "The front is moderate to rough during hurricane season, turbulence is moderate the year around."

Capt. C. P. Felice: "I think that the front is far more intense during

the wet season than the dry; in fact, during the dry season, it is practically nil.

"The average weather during the wet season is usually build-ups with many scattered cumulonimbus clouds, sometimes being widespread and sometimes only forming a thin line. During the dry season, the cloud formations are usually low stratocumulus and cumulus, with clear skies and high haze. In the transitional period, the weather may be built up as during the wet seasons or it may be dormant. However, again, it must be remembered that the changes in conditions may be only a matter of hours and not of seasons.

"Turbulence within the cloud formations is far greater during the wet season, than the dry. In fact, during the dry season, the stratus type clouds afford good instrument flying. Of course, cumulonimbus clouds are extremely turbulent regarding of the season or time of day, but there are more of them during the wet season."

Capt. C. E. Glassmeyer, Jr.: "The front is generally less intense from March to November, however, rather than being a seasonal change, it has a daily change making prediction of the front very difficult.

"The average weather south of the front is moderately dry with light rain from stratocumulus cover. Weather in the front varies from areas of no or light rain in cumulus and stratocumulus, to heavy rain in cumulonimbus.

"Turbulence is usually light to moderate in all seasons, depending on type of cloud cover. Front rarely is composed of a single type cloud, usually a confusion of towering cumulus, nimbostratus, altostratus and stratocumulus cloud forms. Severe turbulence is encountered occasionally in well developed cumulonimbus even at minimum altitude."

Capt. W. R. Hansen: "The front is about the same at all seasons consisting of wet soupy weather with light to heavy turbulence."

Capt. J. M. Huffman, Jr.: "The front is always rough with moderate to heavy turbulence."

Capt. W. H. Hunt: "I believe that the front is strongest and most turbulent during May to September."

Capt W. R. Knight: "It seems that the front has a three day cycle, rather than seasonal. Aside from the shift to the north and south there is little seasonal change. It is furthest south in January and February and north in June and July.

5. What is your opinion of the front during different seasons?
(Weather, turbulence, etc.)

"Weather is variable. As a rule, all rain is encountered and passed through within one hour, although at times, heavy rain may be encountered for as long as two hours flying time. Turbulence is moderate during all seasons, some cloud formations can be found to contain rough turbulence the year around."

Capt. S. E. Nast: "As best I can remember, I have noted no significant difference in the front during different seasons, except, of course, its latitudinal shift. I believe I may have observed a narrowing of the front during its proximity to the equator (near the continent), but my experience has been insufficient to justify a declaration to that effect. On the whole, I think that day-to-day changes are more significant than seasonal changes. I believe that the frontal activity can be, and frequently is, as pronounced in one season as in any other. I should judge the over-all average of turbulence in the front to be moderate, bearing in mind that most of my passages thru the front have been made at altitudes of less than 2000 ft., with many at 500 ft."

Capt. C. A. Neel: "Not much change."

Capt. T. T. Ott: "The general build-up varies little from season to season but apparently it moves further north more frequently during Panama's wet season. The average turbulence through the front is moderate."

Capt. R. W. Scheller: "Front is more intense and built up in wet season. In the dry season, parts of it may be intense, but generally it is weaker.

"In all seasons, I've encountered conditions varying from light rain, smooth overcast, to heavy rain, heavy lightning, and turbulence. The turbulence is moderate, occasionally severe at higher altitudes (9,000 to 10,000 ft.) in build-ups and usually more severe in the wet season."

Lt. I. J. Scott, USNR: "The front may be more intense in summer than in fall. The turbulence is generally moderate, perhaps a bit more intense in June than September."

Capt. M. W. Williams: "I would say that the worst weather in the frontal area is encountered in the period from July until September, inclusive. Turbulence by seasons is hard to define, because the front is always of varying intensity being more turbulent in some parts, usually only moderate."

Lt. (jg) H. W. Barradale, USNR: "It has always been a mild front with moderate turbulence."

5. What is your opinion of the front during different seasons?
(Weather, turbulence, etc.)

1st Lt. B. L. Bergesen: "In all seasons the front consists of occasional line squalls and 5/10 cloud coverage. In the dry season there is moderate turbulence; in the wet season the front is more intense with moderate to severe turbulence."

1st Lt. W. E. Christensen: "The front is very weak in the dry season, but has moderate to severe turbulence in the wet season."

1st Lt. J. L. Cuneo: "The front is worse in the wet season, turbulence is moderate."

1st Lt. J. T. Dowling, Jr.: "It varies a great deal in coverage (area) and intensity, turbulence is mild to moderate, strong only infrequently."

1st Lt. S. P. Easley: "There is less activity during dry season; more turbulence during the wet season."

1st Lt. E. H. Gibb, Jr.: "Average weather has been a low overcast; during the rainy season the turbulence is usually moderate, and in the dry season there is very little turbulence, if any."

1st Lt. C. E. Hall: "The front is most severe during the wet season, turbulence is moderate, sometimes severe with from 30 to 90 minutes instruments. During the transitional season turbulence is moderate, sometimes severe with clear sailing to occasional 1 hour instruments. In the dry season turbulence is moderate and contact conditions prevailed."

1st Lt. W. J. Hastie: "It can be severe both seasons, but it is more constantly so in the wet season. There is no seasonal variation in turbulence."

Lt. (jg) T. L. Healey, USNR: "The front more or less follows the path of the sun. At this time of the year when the sun is south, the front is further south than it was when the sun was further north. Heavy rains are present at all times in the front and there is moderate to rough turbulence."

1st Lt. F. W. Holer: "The front seems most severe in winter. The turbulence can be extremely severe at any time if you fail to pick the correct holes."

1st Lt. E. E. Koken: "The front is more violent during the wet season. During all seasons the turbulence is moderate to rough, violent on occasion."

5. *What is your opinion of the front during different seasons?*
(Weather, turbulence, etc.)

1st Lt. V. W. Lange: "During the wet season the intensity of the front is moderate to strong, with heavy rain, broken to overcast sky, moderate to severe turbulence in the front and light turbulence away from the front. In the dry season the intensity is weak to moderate, with scattered showers, clear to broken sky, and light to moderate turbulence in the front, and moderate turbulence over land away from the front."

1st Lt. A. W. Luce: "During the fall and winter months the equatorial front seems milder with larger abundance of fair weather clouds; during the spring and summer the front is severe. Most of our flying was between 0° N. and 6° N. where throughout most of the year clear weather prevails, with the exception of north of 4° N. Mild turbulence was encountered in the weather occurring from 0° N. to 4° N. during spring and summer becoming moderate the rest of the year. Moderate and severe turbulence occurred north of 4° N. the year around."

1st Lt. H. B. McMullon: "The front seems to become more severe as it moves north, and tends to be composed of several lines instead of the usual solid front, as it is when in its southern position. The weather and turbulence in the front is worst during the wet season, but the turbulence is bad during the entire year."

1st Lt. G. L. Newkirk: "Mild turbulence at lower altitudes."

1st Lt. G. F. Piker: "The front seemed to change from day to day rather than season to season. The average turbulence is moderate."

1st Lt. T. L. Ruddy: "The front is more intense and has more rain during the wet season. The average turbulence is about the same during the entire year."

1st Lt. H. C. Sachs: "Slight, if any, seasonal change. Extreme changes may be noted in a period of two to five days all during the year. Weather north and south of the front is generally dry with scattered showers; variable in the frontal area. Turbulence is light to moderate, increasing to severe in cumulonimbus clouds regardless of altitude."

1st Lt. T. V. Sawyer: "The front is more severe during the Panamanian wet season. It may be more turbulent in wet season but it is always very moderate except on rare occasions."

1st Lt. H. R. Schlesinger: "It is smaller in size and width during the dry season. At times during late afternoon I found practically no front at all while a few days later it was large and severe with

5. *What is your opinion of the front during different seasons?*
(Weather, turbulence, etc.)

heavy rain and moderate turbulence. However we were able to penetrate easily between 7000 and 9000 ft. in the layer of altostratus clouds. During the wet season the tops are very high ranging to 15,000 ft. or higher, made up of towering cumulus of severe intensity. The front itself may be spread over an area of several hundred miles or possibly there are two fronts with varying scattered clouds at all altitudes up to 11,000 ft. in between; it's hard to tell which it is. It's also difficult to choose a point at which to penetrate the front during the wet season since conditions are so variable.

"(Dry Season) Ceilings 2000 to 3000 ft., nimbostratus, stratocumulus, and small cumulonimbus clouds with tops at 6000 to 8000 ft. with light or no rain and light turbulence. Usually a thin layer of clouds, stratus type, exists at about 4000 to 5000 ft. for some distance to the front on the south side and the front breaks abruptly on the north side with no layer existing.

"(Wet Season) Ceilings 200 to 1000 ft. with heavy rain and severe turbulence. Large cumulonimbus clouds in the center rising to 15,000 to 20,000 ft. or more. Turbulence severe enough to damage airplane, violent up and down drafts with accompanying extreme rain at altitudes as high as 11,000 ft. and lightning in extreme cases, but not enough to strike airplane. Instrument conditions may be encountered for 30 minutes to an hour. In this case penetration is better at 8000 to 11,000 ft. if cumulus can be dodged. An airplane could be driven into the sea by severe down drafts if flying at 200 ft.

"(Transitional Season) It's generally hard to predict or see the exact position of the front between seasons, since bad weather is spread over a wide area of several hundred miles. Holes can be found at any altitude above 5000 ft. Less instrument weather exists above 5000 ft. and it is easy to fly between and around cloud banks and cumulus. Turbulence is generally moderate. At night most clouds may be topped at 10,000 ft."

1st Lt. T. B. Small: "Nearly all of my experience has been during the wet season. The frontal area is usually close to Cape Mala or right at the Cape. Sometimes it is an hour south of the Cape but usually it is around fifty to one hundred miles south of the Cape. At low altitude there is moderate turbulence and lots of rain. At about 8000 ft. it is not as far through the frontal area, however, there is a good bit of rain, more turbulence and sometimes up and down drafts."

1st Lt. K. C. Sumnicht: "The front is generally most severe during the

5. *What is your opinion of the front during different seasons?*
(Weather, turbulence, etc.)

winter months but radical changes are often experienced from day to day. Turbulence is usually moderate although it may be severe in cumulonimbus."

1st Lt. S. K. Thompson: "I think the front is more consistent and intense during the wet season. Turbulence is moderate to heavy in wet season; light to moderate in dry season."

1st Lt. J. F. Wilcoxson, Jr.: "The front is at its worst during rainy season. It usually consists of scattered squalls, storms, and very heavy rain. Turbulence is not necessarily seasonal, however, it becomes worst during the latter part of the wet season, and then tapers off."

1st Lt. D. E. Whittenberg: "The front is more intense from June through September. Turbulence is moderate to intense from June through September; light to moderate the rest of the year."

2nd Lt. C. G. Beard: "The front is more severe during the wet season in both turbulence and intensity."

2nd Lt. D. H. Binder: "It is likely to be worse in midsummer than in the cooler seasons."

2nd Lt. K. J. Bogert: "The front is more severe during the wet season in both turbulence and intensity."

2nd Lt. R. J. Cherkauer: "It seems to be slightly more severe with moderate turbulence during the wet season. The turbulence is light or moderate during both the dry and transitional seasons."

2nd Lt. G. M. Dann: "In the wet season it is more active than during the dry season."

2nd Lt. R. L. Fleming: "The front remains fairly constant at all times, usually consists of rain squalls and thunderstorms."

2nd Lt. D. S. Gurman: "I have only had experience during the wet season at which time fronts lying off land seem most turbulent."

2nd Lt. R. A. Klussendorf: "The seasons do not seem to affect the front as much as its position north of the equator. As the front retreats toward the equator it seems less intense. Its position of greatest intensity is from 5° N. to 10° N. The seasons do not seem to affect the turbulence as much as the intensity of the front, which varies from day to day. During the season when the front is nearest the equator turbulence seems to be the least."

5. *What is your opinion of the front during different seasons?*
(Weather, turbulence, etc.)

2nd Lt. J. H. Lindenmuth: "Dry season the front is mild, in the wet season the front is at its worst."

2nd Lt. A. M. Mason: "November to February is quite mild with moderate turbulence."

2nd Lt. J. O. Meeks: "Regardless of the season the front remains about the same, having many rain squalls and very low ceilings. I have found the turbulence very rough the year around."

2nd Lt. R. M. Richberger: "The front is more intense during the wet season in Panama. In the front itself, the turbulence remains constant during both seasons."

2nd Lt. J. E. Rinks: "Not much difference except front is nearer the Isthmus in the wet season, however the front is never consistent from one day to another."

2nd Lt. P. H. Smith: "The front is usually south of Panama during the winter months. The most turbulence occurs during late summer and fall."

2nd Lt. H. D. Vincent: "I have flown through the front only in the wet season during which time the turbulence was moderate to severe."

2nd Lt. W. R. Williams: "During the dry season the front is mild; during the wet season the front is severe. Turbulence is more intense in the wet season."

2nd Lt. L. C. Wright: "The front is weak in the dry season. Turbulence is moderate to severe during the wet season."

CWO L. M. Sympson: "Except for the fact that the front often gets as far north as 10° N. and thereby covers the Isthmus during the latter part of Panama's wet season, there is nothing notable about seasonal variations. Through the seasons, except as noted above, it would be difficult to strike an average. Turbulence seems to depend mostly on the actual build-up of the front rather than to seasonal changes, although more turbulence is noticed when the front moves to 7° N."

6. When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?

Col. R. M. Bristol: "Separate bands."

Col. E. M. Day: "The front appears to be defined with bands of more severe weather at each edge. Between the edge bands it is spotty and there is frequent light to moderate rain with heavy rain in the edge bands."

Col. P. B. Griffith: "It is a solid band made up of separate bands varying in intensity."

Col. J. E. Roberts: "When the front is moderate you will usually encounter separate bands of weather and it becomes difficult to definitely define the exact locality of the front. When the front is strong, you are more apt to run into a solid band of weather, and may be on instruments for as long as two hours or more."

Lt. Col. J. G. O'Brien: "Separate bands."

Lt. Col. A. F. Tucker: "Separate bands."

Maj. D. W. Bailey: "When the front is moderate there are usually two separate bands of weather, both narrow but quite turbulent. When strong it is a solid band of rain and low ceilings."

Maj. A. H. Carver, Jr.: "May be either, but usually not more than two bands if very strong. However, often it is continuous for a period of two or three hours flying."

Maj. C. M. Cramer: "Under this condition the front is usually one solid band with smaller weather bands on either side."

Lt. Cmdr. R. K. Henderson, USNR: "In a moderate or mild front, the frontal zone may be as much as 300 miles wide with changing winds, various type cloud formations, etc. Near the middle of the front, i.e., where the permanent wind shift occurs, the clouds will go right down to the water, and are usually very wet. On the temperate zone side, i.e., the north side of the front in our area, thunder storms of various sizes move over the ocean. The bottoms of these usually are 600 ft. to 1000 ft. and may be flown under. Considerable turbulence will be encountered if a cumulonimbus or even a good sized cumulus is flown through on a 2000 ft. to 8000 ft. level."

Maj. J. A. Irwin: "Separate bands when the front is moderate. During the wet season, the front is more defined."

Maj. D. L. Roberts: "When the front is strong several distinct fronts are generally encountered with squall lines."

6. When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?

Capt. J. W. Adair: "The front varies in this respect, however, strong fronts are usually one solid band."

Capt. L. H. Agard: "There are more or less separate bands of weather but they are close together and fairly wide. Sometimes it is pretty solid with no clearing breaks."

Capt. W. F. Bond: "One band."

Capt. R. M. Brown: "Quite frequently it is separated into two bands at a distance of 20 to 200 nautical miles apart. Both bands seem of equal intensity."

Capt. L. W. Cunningham: "Varies from day to day, usually fairly solid."

Lt. H. Dickerson, USNR: "When the front is strong a solid band is present. When the front is moderate separate bands are encountered."

Capt. J. H. Eichler: "Usually total instruments one to two hours when bad with bands of heavy to light rain."

Capt. C. V. Eld: "Varies."

Capt. C. P. Felice: "When the front is moderate or strong, there is just as much chance that there will be more than one band as not. We can never tell by looking at it from one side or the other how wide the front will be or whether there will be two or more bands of extreme turbulence. When there are two bands, the pilot is usually given a small period of relief, whereas if the mass is solid, the flying becomes very tiring. So, as far as I have been able to judge, we cannot fly up to the weather and forecast a single band of weather or a double band at any time during our flying. During the wet season, however, the bands appeared to be closer together when there was more than one band, and during the dry season they seemed to be much farther apart, sometimes several degrees."

Capt. C. E. Glassmeyer, Jr.: "Comparing the weather reports of the various patrol tracks, weather through the front was rarely in a solid band, however, by encountering intermittent cumulonimbus build-ups it might indicate that it was solid. One track could run through heavy rain for a few hours while an adjacent track, 60 miles away, would be flying in comparatively clear weather. Intensity seemed solely dependent on type of clouds encountered."

Capt. W. R. Hansen: "Usually there would be two bands, from south to north, first a moderately thick band and then a thick one."

6. When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?

Capt. W. H. Hunt: "When the front is moderate it sometimes is made up of bands; when it is strong it usually is one solid turbulent band."

Capt. W. R. Knight: "During strong frontal conditions (noticed during November 1943) there seemed to be two bands, with the more intense band to the south. A second band was usually encountered about a half hour to the north of the first."

Capt. S. E. Nast: "When the front is moderate, weather is consistently scattered, or in separate bands. As the activity approaches strong to intense, weather becomes more concentrated. Again, I should impress that most of my observations have been made at low altitudes."

Capt. C. A. Neel: "Usually separate bands."

Capt. T. T. Ott: "The front has a clearly defined area that represents its core. Layers can be encountered quite frequently, however, that lead the pilot to believe it is the actual core. Flying in these strata is much easier than in the true core, but a few minutes flying in them proves quickly that the core is still to be penetrated."

Capt. R. W. Scheller: "Strong front, solid band of weather; moderate to weak front usually separate bands."

Capt. E. L. Stevens: "One solid band."

Capt. M. W. Williams: "There are usually light bands of weather on either side of the front itself, but the front is usually pretty solid."

Lt. I. J. Scott, USNR: "Usually one solid band."

Lt. (jg) H. W. Barradale, USNR: "One band."

1st Lt. B. L. Bergesen: "Usually separate bands of weather."

1st Lt. W. E. Christensen: "There are bands of weather if it is moderate and solid when it is strong."

1st Lt. J. L. Cuneo: "In bands."

1st Lt. J. T. Dowling, Jr.: "Separate bands at times, but usually solid."

1st Lt. S. P. Easley: "Separate bands with turbulence varying."

1st Lt. E. H. Gibb, Jr.: "Separate bands."

1st Lt. C. E. Hall: "Separate bands."

6. When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?

1st Lt. W. J. Hastie: "Separate bands."

Lt. (jg) T. L. Healey, USNR: "Solid band."

1st Lt. R. E. Henderson: "Usually one band with a few slight breaks."

1st Lt. F. W. Holer: "When the front is most severe it is one continuous solid band. When two bands are encountered it is usually of less intensity."

1st Lt. J. R. Irwin: "When the front is strong, one band; when moderate, possibly two bands."

1st Lt. E. E. Koken: "A solid band whose top varies."

1st Lt. J. C. Kline: "Separate bands."

1st Lt. V. W. Lange: "Usually two separate bands, with an area of calm overcast between them, the overcast generally being at 1000 ft. to 2000 ft."

1st Lt. A. W. Luce: "The equatorial front varies. Sometimes it can be a solid band of thirty minutes to an hour, while many times instrument conditions prevail for three and four hours on a flight north and south. East and west flights are variable as they parallel the front."

1st Lt. H. B. McMullon: "When the front is bad, it is usually one solid mass."

1st Lt. G. L. Newkirk: "Separate bands."

1st Lt. G. F. Piker: "The weather was usually in one separate band."

1st Lt. H. C. Sachs: "The front has been solid on few occasions, but is usually in bands having a large but scattered area of rainfall."

1st Lt. T. V. Sawyer: "Solid."

1st Lt. H. R. Schlesinger: "Usually one solid band."

1st Lt. J. E. Shelton, Jr.: "One band."

1st Lt. T. B. Small: "When the front is strong it is usually solid weather through it. When the front is weak it may be split in several bands with open spots between and sometimes it is clear between two layers of clouds and no weather at flight altitude at all."

6. *When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?*

1st Lt. H. B. Stone: "One band."

1st Lt. K. C. Sumnicht: "Instrument weather is usually continuous, but severity appears to be in bands."

1st Lt. S. K. Thompson: "It varies. Sometimes you hit a strong front in a solid band, and sometimes you will break in and out of different bands."

1st Lt. D. E. Whittenberg: "When front is strong it is usually a solid band."

1st Lt. J. F. Wilcoxson, Jr.: "Usually a number of separate bands."

2nd Lt. I. A. Ailara: "Separate bands."

2nd Lt. F. B. Allen: "Solid when strong."

2nd Lt. L. M. Asbury: "Usually a solid band."

2nd Lt. W. M. Baldridge: "Never noticed. I have encountered both."

2nd Lt. C. G. Beard: "Separate bands."

2nd Lt. K. J. Bogert: "Separate bands."

2nd Lt. R. J. Cherkauer: "When moderate it usually is in bands of weather. When strong it usually is one band of weather."

2nd Lt. G. M. Dann: "One solid band."

2nd Lt. R. L. Fleming: "With a moderate front the weather is usually found to be rather solid. In a strong front the weather is found to be in separate bands."

2nd Lt. D. S. Gurman: "Unpredictable. I have experienced both types."

2nd Lt. R. A. Klussendorf: "That is unpredictable. If the front is strong, it is more apt to be one solid band. We have encountered several bands of rather intense turbulence, but that is unusual."

2nd Lt. J. H. Lindenmuth: "Separate bands."

2nd Lt. A. P. Lundberg: "It is usually one solid band when the front is strong."

2nd Lt. A. M. Mason: "Patchy."

6. *When the front is moderate or strong do you usually encounter separate bands of weather or is it usually one solid band?*

2nd Lt. J. O. Meeks: "The front usually lies in one band. Occasionally there are several bands of weather."

2nd Lt. R. M. Richberger: "Usually one solid band."

2nd Lt. J. E. Rinks: "Separate bands of cumulus."

2nd Lt. P. W. Scott: "One solid band."

2nd Lt. G. P. Sheen: "Separate bands."

2nd Lt. P. H. Smith: "Usually there are separate bands in a moderate front and one solid band in stronger fronts."

2nd Lt. W. C. Touchton, Jr.: "Separate bands."

2nd Lt. H. D. Vincent: "Separate bands."

2nd Lt. R. L. Walker: "Separate bands."

2nd Lt. W. R. Williams: "One solid band when the front is intense."

2nd Lt. W. B. Walling: "Usually several bands."

2nd Lt. L. C. Wright: "Moderate - bands. Strong - solid."

CWO L. M. Sympson: "A moderate to strong front will usually indicate one solid band of weather generally from 50 to 100 miles wide. Some deviation from this may be expected in moderate turbulence."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

Col. R. M. Bristol: No answer.

a. "Not much."

b. "No."

c. "Unknown."

Col. E. M. Day: "None experienced."

a. "Have not encountered lightning. No night experience included."

b. "None."

c. "South of front from the south. North of front from the north at lower altitudes. At high altitudes prevailing winds appear to be from a northerly direction all the way."

Col. P. B. Griffith: "I have tried to get over it at 18,000 ft. and I have gone through it at all other altitudes below. I have found, however, that if you stay at about 800 ft. off the water you will encounter better flying conditions."

a. "I have never seen much lightning."

b. "I have never encountered hail but I have encountered sleet."

c. "North of the front the wind is from the north, south of the front it is from the south."

Col. J. E. Roberts: "None."

a. "Very seldom will you ever catch a lightning flash during the day. I have been through the front only one time at night, and was on instruments for about one and one half hours, rain was heavy, turbulence moderate and I only saw one flash of lightning during the entire period."

b. "No."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

c. "North side winds are usually northeasterly from surface to about seven or eight thousand feet. South side the winds at the surface are usually southeasterly while up at high altitudes the wind seems to be more northerly at all times."

Lt. Col. J. G. O'Brien: "On a flight to Galapagos to Guatemala City, the winds almost reached hurricane velocities."

a. "No."

b. "No."

c. "South of the front winds are from the south. North of the front winds are from the north."

Lt. Col. A. F. Tucker: "Approximately, the same as in wide occluded frontal zones in the States. Solutions are the same - fly high in stratified systems - low in unstable cumulus conditions."

a. "No."

b. "No, but heavy large rain drops sometimes makes you think it is light hail."

c. "Not sure from personal observations."

Maj. D. W. Bailey: "Often find strong winds that make sudden shifts. When on instruments you don't notice these shifts immediately and may get off on your navigation. When the front is moderate it is possible to dodge most of the bad weather. By flying low the weather is never extremely turbulent."

a. "Very little in the day. Have noticed none at night except in scattered thunderheads."

b. "No."

c. "The wind usually blows toward the front below 4000 ft. to 5000 ft. and changes 180 degrees above these altitudes."

Maj. A. H. Carver, Jr.: "No special phenomena other than torrential rain.

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

Winds are often very heavy on the surface and change rapidly and suddenly within a short period of flying. Tremendous build-ups occur, but flying under them is usually safe, and mild turbulence is experienced."

a. "During the day there is not much lightning, though there is some every now and then through the more severe portions of the front. Quite a bit of lightning is seen at night through the front.

b. "No."

c. "Usually southerly winds south of 5° N. and northerly winds north of this latitude. Shifts are frequent, however, and the prevailing winds do and can become extremely strong around 8000 ft., sometimes approaching thirty to forty knots."

Maj. C. M. Cramer: "Large area of convectional currents (usually much larger but not necessarily stronger than a cold front)."

a. "No."

b. "Very small amount, and usually in heavy rain areas."

c. "40 to 70 degrees at 18 knots, with extreme wind shifts in the front itself."

Lt. Cmdr. R. K. Henderson, USNR: "Layers of almost dry stratus clouds."

a. "No."

b. "No."

c. "North of front, light northerly winds. South of front, moderate southerly and southeasterly winds."

Maj. J. A. Irwin: "None."

a. "I have encountered lightning once during the day during the wet season. There is more lightning at night."

b. "No."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

c. "Northeasterly on north side. Southeasterly on south side."

Maj. D. L. Roberts: "No special phenomena except electrical activity and extreme turbulence."

a. "Not as a rule - but when lightning is encountered it is usually violent."

b. "On rare occasions, at high altitudes."

c. "If there are any prevailing winds I would say northeast north of the equator and southeast south of the equator."

Maj. F. A. Sanders: "None other than severe lightning."

a. "Depending on strength of front and over-all size."

b. "No."

c. "Quite variable."

Maj. O. G. Stephens: "Nothing usual."

a. "Lightning is usually light to moderate."

b. "Have encountered hail only once over water in the frontal zone and that was light at 13,000 ft. altitude."

c. "To the north, northeasterly. To the south, southeasterly."

Capt. J. W. Adair: "None."

a. "Usually none."

b. "No."

c. "Northeast north of the front. Southwest south of the front."

Capt. L. H. Agard: "None that I can recall."

a. "No. I saw lightning once on a night trip. It was not severe.

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   b. *Have you ever encountered hail?*
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It seemed to be heat lightning and not lightning from a storm."

b. "No."

c. "Approximately from the vicinity of the north on the north side, and from the south on the south side."

Capt. W. F. Bond: "Sudden wind and temperature changes."

a. "Not much, but occasionally when front is very intense."

b. "No."

c. "Usually northeast when north of front, and from southwest to southeast when south."

Capt. R. M. Brown: "None."

a. "Not frequently."

b. "No."

c. "At the lower flight levels the winds south of the front are southerly. North of the front the winds are southwesterly."

Capt. L. W. Cunningham: "Water spout once, hurricane winds, and severe wind shifts."

a. "Rarely in the daytime, noticeable at night."

b. "Once or twice in big cumulonimbus."

c. 40° - 70°, 18 knots, I think."

Lt. H. Dickerson, USNR: "A definite change in wind direction - in the north the wind is from northeast, in south from southeast (in the front area, the water is fairly calm)."

a. "Very little lightning, if any."

b. "No hail."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

c. "Northeast in the north. Southeast in the south."

Capt. J. H. Eichler: "Heavy rain, lightning, moderate to severe turbulence. Never hail."

a. "Yes, when the front is built up. (About half the time.)"

b. "No."

c. "Surface winds north of the front are north to northeast, 0 to 10 mph."

Capt. C. V. Eld: "Few large storms that cannot be gotten around. Best altitude thru them about 1000 ft."

a. "No."

b. "No."

c. "Don't know."

Capt. C. P. Felice: "There has been very little special phenomena encountered, other than the usual characteristic weather of warm and cold and occluded fronts. From what I have been able to gather in reading and studying weather, the cumulonimbus clouds of this front usually rise higher into the sky and have at the same time a much lower base, sometimes right on top of the water. Invariably the forecasters of weather present the tops as being much lower than they actually are. I believe this goes for the freezing-level line as well."

a. "From the ground at right time, much lightning can be seen as present within the frontal area, and much of this lightning is not seen during the day at all. However, lightning has been encountered, and usually is avoided whenever possible."

b. "I have no knowledge of ever encountering any hail. I believe that is because of the much higher freezing line in this tropical weather."

c. "In general the winds north of the front are northeasterly, and

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   c. *What are the prevailing winds at flight levels north and south of the front?*

south of the front they are southeasterly. The winds appeared to become dominantly easterly closer to land and dominantly westerly out to sea."

Capt. C. E. Glassmeyer, Jr.: "No special phenomena encountered. Conditions normally noticed while passing through a front are a wind shift north and south of front, temperature change and change in cloud formations. The area of the front itself is confused with winds unstable in velocity and direction. Position of front is variable from day to day, though it generally tends to follow and lag behind the sun's declination."

a. "Lightning was rarely encountered."

b. "No."

c. "At minimum altitudes south of the front the wind was generally from 160°, 10 to 15 knots. There was an occasional variation from 150° to 230°; at altitudes above 8000 ft. the wind was generally 40° to 60° at 15 to 30 knots. North of the front the wind was 10° to 70°, 10 to 15 knots varying from 140° to 250°; at altitudes over 8000 ft., 40° to 60°, 15 to 30 knots. In the front itself at minimum altitude the wind was confused with velocities from calm to 60 knots; sudden and sharp wind shifts were noted."

Capt. W. R. Hansen: "Lightning, hail (high up), water spouts, cumulonimbus, and violent wind changes."

a. "Yes, if the front is heavy."

b. "Once at 11,000 ft."

c. "North of front, northwest; south of front, southeast."

Capt. J. M. Huffman, Jr.: No answer

a. "No."

b. "Yes"

c. "South."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

Capt. W. H. Hunt: "None."

a. "No."

b. "No."

c. "North of the front the winds are northwesterly. South of the front the winds are southeasterly."

Capt. W. R. Knight: "Very black towering "clouds" inside of which there seemed to be nothing but moderate rain - as if being inside a huge room, able to see about. Apparently the clouds have come together, but not completely merged. Also before emerging from clouds, a very brilliant white glow made it hard to see, even inside the cockpit.

"About 200 miles south of San Jose, Guatemala, when emerging from front at 500 ft. to 1000 ft., visibility and ceiling became very low with extremely heavy sea, very high winds, and much turbulence. Safety belts had to be fastened, and upon climbing through the clouds we broke out at about 5000 ft. over what seemed to be a normal thick overcast, sloping off to the north. We had continued at 1000 ft. for fifteen or twenty minutes expecting to break out, but didn't."

a. No answer

b. No answer

c. No answer

Capt. S. E. Nast: "Of special phenomena I have observed none, unless because the particular portion of the front is so misbehaved, characteristic frontal weather can be regarded as special phenomena. Certainly a wind shift should be expected upon passing through the front, with a region of relative calm in the front. I suppose it is assumed that a layer of clouds marks a dividing line between two different winds, i.e., winds above and below the cloud layer. I have found this to be true, with the winds being 90° to 180° different.

"On two separate occasions I have made dog-legged, nine-hour

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   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

flights between Guatemala City and Galapagos, during which not one white cap was observed, and much of the time the surface was unrippled - smooth enough to reflect an occasional cumulus cloud. The absence of wind, and this at the 5000 to 7000 foot flight level, was borne out by carrying a no-wind position by use of accurate sun lines and by a lani-fail accurate within two minutes. However, the significant feature in each case was that on the following day, the same region though perhaps not on the same track, the sea was very choppy and the front was encountered with its characteristic weather, cloud build-up and turbulence.

"On only two occasions do I recall encountering lightning. In both cases it was intense, with accompanying severe turbulence. The region of this activity was extensive. In one of these instances, at approximately 1500Z, it was necessary to turn on lights in the nose for some ten minutes in order to see the charts well enough to perform the usual navigation plotting. The thickness and density of clouds that would necessitate such a procedure can be surmised when you realize that normally the light in the nose of a B-17, with all its windows, is glaring.

"Surface winds south of the front invariably have a dominant southerly component, with usually an easterly component, although it isn't surprising to find a southwesterly wind. On the average the velocity will be 12 knots, varying from 6 to 25, and sometimes reaching 30 knots. On numerous patrols, still south of the front, the wind at 5000 ft. to 7000 ft. (always, in my experience, accompanied with a sky coverage of 8/10 to 10/10 stratocumulus), was northerly, usually with a westerly component. I do not recall flying above 7000 ft. and this was outside of the front. Incidentally, the cloud deck mentioned above always seemed to slope up away from the front, toward the equator. Flights were made at the surface from Galapagos north to approximately 8° N., usually past the front, then east or west for 100 to 200 miles, still at the surface. Turning on to the south leg toward Galapagos, the front would be passed at the surface, then a climb to 5000 ft. would clear the tops of the stratocumulus. It was found, however, that to remain above the stratocumulus further climbing, usually to about 7000 ft. was necessary. It is possible that the clouds were building up slowly as we proceeded south, rather than there being an up-slope to the south.

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

"Surface winds north of the front usually have a northerly component dominant, with an almost equal easterly component, though it isn't usual to have the wind more easterly than northerly. These winds should average 10 to 12 knots. Of the high winds I do not remember enough to make discussion worth while."

Capt. C. A. Neel: No answer

a. "No."

b. "No."

c. No answer

Capt. T. T. Ott: No answer

a. "No."

b. "No."

c. "Winds north of the equator run an arc from east to northwest thru north. South of the equator the winds run an arc of east to southwest thru south. At a higher altitude (varies considerably) winds are found running away from the equator rather than toward it as at lower altitudes."

Capt. R. W. Scheller: "None."

a. "Not in daytime. At night there may be considerable lightning, it may be varying distant "sheet" lightning or close crashing streaks in the build-up."

b. "No."

c. "Winds are northeasterly changing to southeasterly when going thru the front from north to south."

Lt. I. J. Scott, USNR: "Almost no wind just north of the front. Very heavy rain and mild turbulence."

a. "Not noticeable during day except for considerable static on

7. What special phenomena have you encountered in flights in the area of the front?
a. Is there usually much lightning?
b. Have you ever encountered hail?
c. What are the prevailing winds at flight levels north and south of the front?

voice radio."

b. "No."

c. "800 to 1000 ft. in early summer, north of front wind was northerly. South of front was southerly. During the fall the wind is southerly in south shifting somewhat west at front."

Capt. E. L. Stevens: No answer

a. "Sometimes yes, sometimes no."

b. "No."

c. No answer

Capt. M. W. Williams: "None."

a. "During the wet season when there is a lot of thunderstorm activity lightning is quite common."

b. "No."

c. "North of the front the prevailing winds range from forty to seventy degrees, and south from one hundred fifty to one hundred seventy degrees. These winds prevail as far as I know only up to about 7000 ft."

Lt. (jg) H. W. Barradale, USNR: No answer

a. "No, only at night."

b. "No."

c. "North from 270°; south from 180°."

1st Lt. B. L. Bergesen: "Severe to moderate turbulence, radio interference, lightning, poor visibility."

a. "Yes."

b. "Yes."

7. What special phenomena have you encountered in flights in the area of the front?
a. Is there usually much lightning?
b. Have you ever encountered hail?
c. What are the prevailing winds at flight levels north and south of the front?

c. "North, winds northeast; south, winds southwest."

1st Lt. W. E. Christensen: "I have seen St. Elmo's fire at night."

a. "Yes."

b. "No."

c. "North of front winds approximately northeast; south of front southwest."

1st Lt. J. L. Cuneo: "Rough with rain."

a. "Very little."

b. "No."

c. "Northeast to southwest."

1st Lt. J. T. Dowling, Jr.: "No special phenomena."

a. "No."

b. "No."

c. "Surface winds blow toward the front if considered from the south. Winds blow away from front, if considered from north."

1st Lt. S. P. Easley: No answer

a. "When front is concentrated, yes."

b. "No."

c. "North of front wind is from the east; south of front wind is from the south."

1st Lt. E. H. Gibb, Jr.: No answer

a. "Usually no lightning."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

b. "No."

c. "South of front, southeasterly; north of front, northeasterly."

1st Lt. C. E. Hall: No answer

a. "Usually at night, I have never seen any in daytime."

b. "Not in the equatorial front in the Pacific."

c. "South of front, southeast; north of front, east."

1st Lt. W. J. Hastie: "Wind shift usually."

a. "Not usually."

b. "No. There often is at high altitudes, however."

c. "North of front, northerly; south of front, southerly."

Lt. (jg) T. L. Healey, USNR: "Water spouts are numerous with several wind changes."

a. "No."

b. "No."

c. "Winds prevail from 180° both sides of front, although the winds in the front change direction several times."

1st Lt. R. E. Henderson: "None."

a. "Yes."

b. "No."

c. "East."

1st Lt. F. W. Holer: "Only thunderstorms. Usually, there is very little lightning visible in the daytime, and I have never encountered hail. From Panama south, the prevailing winds are from the north. South

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

of the equator the winds are from the south."

1st Lt. J. R. Irwin: No answer

a. "In black areas, yes."

b. "No."

c. No answer

1st Lt. E. E. Koken: "Lightning - ship has been struck."

a. "Yes."

b. "No."

c. "East."

1st Lt. J. C. Kline: "Bad weather."

a. "No."

b. "No."

c. "South and southwest."

1st Lt. V. W. Lange: "Extremely strong winds, which vary rapidly in direction and velocity. Dead calm areas are frequently encountered along with the above within the space of a few minutes. Severe turbulence sometimes occurs while flying in the clear, and comparative smoothness exists in the clouds at low altitudes, though the reverse is ordinarily true."

a. "No. I have seen comparatively little of it in build-ups of local storms."

b. "No."

c. "South of the front the winds at 5000 ft. are 190°, 15 knots; 10,000 ft., 100° at 10 knots. North of the front the winds at 5000 ft. are 70° at 12 knots; 10,000 ft., 70° to 100° at 10 to 15 knots."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

1st Lt. A. W. Luce: "Even at low altitudes, 1000 to 2000 ft., extreme turbulence may be encountered."

a. "No. At night it can be seen in vicinity of front."

b. "No hail except once at 13,000 ft. over Guatemala City."

c. "Winds below 4° N. and 5° N. are generally southerly at low levels, 0 to 2000 ft. North of 5° N. winds are quite variable. At higher levels 180 degree shifts of winds are often encountered and sometimes as much as 30 knots."

1st Lt. H. B. McMullon: "The most significant special phenomena of the front consist of terrific up and down drafts in the absence of turbulence. Also, there is rain in such amounts as to be called solid water. In addition there is the usual sheet lightning and vertical stuff."

a. "Usually just a moderate amount."

b. "Yes, but I was higher than I should have been in the front."

c. No answer

1st Lt. G. L. Newkirk: No answer

a. "No."

b. "No."

c. "None."

1st Lt. G. F. Piker: "None."

a. "No."

b. "No."

c. "From the south, south of the front and from the north, north of the front."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

1st Lt. T. L. Ruddy: No answer

a. "No, not in the daytime; at night you see some lightning."

b. "Yes."

c. "North of the front the wind is from the northeast. South of the front the wind is from the southwest."

1st Lt. H. C. Sachs: "South of the front, the winds are predominantly from the south; north of the front they are from the north. Both winds seem to increase in intensity as they near the front. Within the frontal area, an almost calm conditions have been noted, regardless of the winds to the north and south. This is not always true, but has been noted on several occasions. Change is the only constant thing about the front."

a. "Lightning has been noted on very few occasions. It is usually seen at night."

b. "I have never encountered hail."

c. "Winds are from the north to the north; from the south to the south."

1st Lt. T. V. Sawyer: "None with the exception of shifting winds."

a. "No."

b. "No."

c. "North of front - northeasterly. South of front - southeasterly."

1st Lt. H. R. Schlesinger: "One night near Panama on the Caribbean side, we encountered St. Elmo's fire twice in five minutes. Each case lasted about 10 to 15 seconds. I don't know whether we passed over a small front or not. Several large cumulonimbus clouds were in the vicinity and lightning was moderate in the area. Only about 15 minutes of instruments at different times during the first hour away from Panama was necessary. No damage to the airplane resulted.

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

Other airplanes on the same course a few miles away encountered no lightning and no clouds."

a. "No, very little lightning."

b. "No."

c. "Usually from the north or northeasterly direction on both sides of the front. The north side may be variable and unreliable for any period of time."

1st Lt. J. E. Shelton, Jr.: "Strong updrafts with great turbulence during rain."

a. "No."

b. "No."

c. No answer

1st Lt. T. B. Small: No answer

a. "In daytime there is seldom much lightning. At night sometimes there is quite a bit of lightning, however, I have had little experience at night."

b. "I have encountered hail; highest altitude I have flown through is 12,000 ft."

c. "South of front, usually between 40° to 80° at approximately 10 knots at 8000 ft. North of front, around 200° at 8000 ft."

1st Lt. H. B. Stone: "Lightning, sudden wind shifts, sudden temperature drop."

a. "Moderate."

b. "None."

c. "North of front, average wind northeast to north. South of front, average wind southwest to south."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

1st Lt. K. C. Sumnicht: "Peculiar windshifts, occasional extreme wind velocity, two "twisters" or small water spouts from 600 foot clouds to water."

a. "No, very rare."

b. "On one occasion."

c. "North of the front, north-northeast, 10 to 15 knots; south of the front, south-southeast, 10 to 15 knots. These winds are at lower altitudes."

1st Lt. S. K. Thompson: "I have encountered inversions, no front, head winds, tail winds, cross winds, high overcast, low overcast, haze, big fronts, little fronts, split fronts, lightning, rain, etc."

a. "Yes, a moderate amount."

b. "No."

c. "Winds around 8000 ft. are out of the north-northeast to northeast. Down below 1000 ft. around the equator and below the wind is out of the southwest."

1st Lt. D. E. Whittenberg: "None unless it might be flying through heavy rain for two to four hours."

a. "No."

b. "No."

c. "North of the front - northeast; south of the front - southwest."

1st Lt. J. F. Wilcoxson, Jr.: "St. Elmo's fire on props."

a. "Not usually."

b. "Occasionally very light hail."

c. No answer

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

2nd Lt. I. A. Allara: "None other than St. Elmo's fire (once)."

a. "Sometimes, usually not visible during daytime."

b. "No."

c. "South of front - southeast. North of front - north to northeast."

2nd Lt. F. B. Allen: "None."

a. "No, but occasionally there is some."

b. "No."

c. "On surface south of front, southeast; north of front, northeast. At altitude north of front, north-northwest; south of front, east-northeast."

2nd Lt. L. M. Asbury: "None."

a. "Always some."

b. "No."

c. "Don't know."

2nd Lt. W. M. Baldridge: "Conditions are only what is to be expected."

a. "Yes."

b. "No."

c. "North, north to east. South, east to south."

2nd Lt. C. G. Beard: No answer

a. "No."

b. "No."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

c. "Surface winds to south average 180°. Surface winds to north of front average 270°."

2nd Lt. D. H. Binder: "Extreme turbulence, lightning, and heavy rain."

a. "Yes."

b. "No."

c. No answer

2nd Lt. K. J. Bogert: "Heavy rain - heavy turbulence."

a. "No."

b. "No."

c. "Surface winds south average 180°; surface winds north of front average 270°."

2nd Lt. R. J. Cherkauer: "A great deal of static electricity sometimes."

a. "No, the lightning is slight."

b. "No."

c. "South of front, south to southeast. North of front, north to northwest."

2nd Lt. G. M. Dann: "St. Elmo's fire."

a. "Yes."

b. "Yes."

c. No answer

2nd Lt. R. L. Fleming: "Very heavy rain squalls and extremely low visibility."

a. "Only light."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

b. "Yes, once. (Very small size.)"

c. "A wind shift is usually encountered with the passing of the front."

2nd Lt. D. S. Gurman: "None except for severe vertical currents at times."

a. "No."

b. "No."

c. "Opposite in direction."

2nd Lt. R. A. Klussendorf: "As a rule there seems to be no special phenomena. There are areas of very distinct wind shifts, with local cloud formations approaching the water. The turbulence in these areas will be greater than elsewhere, but hardly sufficient to warrant circumnavigating them."

a. "The areas of lightning seem to be very wide spread. I recall only one or two occasions during which we flew through lightning."

b. "Not in the front. We seldom fly very high through the front."

c. "South of the front generally southeasterly. North of the front generally northeasterly. At high altitudes the prevailing winds are generally northerly to northeasterly."

2nd Lt. J. H. Lindenmuth: "Towering cumulus, overcast."

a. "No."

b. "No."

c. "South of the front 180°, surface; north of the front 270°, surface. Above the clouds east to northeast."

2nd Lt. A. P. Lundberg: "Extreme turbulence."

a. "At night much lightning can be seen."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

b. "No."

c. No answer

2nd Lt. A. M. Mason: "None."

a. "No."

b. "No."

c. No answer

2nd Lt. J. O. Meeks: "Extreme turbulence."

a. "At night there appears to be an abundance of sheet lightning."

b. "No."

c. "South of the front the winds blow toward the land. North of the front the winds are seaward."

2nd Lt. R. M. Richberger: "None."

a. "No."

b. "Yes, one flight."

c. "North - northeast. South - southwest."

2nd Lt. J. E. Rinks: "Lightning, rain, and turbulence."

a. "Night, usually more or easier to detect."

b. "No."

c. "Northerly swinging to southeast coming from north to south."

2nd Lt. P. W. Scott: No answer

a. "No."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

b. No answer

c. No answer

2nd Lt. G. P. Sheen: "Mild at sides, heavy and rough in middle."

a. "No."

b. "No."

c. "South of front 180°, north of front 270°."

2nd Lt. P. H. Smith: "High winds and complete change of direction."

a. "No, just around large thunderheads."

b. "No."

c. "Northeasterly north of the front. Southeasterly south of the front."

2nd Lt. W. C. Touchton, Jr.: No answer.

a. "Usually not."

b. "Yes."

c. "Northeasterly north of front, southwesterly south of front."

2nd Lt. H. D. Vincent: "None."

a. "Not usually."

b. "No."

c. "North of front - northeast. South of front - south."

2nd Lt. W. B. Walling: No answer

a. "No."

7. *What special phenomena have you encountered in flights in the area of the front?*
   a. *Is there usually much lightning?*
   b. *Have you ever encountered hail?*
   c. *What are the prevailing winds at flight levels north and south of the front?*

b. "No."

c. "North of the front at low altitudes, north to northeast; high altitudes south to southeast. South of the front at low altitudes, southeasterly; high altitudes easterly."

2nd Lt. W. R. Williams: "None."

a. "No."

b. "No."

c. No answer

2nd Lt. L. C. Wright: No answer

a. "Yes."

b. "No."

c. "North of front winds are generally northeast. South of front generally southwest."

CWO L. M. Sympson: "No special phenomena have been encountered except for occasional abrupt changes in cloud conditions and turbulence over periods as short as four hours."

a. "Little lightning has been encountered."

b. "I have never encountered hail."

c. "North of the front and above 2500 ft., winds from 345° to 60° (true) are usually encountered. Below 2500 ft. they are light and variable as a general rule."

8. Is there any relationship between the width of the front and its intensity?

Col. R. M. Bristol: "None observed."

Col. E. M. Day: "I have not noticed such a condition; contrariwise it has been erratic."

Col. P. B. Griffith: "I believe so. The wider it is the worse it has been, is my experience."

Col. J. E. Roberts: "I am inclined to believe that it is more intense when the front is narrowed down in width. Doubtful."

Lt. Col. J. G. O'Brien: "Not in every condition."

Lt. Col. A. F. Tucker: "Not for sure."

Maj. D. W. Bailey: "There is no dependable relationship, however, when the front is wide it is usually less violent."

Maj. A. H. Carver, Jr.: "If the front is wide and deep, then there is usually greater intensity. At times there is complete lack of any indication of a front. However, this is rare. The front can last, or has lasted, anywhere from half an hour to five hours flying time."

Maj. C. M. Cramer: "Yes. During summer months when the front was wider, the intensity was greater."

Lt. Cmdr. R. K. Henderson, USNR: "I believe not."

Maj. J. A. Irwin: "I believe that the more intense the front the narrower the band of weather."

Maj. D. L. Roberts: "There is no set rule. At times the front can be four degrees wide and intense all the way."

Maj. F. A. Sanders: "I feel that width is nothing more than continued severe turbulence and heavy rain."

Maj. O. G. Stephens: "The front is usually more intense as it narrows."

Capt. J. W. Adair: "None."

Capt. L. H. Agard: "It seems that if the front is more intense it covers a wider band."

Capt. W. F. Bond: "When it is wide it is usually intense in the center."

Capt. R. M. Brown: "A narrow front seems to be more intense for a short

time than a wide front and is definitely more turbulent."

Capt. L. W. Cunningham: "Not as a rule - it varies the year around."

Lt. H. Dickerson, USNR: "Not noticeable."

Capt. J. H. Eichler: "No, none apparent."

Capt. C. V. Eld: "Direct relation."

Capt. C. P. Felice: "I cannot definitely say there is any relationship between the width of the front and the intensity. Often times three hours of instruments may be encountered on a flight at one time without much turbulence whatsoever, on other occasions there may be quite a bit of turbulence. However, I would say that the most intensity seemed to be in isolated spots and not in widths. Several planes have flown thru the front at approximately the same time, just a few minutes apart, on slightly different courses, and have encountered great differences of weather - one meeting with extreme turbulence and the others with only light rain or moderate turbulence."

Capt. C. E. Glassmeyer, Jr.: "No relationship of front between width and the intensity."

Capt. W. R. Hansen: "If it is wide it is generally quite thick."

Capt. J. M. Huffman, Jr.: "Yes."

Capt. W. H. Hunt: "Yes, the wider the front the greater the intensity."

Capt. W. R. Knight: "If the front is wide, the intensity is usually more intense. If narrow, the build-ups can be topped or avoided. It varies directly, as a rule."

Capt. S. E. Nast: "For the most part I should say that the intensity of the front varies inversely with its horizontal depth or width."

Capt. C. A. Neel: "No."

Capt. T. T. Ott: "Generally speaking, I find the fully developed and intense front covering a smaller area in width."

Capt. R. W. Scheller: "I have not noticed such a condition."

Lt. I. J. Scott, USNR: "When the front is wide, there is usually more rain but turbulence is never severe."

8. Is there any relationship between the width of the front and its intensity?

Capt. M. W. Williams: "I would not say that there is any perceptible difference when the front is wide and when it is narrow in intensity."

Lt. (jg) H. W. Barradale, USNR: "Yes - more intense the broader."

1st Lt. B. L. Bergesen: "No."

1st Lt. W. E. Christensen: "No."

1st Lt. J. L. Cuneo: "I do not think so."

1st Lt. J. T. Dowling, Jr.: "Possibly a slight increase in intensity but not conclusively so."

1st Lt. S. P. Easley: "Not particularly."

1st Lt. E. H. Gibb, Jr.: "No."

1st Lt. C. E. Hall: "No, it is just as intense at the edge as the center, sometimes more turbulent."

1st Lt. W. J. Hastie: "Not necessarily."

Lt. (jg) T. L. Healey, USNR: "No. It is more or less general."

1st Lt. R. E. Henderson: "I believe it is much more turbulent in the center."

1st Lt. F. W. Holer: "Yes. The wider the front the more intense it is."

1st Lt. J. R. Irwin: "Yes."

1st Lt. E. E. Koken: "Depending upon cloud formation and type - generally yes."

1st Lt. J. C. Kline: "Yes."

1st Lt. V. W. Lange: "My impression has been that the wider the front, the lesser the intensity."

1st Lt. H. B. McMullon: "Yes. The wider it is the higher and more intense it is."

1st Lt. G. L. Newkirk: "As the width of the front increases the rain and turbulence usually increase."

8. Is there any relationship between the width of the front and its intensity?

1st Lt. G. F. Piker: "There didn't seem to be."

1st Lt. H. C. Sachs: "No dependable relationship between width and intensity."

1st Lt. T. V. Sawyer: "None."

1st Lt. H. R. Schlesinger: "In some cases a narrow front can be worse than a wider front, but no rain or light rain would exist. A wider front could have less turbulence but more rain and some lightning."

1st Lt. J. E. Shelton, Jr.: "Wider, less severe."

1st Lt. T. B. Small: "If the front is wide it may be weak and broken. If it is narrow, sometimes it is strong and sometimes very weak."

1st Lt. H. B. Stone: "Generally when partially dissipated the width is much greater, the intensity (turbulence) is less."

1st Lt. K. C. Sumnicht: "I believe not."

1st Lt. S. K. Thompson: "It seems that the wider the front the less intense it will be, on the average. The opposite also applies."

1st Lt. D. E. Whittenberg: "Yes. The front is more intense in activity when it is not very wide."

1st Lt. J. F. Wilcoxson, Jr.: "Not usually."

2nd Lt. I. A. Ailara: "No."

2nd Lt. F. B. Allen: "Generally, stronger with width."

2nd Lt. L. M. Asbury: "Yes."

2nd Lt. W. M. Baldridge: "The wider - the weaker."

2nd Lt. C. G. Beard: "None."

2nd Lt. D. H. Binder: "Yes."

2nd Lt. K. J. Bogert: "None."

2nd Lt. R. J. Cherkauer: "I have found that the most intense fronts are not very wide."

2nd Lt. G. M. Dann: "Yes. Usually the wider it is, the stronger it is."

8. Is there any relationship between the width of the front and its intensity?

2nd Lt. R. L. Fleming: "The wider the front the more intense it becomes. Turbulence being more prominent along the outer edges."

2nd Lt. D. S. Gurman: "I have found those fronts with less width and greater vertical development have greatest intensity."

2nd Lt. R. A. Klussendorf: "It seems that the wider the front is, the more intense it is, except that there are often small areas of strong turbulence in narrow fronts."

2nd Lt. A. P. Lundberg: "The wider the front the more intense."

2nd Lt. J. O. Meeks: "Yes."

2nd Lt. R. M. Richberger: "Less intense when the front is narrow."

2nd Lt. J. E. Rinks: "No."

2nd Lt. G. P. Sheen: "Yes, the wider it is the more intense."

2nd Lt. P. H. Smith: "No, I believe only the movement of the front itself will increase the intensity."

2nd Lt. H. D. Vincent: "Yes, the wider it is, the less turbulent it is."

2nd Lt. W. B. Walling: "No."

2nd Lt. W. R. Williams: "No."

2nd Lt. L. C. Wright: "Generally more intense with width."

CWO L. M. Sympson: "Definitely. The more intense the activity, the more narrow the front. Intense activity is usually indicative of zero or very low ceilings through the active area and is also indicative of severe turbulence."

9. What is usually the state of the sea in the area of the front?

Col. R. M. Bristol: "Moderate."

Col. E. M. Day: "From calm to light seas."

Col. P. B. Griffith: "Choppy, although around the Cocos Islands where the front seems to hang all the time, I have seen waves that indicated a wind of at least 18 knots on the surface. We found around the Galapagos that the winds most of the time were about 20 knots."

Col. J. E. Roberts: "Rough to heavy seas."

Lt. Col. J. G. O'Brien: "Calm to light."

Lt. Col. A. F. Tucker: "Most of my flights are at night so I would not know."

Maj. D. W. Bailey: "Rough."

Maj. A. H. Carver, Jr.: "The sea is usually exceptionally rough, the winds causing tremendous waves."

Maj. C. M. Cramer: "Rough."

Lt. Cmdr. R. K. Henderson, USNR: "In the middle and north side of the frontal area, calm sea with light and variable winds."

Maj. J. A. Irwin: "Rough seas, occasionally heavy."

Maj. D. L. Roberts: "Moderately rough."

Maj. F. A. Sanders: "Usually running high and rough in the frontal area."

Maj. O. G. Stephens: "Calm to slight."

Capt. J. W. Adair: "Moderate to rough."

Capt. L. H. Agard: "Rough."

Capt. W. F. Bond: "The sea is usually very rough depending on the intensity of the front."

Capt. R. M. Brown: "Quite choppy with numerous wind changes."

Capt. L. W. Cunningham: "Very rough with high surface winds."

Lt. H. Dickerson, USNR: "Usually calm."

9. *What is usually the state of the sea in the area of the front?*

Capt. J. H. Eichler: "Calm or confused."

Capt. C. V. Eld: "Calm to moderate."

Capt. C. P. Felice: "When flying in the front we have had very little opportunity to see the sea; however, when that was possible, within the most turbulent areas the sea was rough with shifting winds, and other times just moderately so."

Capt. C. E. Glassmeyer, Jr.: "The state of sea tends to be dependent on the degree of cumulonimbus development, and varies from complete calm to high sea."

Capt. W. R. Hansen: "Very rough."

Capt. J. M. Huffman, Jr.: "Rough."

Capt. W. H. Hunt: "Rough."

Capt. W. R. Knight: "Sea becomes rougher on edges of front, but is calm and glassy in center just before the wind shift occurs."

Capt. S. E. Nast: "Within the front itself the sea is usually calm, but "fishtailing", intermittent winds of low velocity are sometimes encountered."

Capt. C. A. Neel: "Sometimes the sea is calm for 30 to 60 miles before reaching the area of the front, then the sea is choppy under the front."

Capt. T. T. Ott: "Moderately disturbed."

Capt. R. W. Scheller: "Rough and heavy."

Lt. I. J. Scott, USNR: "Light to moderate, surface wind seldom exceeds 18 knots."

Capt. E. L. Stevens: "Rough."

Capt. M. W. Williams: "The sea is usually moderate in that area of the front with anywhere from a fifteen to a thirty knot wind on the surface."

Lt. (jg) H. W. Barradale, USNR: "Moderate."

1st Lt. B. L. Bergesen: "Whitecaps dependent upon wind velocity."

9. *What is usually the state of the sea in the area of the front?*

1st Lt. W. E. Christensen: "Choppy."

1st Lt. J. L. Cuneo: "Little rough."

1st Lt. J. T. Dowling, Jr.: "Very turbulent."

1st Lt. S. P. Easley: "Moderate to rough."

1st Lt. E. H. Gibb, Jr.: "I have no idea."

1st Lt. C. E. Hall: "Very choppy, I have encountered winds at 32 knots."

1st Lt. W. J. Hastie: "Rough."

Lt. (jg) T. L. Healey, USNR: "Very rough."

1st Lt. R. E. Henderson: "Usually choppy."

1st Lt. F. W. Holer: "It is usually pretty choppy."

1st Lt. J. R. Irwin: "Calm."

1st Lt. E. E. Koken: "Instrument conditions prevent visual contact generally, rough."

1st Lt. J. C. Kline: "Rough."

1st Lt. V. W. Lange: "Very rough on both sides and quite often calm in the center, but sometimes rough throughout."

1st Lt. A. W. Luce: "Beneath high cumulus domes and in the vicinity of the front, the sea is very rough. Moderate equatorial front -- usually a variable sea."

1st Lt. H. B. McMullon: "There is generally an undercast, hence, you can't see the ocean."

1st Lt. G. L. Newkirk: "Moderately rough and choppy."

1st Lt. G. F. Piker: "Rough."

1st Lt. T. L. Ruddy: "Usually rather choppy."

1st Lt. H. C. Sachs: "The sea may be heavy in the front or be absolutely calm."

1st Lt. T. V. Sawyer: "Sea usually moderate choppy."

9. *What is usually the state of the sea in the area of the front?*

1st Lt. H. R. Schlesinger: "Calm to moderate."

1st Lt. J. E. Shelton, Jr.: "Rough."

1st Lt. T. B. Small: "If you are able to see the water, it is usually pretty choppy."

1st Lt. H. B. Stone: "Heavy sea unless front is quite broken."

1st Lt. K. C. Sumnicht: "Varies as does the wind, from apparent calm to very rough."

1st Lt. S. K. Thompson: "Big swells with lots of white caps."

1st Lt. D. E. Whittenberg: "Moderate."

1st Lt. J. F. Wilcoxson, Jr.: "Usually, if flying above 500 ft. the water is not visibile because of rain or clouds. When below 500 ft. the water appears to be much the same as the weather. If the weather is very turbulent with lots of rain, the sea is usually choppy with large whitecaps and considerable ground-swell."

2nd Lt. I. A. Ailara: "Choppy, moderate to brisk surface wind."

2nd Lt. F. B. Allen: "Choppy, although no definite swell is visible from the air."

2nd Lt. L. M. Asbury: "Don't know."

2nd Lt. W. M. Baldridge: "Have never been that low."

2nd Lt. C. G. Beard: "Moderately rough."

2nd Lt. K. J. Bogert: "Moderately rough."

2nd Lt. G. M. Dann: "Moderately rough."

2nd Lt. R. L. Fleming: "Fairly rough."

2nd Lt. D. S. Gurman: "The sea is usually calm."

2nd Lt. R. A. Klussendorf: "The state of the sea is as variable as the front. The sea has been calm with no wind, and again it has been very rough with wind as high as 60 knots."

2nd Lt. J. H. Lindenmuth: "Slightly rough."

9. *What is usually the state of the sea in the area of the front?*

2nd Lt. A. P. Lundberg: "Moderately rough with wind from 10 to 25 knots."

2nd Lt. A. M. Mason: "Confused."

2nd Lt. J. O. Meeks: "Rough. Winds of perhaps 15 to 20 knots."

2nd Lt. R. M. Richberger: "Very rough."

2nd Lt. J. E. Rinks: "Sometimes fairly rough."

2nd Lt. P. W. Scott: "Rough."

2nd Lt. G. P. Sheen: "Rough."

2nd Lt. P. H. Smith: "Rough."

2nd Lt. W. C. Touchton, Jr.: "Rough - probably."

2nd Lt. H. D. Vincent: "Calm."

2nd Lt. R. L. Walker: "Never noticed, usually flew too high to see."

2nd Lt. W. B. Walling: "Rough and choppy."

2nd Lt. L. C. Wright: "Rough."

CWO L. M. Sympson: "Generally speaking, the sea is calm and glassy thru the frontal area. White caps are common north and south however."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

Col. R. M. Bristol: "Ceiling averages 1000 ft. to 1500 ft. with lower cumulus and stratus tops at about 7000 ft. Towering cumulus and rain clouds build-up to 20,000 ft. or higher."

Col. E. M. Day: "Weak - 1000 ft. to 8000 ft. tops, nimbostratus, and scattered cumulus.
Moderate - 300 ft. to 500 ft., with tops above 10,000 ft. stratus, nimbus, and some towering cumulus.
Strong - zero ceilings, nimbus, stratus, cumulonimbus, tops unknown."

Col. P. B. Griffith: "If the front is weak, I have seen scattered, fluffy cumulus clouds at all altitudes. If it is moderate, the base will come down to about 2000 ft. and go up to around 18,000 ft. This will be cumulus for the most part, with stratus. If the front is intense, the base will be right down to within 200 or 300 ft. off the water and the top will go to infinity. The clouds are cumulonimbus and they are extremely rough."

Col. J. E. Roberts: "Weak - 2500 to 4000 ft., broken and can usually be topped at 6000 ft. to 8000 ft. Fluffy cumulus clouds with a few built up to high levels.
Moderate - 1000 ft. to 2500 ft., broken to overcast and can usually be topped from 8000 to 10,000 ft. Towering cumulus and some nimbus is nearly always present.
Strong - ceiling will appear to be zero but in most cases this is caused from the heavy rain. Generally, the ceiling will range from 500 ft. to 1000 ft. and be somewhat ragged. Tops of the cumulonimbus are unknown."

Lt. Col. J. G. O'Brien: "Weak - 1500 to 7000 ft. Cumulus, stratus.
Moderate - 500 ft. to 15,000 ft. Nimbus, cumulus.
Strong - zero to 40,000 ft. Nimbus, cumulonimbus."

Lt. Col. A. F. Tucker: "Do not know any average ceiling. High overcast with lower layers and sometimes cumulonimbus."

Maj. D. W. Bailey: "Weak - scattered cumulus clouds with bases around 1500 ft.
Moderate - ceiling 1000 ft. to 1500 ft. Stratocumulus clouds below and towering cumulus above. Also scattered rain showers.
Strong - ceiling zero to 1500 ft. Mostly zero with no visibility and very strong rain. Cloud types, same as above with more high cumulus. These towering cumulus are usually quite rough and it is not advisable to fly into it if it can be avoided."

Maj. A. H. Carver, Jr.: "Weak - ceiling is usually 4000 ft. Cloud height to 6000 ft. or 8000 ft.

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

Moderate - ceiling is usually 2000 ft. Clouds to 10,000 ft.
Strong - ceiling is around 500 ft. or less. Clouds 20,000 ft. to 40,000 ft."

Maj. C. M. Cramer: "Weak - 4000 ft. Stratocumulus with a few built up cumulus.
Moderate - 2000 ft. to 4000 ft. with greater convectional development to the clouds.
Strong - 500 ft. to 1000 ft. with many rain squalls, thunderheads, and cloud development up to 25,000 ft. or 30,000 ft."

Maj. J. A. Irwin: "Weak - 500 ft. to 800 ft. Built up to 6000 ft. or 8000 ft.
Intense - zero to 500 ft. ceiling. Built up to 8000 ft. or 10,000 ft. Cumulus with scattered high cumulonimbus."

Maj. D. L. Roberts: "Weak front - 2000 ft. ceiling. Tops at about 10,000 ft. or over.
Moderate front - 1000 ft. ceiling. Tops at about 15,000 ft.
Strong front - no ceiling. Tops to infinity (25,000 ft. to 40,000 ft.)."

Maj. F. A. Sanders: "Moderate - ceiling 500 ft. to 1000 ft. Cloud heights, 15,000 to 20,000 ft.
Strong - ceiling 500 ft. to 1000 ft. Cloud heights, 20,000 ft. to 30,000 ft."

Maj. O. G. Stephens: "As the front develops in intensity from weak to strong, a sharp vertical development in cloud formation is noticed and cumulonimbus activity becomes strong. Ceilings when the front is strong are from zero to 1000 ft. and fogs are higher than birds or DC-3's can fly."

Capt. J. W. Adair: "Weak - cumulus from 3000 ft. to 8000 ft.
Moderate - cumulus from 3000 ft. to 10,000 ft.
Strong - cumulonimbus from 800 ft. to 20,000 ft. or 25,000 ft."

Capt. L. H. Agard: "Weak front - scattered clouds; ceiling 3000 ft. tops of clouds 6000 ft. to 8000 ft.
Moderate front - scattered clouds; few build-ups; general cloud tops at 6000 ft. to 10,000 ft.
Strong front - clouds more intense; ceiling down to 200 ft. or 300 ft.; height of build-ups, 20,000 ft. or more."

Capt. W. F. Bond: "Weak - there are usually scattered to broken clouds from 1000 ft. to 3000 ft. with occasional cumulonimbus and a layer of stratus, stratocumulus or nimbostratus above the lower cumulus at

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

various altitudes, 6000 ft. to 8000 ft."

Capt. R. M. Brown: "Ceiling zero ft. to 100 ft. with towering cumulus up to 25,000 ft."

Capt. L. W. Cunningham: "Weak front - very high (25,000 ft.) cirrus, wispy; some very small cotton-like cumulus 2000 ft. or 3000 ft. high scattered and not more than 25 ft. or 30 ft. thick. CAVU.
Moderate front - usually solid overcast from 1500 ft. to 3000 ft. or 5000 ft. in thickness; moderate to light turbulence; occasional rain squalls; 1 to 5 miles visibilities; high solid overcast to six tenths broken; 12,000 ft. to 15,000 ft. high and 2000 ft. to 5000 ft. thick. Some towering cumulus to 15,000 ft.
Strong front - solid walls of cumulonimbus to 30,000 ft.; lots of rain; severe turbulence at 5000 ft. to 12,000 ft.; heavy rains on "deck"; wind shifts often; overcast ceiling will vary as much as 5000 ft. in one hour."

Lt. H. Dickerson, USNR: "Ceiling 50 ft.; cloud heights unknown; thick stratus clouds."

Capt. J. H. Eichler: "When the front is weak there is an overcast at 10,000 to 20,000 ft. with cumulus, at base 2000 ft. and tops 3000 ft. When the front is moderate the base of the cumulus is 2000 ft. and the tops 10,000 ft. there are no high clouds. When the front is strong there are cumulonimbus clouds with bases 300 ft. and tops 30,000 ft. Also associated with the strong front is a high overcast and layers of stratus at all altitudes."

Capt. C. V. Eld: "2500 ft. to 3000 ft. cumulus."

Capt. C. P. Felice: "Weak front - the average heights are about 10,000 ft. or 11,000 ft., and the ceilings usually appear to be between 1000 ft. and 2000 ft.
Moderate front - the ceiling is about the same or lower, but the clouds may be built up to 16,000 ft. or 18,000 ft.
Strong front - the ceilings can go down to the surface of the ocean and the tops rise to 30,000 ft. or 40,000 ft. In weak fronts the clouds are stratus and stratocumulus and in the stronger front, the clouds become predominantly stratocumulus and cumulus. In intense fronts, clouds are usually cumulonimbus and cumulus. The appearances are deceptive as often as not; a dark appearance may be caused by rain from overhanging clouds and the flying would be smooth except for reduced visibility, or it may be from the overhanging anvil heads of cumulonimbus in which case the flying would be rough. When the appearance of the front seems to be lighter, then invariably it is built up with solid lines of cumulonimbus and most difficult to

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

penetrate. In other words, the light spots are very deceiving, unless blue skies can definitely be discerned."

Capt. C. E. Glassmeyer, Jr.: "Weak - ceiling 1200 ft. to 1800 ft.; height of clouds at 8000 ft. extent, 5 tenths to 8 tenths cumulus.
Moderate - ceiling 500 ft. to 1000 ft. with scattered cumulonimbus; extent 9 tenths to 10 tenths; visibility zero to 10 miles.
Strong - ceiling zero to 500 ft.; five tenths to eight tenths cumulonimbus over large areas towering from 18,000 ft. to estimated 30,000 ft. to 40,000 ft."

Capt. W. R. Hansen: "Weak - 1000 ft.; light cumulus, stratus, mist and fog.
Moderate 500 ft. to 1000 ft.; cumulus, stratus and rain.
Strong - zero to 1000 ft.; cumulus, cumulonimbus."

Capt. J. M. Huffman, Jr.: "200 ft. to 2000 ft."

Capt. W. H. Hunt: "Weak - 3000 ft.
Moderate - 1200 ft.
Strong - 500 ft."

Capt. W. R. Knight: "Average ceiling in the whole area is 1000 ft. In the front it drops to 300 ft. or 500 ft. and cumulonimbus ascend to 20,000 or 40,000 ft. when intense. If weak, only isolated cumulus. At times, it appears as a wall of black clouds if intense. In moderate fronts, stratus clouds increase in altitude as front approaches. Stratus usually stops at 10,000 ft."

Capt. S. E. Nast: "Weak front - clouds are much like those of air mass weather; two tenths to four tenths cumulus at 1500 ft. to 2500 ft., perhaps with broken to overcast stratocumulus at the front, depending upon its weakness. No upper clouds.
Moderate front - outside of the front on either side, eight tenths to overcast stratocumulus at 1000 ft. to 1500 ft. is characteristic, with towering cumulus, and perhaps cumulonimbus in a 50 to 150 mile belt of the frontal zone proper, where the ceiling becomes 500 ft. to zero as a general rule. Upper clouds unknown.
Strong front - comparatively narrow region of activity. 30 miles to 50 miles, is marked by a complete overcast with a ceiling of zero. Judging from darkness of clouds, turbulence and lightning, the clouds are cumulonimbus. From 100 miles to 300 miles north and south of the frontal area, eight tenths to overcast stratocumulus at 500 ft. to 1000 ft. will be found. On occasions when I have flown through these lower clouds in a strong front (and this has been infrequent), middle clouds, five tenths to eight tenths altocumulus and altostratus at 8000 ft. to 10,000 ft. have been observed, along

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

with five tenths to eight tenths altocumulus and altostratus at 8000 ft. to 10,000 ft. have been observed, along with five tenths to overcast cirrostratus, usually thick and at about 20,000 ft."

Capt. C. A. Neel: "Clouds reach to 25,000 ft. in severe fronts. 18,000 ft. in moderate fronts and up to 12,000 ft. in weak fronts."

Capt. T. T. Ott: "Weak front - usually has a low layer of scattered or broken clouds, seldom above 5,000 ft.
Moderate front - has lower scattered or broken cumulus and a higher layer or layers, usually topped at 12,000 ft.
Strong front - generally runs with a ceiling of 700 ft. with a very high and indefinite top."

Capt. R. W. Scheller: "Weak - 1000 ft. ceiling; overcast, solid in front to 6000 ft., occasional build-up.
Moderate and Strong - zero to 500 ft. ceilings; solid up to 8000 ft.; build-up to 20,000 ft. or 30,000 ft., often in intense part."

Lt. I. J. Scott, USNR: "Weak - up to 2000 ft., lower in squalls.
Moderate - no answer.
Strong - 600 ft. with lower bulges and broken."

Capt. M. W. Williams: "Weak front - ceilings usually up to 3000 ft. cloud heights up to 10,000 ft.
Moderate front - ceilings usually around 2000 ft. Cloud heights up to 15,000 ft.
Heavy front - ceilings from zero to 1000 ft. Cloud heights up to and over 20,000 ft."

Lt. (jg) H. W. Barradale, USNR: "Average ceiling 1200 ft. Clouds up to 7000 ft. when weak, higher as front becomes stronger."

1st Lt. B. L. Bergesen: "Weak front - tops 9000 ft.; cumulus.
Moderate front - tops 11,000 ft.; cumulus.
Strong front - tops 35,000 ft.; cumulus."

1st Lt. W. E. Christensen: "Weak - 1500 ft.; clouds to 8000 and 10,000 ft.
Moderate - 1000 ft.; clouds to 13,000 ft. and 15,000 ft.
Strong - 300 ft.; clouds to 20,000 ft. and above."

1st Lt. J. L. Cuneo: "Weak - medium.
Moderate - towering.
Strong - 50,000 ft., etc."

1st Lt. J. T. Dowling, Jr.: "Weak - 1500 ft.; 6000 ft.

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

Moderate - 500 ft.; 10,000 ft. to 12,000 ft.
Strong - unknown."

1st Lt. S. P. Easley: "Weak - 1800 ft. to 6000 ft.; cumulus.
Moderate - 1500 ft. to 10,000 ft.; cumulus.
Strong - 700 ft. to 20,000 ft. or 30,000 ft.; cumulus and cumulonimbus."

1st Lt. E. H. Gibb, Jr.: "Ceiling is always zero and clouds range from 8000 to 20,000 ft."

1st Lt. C. E. Hall: "Weak - average height of clouds, 8000 ft. to 10,000 ft.; towering cumulus appear very white and thin. Not very turbulent.
Moderate base of clouds of approximately 1200 ft. to 1500 ft.
Moderate - height 10,000 ft. to 12,000 ft.; towering cumulus appear grayish and solid; very turbulent but not enough to blow you out the top; base of clouds 800 ft. to 1200 ft.; moderate rain.
Strong front - height 12,000 ft. to 16,000 ft.; cumulonimbus appear dark grayish and solid; very turbulent and really gives the ship a shaking; heavy rain inside and very heavy rain underneath; base of clouds as low as 300 to 400 ft. At 200 ft. the best place to fly, although you encounter heavy rain, your ship maintains a stable attitude."

1st Lt. W. J. Hastie: "Weak - cumulonimbus to 10,000 ft.
Moderate - cumulonimbus to 15,000 ft.; ceiling about 3000 ft.
Strong - cumulonimbus clouds indefinite; ceiling about 1500 ft. to 3000 ft."

Lt. (jg) T. L. Healey, USNR: "Weak front - ceiling 500 ft.; clouds to 8000 ft.; cumulus and weak cumulonimbus.
Moderate - ceiling 300 ft.; clouds to 10,000 and 12,000 ft.; cumulus, cumulonimbus.
Strong - ceiling zero to 200 ft.; clouds 15,000 ft. and up; large cumulonimbus."

1st Lt. R. E. Henderson: "Weak and moderate - ceiling 1000 ft. to 1500 ft.; cumulus up to 8000 ft., some higher.
Strong - ceiling 500 ft. to 700 ft.; cumulus up to 20,000 ft."

1st Lt. F. W. Holer: "Weak - ceiling 4000 ft.; tops 8000 ft.; cumulus.
Moderate - ceiling 2000 ft.; tops 12,000 ft.; stratocumulus.
Strong - ceiling 500 ft.; tops 25,000 ft.; thunderheads."

1st Lt. J. R. Irwin: "Weak - stratus at 12,000 ft.
Moderate - few build-ups and tops of same; many cumulonimbus."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

1st Lt. E. E. Koken: "Weak - 500 ft. to 1500 ft.; stratus.
Moderate - 500 ft. to 20,000 ft.; cumulus.
Strong - zero to 40,000 ft.; cumulonimbus and nimbostratus."

1st Lt. J. C. Kline: "Weak - 800 ft. to 1000 ft."

1st Lt. V. W. Lange: "Weak - ceiling 1000 ft. to unlimited with almost no turbulence. There have been times when the only indication of having passed through the front was the sudden wind shift. When clouds were present, they usually had tops at 3000 ft. to 4000 ft. and were broken cumulus.
Moderate - ceiling 500 ft. to 1000 ft. with usually moderate turbulence in clouds, which were cumulus, cumulonimbus, and layers of stratocumulus. Tops of towering cumulus at 10,000 ft. usually scattered, with top of cumulus overcast at 5000 ft.
Strong - ceiling zero to 1000 ft., more often near zero to 500 ft. severe turbulence in clouds at any altitude and often also in the clear below clouds. Cumulus and stratocumulus overcast up to 10,000 ft. with towering cumulus reaching to over 30,000 ft. (estimated). Very heavy rain limited visibility to zero even if one flew below all clouds, which usually was not possible."

1st Lt. A. W. Luce: "Weak - 4000 ft. to 6000 ft.; grayish stratus and at times broken.
Moderate - 1000 ft. to 9000 ft.; low dark clouds and altostratus.
Strong - 500 ft. to 18,000 ft.; towering dark cumulus with high tufts."

1st Lt. H. B. McMullon: "Weak - can go over at about 10,000 ft. The bases of the clouds (mostly stratus at several levels) are about 3000 ft. or 4000 ft. Sometimes these clouds will build up to 15,000 ft. or so.
Moderate - has cumulonimbus lines which are avoidable. They are usually built-up to about 25,000 ft. The main clouds are again stratus, which can be topped at 10,000 ft. Bases are around 5000 ft. to 6000 ft.; with a lot of rain going down to the sea.
Strong - a solid mass of cumulonimbus clouds that are crowded together. The tops are around 30,000 ft. and the bases at the level of the sea."

1st Lt. G. F. Piker: "Weak - ceiling 1500 ft.; clouds up to 10,000 ft.
Moderate - ceiling 800 ft.; clouds up to 20,000 ft.
Strong - ceiling zero to 500 ft.; clouds up to 35,000 ft."

1st Lt. T. L. Ruddy: "They average from 600 ft. to 1000 ft. for a ceiling and the tops from 5000 ft. to 9000 ft.; cumulus."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

1st Lt. H. C. Sachs: "Weak - ceiling 3000 ft.; cloud heights to 10,000 ft.; five tenths to six tenths cumulus.
Moderate - ceiling 1500 ft.; cloud heights to 15,000 ft. to 20,000 ft.; six tenths or more cumulus.
Strong - ceiling 500 ft. and less; cloud heights to 30,000 ft. or more; nine tenths to overcast cumulus."

1st Lt. T. V. Sawyer: "Approximately 800 ft.; smooth overcast; towering cumulus."

1st Lt. H. R. Schlesinger: "Weak - ceiling 3000 ft. with tops at 6000 ft. to 8000 ft. Stratocumulus mixed with white solid bands.
Moderate - ceiling 2000 ft.; tops at 10,000 to 12,000 ft.; same clouds only more, with several cumulonimbus in the center and surrounding area.
Strong - ceiling 200 ft.; tops 15,000 ft. or above; all types of clouds mixed with cumulonimbus obscured by stratus clouds."

1st Lt. J. E. Shelton, Jr.: "Weak - 1000 ft.;gets lower with intensity."

1st Lt. T. B. Small: "Weak - undercast at around 7000 ft. or 8000 ft., with an overcast or broken clouds with base between 10,000 ft. and 15,000 ft. below cumulus clouds.
Moderate - tops may be 15,000 ft. to 20,000 ft.; bottoms about 1000 ft. with rain below; clouds are usually high cumulus and some cumulonimbus.
Strong - tops may be 30,000 ft. or higher (I guess) - it looks very black; some lightning; turbulence. The clouds are towering cumulus and cumulonimbus. Base is usually 800 ft. to 1000 ft. with heavy rain and moderate turbulence."

1st Lt. H. B. Stone: "When weak or moderate, possible to fly around towering cumulus; estimated at 10,000 ft.
If strong or intense, there is no going over or under."

1st Lt. K. C. Summicht: "Weak - ceiling 1000 ft. to 2000 ft.; height 8000 ft. to 10,000 ft.; moderate cumulonimbus, mostly cumulus.
Moderate - 500 ft. to 1000 ft.; height 10,000 ft. to 18,000 ft.; moderate cumulonimbus.
Strong - zero ft. to 300 ft.; height estimated at 40,000 ft.; large towering cumulonimbus."

1st Lt. S. K. Thompson: "Weak front - bases 5000 to 3000 ft.; stratocumulus and towering cumulus and cumulonimbus.
Moderate front - bases 500 ft. to 3000 ft.;tops 15,000 ft. to 30,000 ft.; cumulus, towering cumulus, frequent cumulonimbus.
Strong front - bases zero to 1000 ft.; tops 50,000 ft. to 90,000; cumulonimbus dark and wet."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

1st Lt. D. E. Whittenberg: "Weak - ceiling of 1500 ft. to 2000 ft. with light clouds.
Moderate - ceiling at 800 ft. to 1500 ft. with varying cloud formations.
Strong - ceiling zero to 1000 ft. with heavy cumulonimbus."

1st Lt. J. F. Wilcoxson, Jr.: "Weak - ceiling 2000 ft.; tops 6000 ft. to 10,000 ft.
Moderate - ceiling 500 ft. to 2000 ft.; tops 8000 ft. to 30,000 ft.; towering cumulus.
Strong - ceiling zero to 500 ft.; tops at 15,000 ft. to undefined towering cumulus."

2nd Lt. I. A. Ailara: "Weak - average ceiling approximately 1500 ft.; average height about 9000 ft.
Moderate - average ceiling about 1000 ft.; average height 12,000 ft.
Strong - average ceiling about 800 ft.; average height 15,000 ft. to 20,000 ft."

2nd Lt. F. B. Allen: "Towering cumulus up to 8000 ft. to 10,000 ft."

2nd Lt. L. M. Asbury: "Ceiling as low as 500 ft.; cloud heights usually as high as 20,000 ft."

2nd Lt. W. M. Baldridge: "Clouds are cumulus. As to ceiling heights, etc., wouldn't know; always fly right thru clouds."

2nd Lt. K. J. Bogart: "Weak - ceiling 3000 ft.
Moderate - ceiling 2000 ft.
Strong - ceiling 500 ft."

2nd Lt. R. J. Cherkauer: "Weak - usually overcast, rising from 3000 ft. to 12,000 ft. or higher; stratus and some cumulus.
Moderate - 10,000 ft. to 20,000 ft.; towering cumulus and cumulonimbus with altocumulus.
Strong - 20,000 ft. to 25,000 ft.; cumulonimbus, towering cumulus, layers of stratus."

2nd Lt. G. M. Dann: "Weak - 10,000 ft.
Moderate - 20,000 ft.
Strong - 40,000 ft. Cumulus clouds at all times with stratiform clouds at outer edges."

2nd Lt. R. L. Fleming: "Weak front - usually remains constant up to 10,000 ft.
Strong front - ceiling from zero to 25,000 ft."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

2nd Lt. D. S. Gurman: "Weak - stratus 500 ft. to 4000 ft.
Moderate - cumulus 800 ft. to 8000 ft.
Strong - cumulonimbus 800 ft. to 12,000 ft."

2nd Lt. R. A. Klussendorf: "Weak - base 2000 ft. to 4000 ft.; tops at 4000 ft. to 6000 ft.
Moderate - base 1500 ft. to 4000 ft.; tops at 6000 ft. to 8000 ft.
Strong - base 300 ft. to 1000 ft.; tops 12,000 ft. on up."

2nd Lt. J. H. Lindenmuth: "Strong - ceiling 10,000 ft.; towering cumulus 10,000 to 15,000 ft."

2nd Lt. A. P. Lundberg: "Weak - 1000 ft. ceiling; top at 8000 ft.
Moderate - 500 ft. to 700 ft. ceilings; top at 15,000 ft.
Strong - 300 ft. ceiling; top at ? ."

2nd Lt. A. M. Mason: "We flew under 1000 ft."

2nd Lt. J. O. Meeks: "Weak front - 1000 ft. ceiling; tops at 10,000 ft.
Moderate - 600 ft. ceiling; tops at 15,000 ft.
Strong - ceiling zero; tops unknown."

2nd Lt. R. M. Richberger: "Ceiling at 500 ft.; cloud height 15,000 ft. Black cumulus and cumulonimbus."

2nd Lt. J. E. Rinks: "Weak - stratus and cumulus tops about 6000 ft.
Moderate - cumulus and not much vertical build-up.
Strong - towering cumulus; thunderstorms with half-light."

2nd Lt. P. H. Smith: "Weak front - around 1500 ft.
Moderate - from 1000 ft. to 10,000 ft.
Strong - from 500 ft. to 20,000 ft. or 30,000 ft."

2nd Lt. W. C. Touchton, Jr.: "Weak - 2000 ft. to 10,000 ft. or 15,000 ft.
Moderate - 500 ft. to 30,000 ft.
Strong - 500 ft. to unknown heights. Of course this varies too much to set a definite scale."

2nd Lt. H. D. Vincent: "Weak - 1500 ft. to 5000 ft.; stratus.
Moderate - 1500 ft. to 7000 ft.; cumulus.
Strong - 1000 ft. to 10,000 ft.; cumulus."

2nd Lt. W. B. Walling: "Weak - 3000 ft.
Moderate - 2000 ft.
Strong - 300 ft. to 1000 ft."

10. *What are the average ceiling and cloud heights when the front is of weak, moderate, or strong intensity?*

2nd Lt. W. R. Williams: "Weak - 5000 ft. to 8000 ft.
Strong - 5000 ft. to 20,000 ft."

2nd Lt. L. C. Wright: "Weak - 2000 ft. to 8000 ft.
Moderate - 1000 ft. to 10,000 ft.
Strong - 200 ft. to 300 ft."

CWO L. M. Sympson: "Weak front - can be topped at 6000 ft. or flown below at 1500 ft. Scattered to broken stratus at the northern and southern extremities with broken (six tenths to eight tenths) cumulus at the center. Turbulence is very light, except in clouds. The front covers from 250 to 400 miles width north to south.
Moderate front - ranges from 1000 ft. to 12,000 ft. to 15,000 ft. high. Broken cumulus clouds mark the northern and southern edges, with occasional towering cumulonimbus near the center. Scattered showers are usually encountered beneath the cloud level. Frontal width is from 150 miles to 200 miles.
Strong front - is indicated by a heavy build-up of cumulonimbus which resemble a solid wall and range from 15,000 ft. to 30,000 ft. or higher. Very low ceilings with heavy rains may be expected. Turbulence is severe, frontal width is from 50 to 150 miles."

11. *Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?*

Col. R. M. Bristol: "Near Panama."

Col. E. M. Day: "It usually appears the nearer Panama the more intense and the heavier the rain. Proximity of a landfall probably influences this belief from a navigational hazard point of view."

Col. P. B. Griffith: "When it is near Panama it seems to be more intense."

Col. J. E. Roberts: "Actually the front is no more severe near Panama than when it is farther south but it does affect the pilot mentally due to the fact that he is nearing his destination. That is the only reason for saying that it is more difficult near Panama."

Lt. Col. J. G. O'Brien: "When near Panama, for in my experience the front is always of strong intensity when this condition is present."

Maj. D. W. Bailey: "When it's near Panama, as the coast is closed in and it is hard to make a land fall."

Maj. A. H. Carver, Jr.: "Usually near Panama. The weather seems to become worse as you approach the Zone if the front is near Panama Bay."

Maj. C. M. Cramer: "Front is strongest when at its extreme north and south positions. It never seems to be very strong when near Panama."

Maj. J. A. Irwin: "Only mental hazard, when it is near Panama."

Maj. D. L. Roberts: "I generally find that when the front is near Panama it will extend over a wide area - possibly to about 3-1/2 degrees."

Maj. F. A. Sanders: "When the front is near Panama it presents problems of bad weather at terminals."

Maj. O. G. Stephens: "As the front moves north it becomes more intense."

Capt. J. W. Adair: "No difference noted."

Capt. L. H. Agard: "Sometimes it is more intense near Panama, usually in the vicinity of Cape Mala. However there is not much difference."

Capt. W. F. Bond: "Believe my most severe encounters have been farther south."

Capt. R. M. Brown: "It is simpler to penetrate when it is farther south. If it is near Panama and that is the destination, the front causes

11. *Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?*

low ceilings and visibilities over the Isthmus."

Capt. L. W. Cunningham: "Not much difference except I sweat out the mountains over land."

Lt. H. Dickerson, USNR: "When it is near Panama - more turbulence."

Capt. J. H. Eichler: "Near Panama, mountains present most difficulty."

Capt. C. V. Eld: "Near Panama, more active nearer Guatemala City."

Capt. C. P. Felice: "Without much hesitation, I think, that I can safely say that more difficulty is encountered in flying thru the front when it is nearer to Panama, or relatively farther north in latitude. As year-around weather maps show, the entire doldrums belt shifts farther north, together with the accompanying equatorial frontal area, in the wet season, and as has been shown, the worst weather is met with during the wet season. The frontal area will often move far above the Isthmus of Panama itself during this season at which time, however, the area south of Panama will be almost unmolested and the flying will be very good, with only small build-ups, which can be easily avoided. But in general, when the fronts sit at about four to six or seven degrees north, the weather is invariably the worst. And coincidently, when it is like that, that is about the time when there may be two bands of extra bad weather. Furthermore, when the front is up north, visibility is so reduced that a hazard is presented the pilot in that he cannot often see land until he is right over it."

Capt. C. E. Glassmeyer, Jr.: "Front is generally more intense further north especially near the Canal Zone."

Capt. W. R. Hansen: "There is no difference in difficulty. However, the mental hazard is greater close to Panama, as one approaches the land."

Capt. J. M. Huffman, Jr.: "Near Panama."

Capt. W. H. Hunt: "The front is more difficult to fly through when it is near Panama."

Capt. W. R. Knight: "Frontal conditions are much more intense in the vicinity of Panama. When farther south toward Salinas, front is often negligible."

Capt. S. E. Nast: "Without exception, flying through the front when it has lain near Panama has been more difficult than when it has lain further south."

11. *Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?*

Capt. C. W. Neel: "Haven't flown much farther south than Panama but it appears that the immediate area of Panama is most severe."

Capt. R. W. Scheller: "Not necessarily near Panama, "near land" is the term we want; this difficulty near land is not due to more intense weather but rather to the strain of sweating out the coast, terrain, the field, etc."

Lt. I. J. Scott, Jr.: "I found it rougher when it was farther north."

Capt. E. L. Stevens: "More trouble near Panama because of mountains."

Capt. M. W. Williams: "I have found that the front is usually more severe farther south."

Lt. (jg) H. W. Barradale, USNR: "Nearer Panama it is more intense."

1st Lt. B. L. Bergesen: "More difficulty is experienced around 6° N. 81° 45' W. up to the coastline of Panama."

1st Lt. W. E. Christensen: "Same, more hazard near Panama."

1st Lt. J. L. Cuneo: "Near Panama."

1st Lt. J. T. Dowling, Jr.: "Most turbulence is encountered near Panama particularly over the land at Cape Mala."

1st Lt. S. P. Easley: "Never noticed much difference."

1st Lt. W. H. Gibb, Jr.: "It makes no difference."

1st Lt. C. E. Hall: "The front near Cape Mala is the most turbulent place in the whole Sixth Air Force - (in my experience)."

1st Lt. W. J. Hastie: "Near Panama, for then it is often much wider and and more severe."

Lt. (jg) T. L. Healey, USNR: "About same."

1st Lt. R. E. Henderson: "When near Panama."

1st Lt. F. W. Holer: "If the front is near Panama we generally turn around."

1st Lt. J. R. Irwin: "Near Panama."

1st Lt. E. E. Koken: "South."

11. *Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?*

1st Lt. V. W. Lange: "Greater difficulty is encountered when it is near Panama, due mostly to the added hazard of mountains."

1st Lt. A. W. Luce: "Always when near Cape Mala and Panama there are exceptions of course."

1st Lt. H. B. McMillon: "It is harder to fly through when it is near Panama."

1st Lt. G. L. Newkirk: "Usually more difficult as you approach the mainland."

1st Lt. G. F. Piker: "No."

1st Lt. T. L. Ruddy: "When near Panama."

1st Lt. H. C. Sachs: "Most difficult to fly thru when near Panama. Moderate to severe turbulence is noted in this area."

1st Lt. T. V. Sawyer: "Near Panama."

1st Lt. H. R. Schlesinger: "Near Panama, because of fear of hitting land and reaching the terminal. Usually there is little difference near Panama or close to Galapagos."

1st Lt. J. E. Shelton, Jr.: "Near Panama."

1st Lt. T. B. Small: "The front is usually stronger when near Panama."

1st Lt. K. C. Sumnicht: "Front more severe farther north."

1st Lt. S. K. Thompson: "It doesn't make much difference. You are usually on instruments, anyway, so it's all the same."

1st Lt. D. E. Whittenberg: "This is variable but seems to be worse when near Panama."

1st Lt. J. F. Wilcoxson, Jr.: "Very little difference."

2nd Lt. I. A. Ailara: "More difficult when front is near Panama."

2nd Lt. F. B. Allen: "When near Panama over Cape Mala but no difference noticed over water."

2nd Lt. L. M. Asbury: "When it is near Panama."

2nd Lt. N. M. Baldridge: "Yes, over the Cape (Cape Mala)."

11. *Do you usually have more difficulty in flying through the front when it is near Panama or when it is farther south?*

2nd Lt. K. J. Bogert: "When it is near Panama."

2nd Lt. R. J. Cherkauer: "No difference."

2nd Lt. G. M. Dann: "I have only flown when it has been near Panama."

2nd Lt. R. L. Fleming: "Panama."

2nd Lt. D. S. Gurman: "Fronts closer to Panama seem more intense."

2nd Lt. R. A. Klussendorf: "Near Panama, it seems more intense and there is more rain as you approach land."

2nd Lt. J. H. Lindenmuth: "Near Panama."

2nd Lt. A. P. Lundberg: "Farther south."

2nd Lt. A. M. Mason: "When it is near Panama."

2nd Lt. J. O. Meeks: "South of Panama and west over the Pacific."

2nd Lt. R. M. Richberger: "Near Panama."

2nd Lt. J. E. Rinks: "No opinion."

2nd Lt. G. P. Sheen: "Nearer Panama."

2nd Lt. P. H. Smith: "Difficulty is greater when approaching land regardless of position of front."

2nd Lt. W. C. Touchton, Jr.: "More difficulty near Panama, it seems."

2nd Lt. H. D. Vincent: "Near Panama."

2nd Lt. W. B. Walling: "Near Panama."

2nd Lt. W. R. Williams: "Nearer Panama."

2nd Lt. L. C. Wright: "Generally more difficult when near Panama due to the fact it shifts north during wet season."

CWO L. M. Sympson: "The most difficult experience in flying through the front when it is near Panama is navigational. Low ceiling and visibility render it difficult to raise a landfall until practically on top of the land. Scattered to broken showers create difficulties of approach and landing."

Col. R. M. Bristol: "No comment."

Col. E. M. Day: "Just what you are doing. Research and maximum pilot reports. Most recent pilot reports from aircraft which have passed through the front currently would help out-going pilots."

Col. P. B. Griffith: "No suggestions except that I would request, for a period of several months, that all pilots flying through the front turn in the route forecast. I believe that over a period of a year a graph could be drawn showing exactly what the weather to be encountered would be."

Col. J. E. Roberts: "The only thing you can do is take the pilot reports. Actually concrete knowledge from this source will prove of little benefit; for example, you can fly two tracks from here to Galapagos fifty miles apart and at the same altitude and one pilot will encounter instrument conditions for half the trip whereas the other will report good weather all the way."

Lt. Col. J. C. O'Brien: "Utilizing pilot weather reports."

Lt. Col. A. F. Tucker: "AAF Regulation and policy to equip and require each long range airplane to take and forward weather reports continually. Present policies are good, particularly this feature of pilot interviewing. Actual forecasts are only fair. Much improvement is possible."

Maj. D. W. Bailey: "More accurate reports from pilots and interrogating them if necessary. Forecasters must study all past records of the front. I believe with each pilot giving accurate information, the altitude which could be flown to avoid all rough weather could be estimated successfully. What we have been given is sufficient but the above would help. This would only be possible when numerous flights are made each day."

Maj. A. H. Carver, Jr.: "No forecasts can be improved unless planes in the front are reporting when forecasts are being made. It is impossible for one to predict accurately what the front will be in five hours."

Maj. C. M. Cramer: "Present form used for forecasts is very good. VI Bomber Command should use weather form #25RR-0 instead of CARIMET form. Suggest better liaison between Bomber Command radio station, where weather reports from airplanes are received, and Base Weather. The most important information we need are accurate winds aloft, and terminal forecasts."

Lt. Cmdr. R. K. Henderson, Jr.: "No. Pilots have no fear of this front, so they pay very little attention to it."

Maj. J. A. Irwin: "More pilot reports, if available."

Maj. D. L. Roberts: "None. (I don't think this front can be forecast - it changes drastically in an hour.)"

Maj. F. A. Sanders: "Send observers on frequent flights."

Maj. C. G. Stephens: "None, unless weather stations could establish themselves in frontal areas."

Capt. J. W. Adair: "None."

Capt. L. H. Agard: "None. Forecasts are OK."

Capt. W. F. Bond: "Better pilot reporting form. The need is not for more information but better quality of present information."

Capt. R. M. Brown: "No suggestions. The only way to gain knowledge of the front is to fly through it."

Capt. L. W. Cunningham: "Hard to say, better interpretation of flight reports."

Capt. J. H. Eichler: "Include synoptic map and cut out cross sectional map. Strong winds aloft at Albrook Field indicate a moderate or severe front."

Capt. C. V. Eld: "File hourly weather reports on route with Flight C.O. Would like information as to the cause of its movement north and south and its relation to season hereabout and elsewhere."

Capt. C. P. Felice: "Suggestions for the improvement of forecasts are very difficult to make. I don't believe accurate forecasts will be made until a thorough knowledge of tropical weather is attained, and until a knowledge of reasons for the hourly cycles, the daily cycles and the weekly cycles is attained. If it were possible to have weather reporting stations at spots like Buenaventura, Colombia, or the Malpelo Isles, or the Cocos Isles, which all lie in the equatorial front, then forecasting could be made accurate. Also if it were possible to use the weather ship daily to go out and look at the front and study it from the air and report it daily in the weather office, first hand information could be given the pilots on the spot for the time being before take-off. Also, it would be sensible idea

to have weathermen, flying more often thru the front with ships that daily fly it, studying and observing all the time."

Capt. W. R. Hansen: "If the forecasts were given in the form of a map, the pilots flying through could make notes on the map correcting mistakes on the forecast. I have flown through the front by day and by night. Is the front actually stronger by night than in the daytime?"

Capt. J. M. Huffman, Jr.: "Have weather officer fly specified routes at least once a month."

Capt. W. R. Knight: "When weather is sent in every two hours with position reports, very little accuracy can be given. Changes often occur within a few minutes. Suggest hourly report from planes, or when change in weather occurs. CARIMET form is best available at present."

Capt. S. E. Nast: "My best suggestion for improving forecasts is a caustic criticism of one source on which they are based. I find the current weather form very cumbersome and even inadequate. A complete weather report at any instant can not be given without a thorough search for each entry, if at all; some conditions are not even represented by code numbers. The result is that weather gets an incomplete picture of conditions if not an erroneous picture, and for my personal part according to the existing form, no picture at all. Consequently, basic information for forecasts is not sufficient or satisfactory. I, personally, would submit many more reports if forms were easier to use."

Capt. C. A. Neel: "I have none - forecasts or weather conditions over the water don't concern bomber pilots much because the only aid would be winds for navigation. We fly through whatever is out there at whatever altitude we happen to be, regardless of weather. Our navigators usually find their own winds anyway. The main thing is an accurate report on the weather at the terminals as regards to ceiling, visibility, fog, etc."

Capt. T. T. Ott: "Obtain a simple weather form for pilots to fill out enroute and one that a pilot can cover existing weather on. The present form is too complicated and impractical. The only thing necessary is to make present reports accurate on the following points: winds from sea level up to 20,000 ft.; the amount and type of build-up to be encountered, the amount of precipitation expected and the extent of turbulence present at all altitudes."

Lt. I. J. Scott, USNR: "Would like more information on the width and height."

Capt. M. W. Williams: "I can only say that unless a daily check is kept on the front, forecasts cannot be predicted too accurately. The front is an ever changing thing."

Lt. (jg) H. W. Barradale, USNR: "Getting more accurate winds aloft sequence."

1st Lt. B. L. Bergesen: "More information given weathermen by ships, planes, etc. experiencing weather in all areas."

1st Lt. W. E. Christensen: "More frequent pilot reports."

1st Lt. J. L. Cuneo: "Let observers fly through to see what it is like."

1st Lt. J. T. Dowling, Jr.: "Better reports by all aircraft flying the area."

1st Lt. S. P. Easley: "None, since I don't have a technical knowledge of meteorology sufficient to forecast from data available."

1st Lt. C. E. Hall: "Have pilots give a more detailed report around the frontal area."

1st Lt. W. J. Hastie: "Personal pilot reports."

1st Lt. J. R. Irwin: "Take a few trips south."

1st Lt. E. E. Koken: "Weather stations or more accurate observations from planes."

1st Lt. J. C. Kline: "Weathermen take the trip occasionally."

1st Lt. V. W. Lange: "Strict enforcement of hourly in-flight weather reports such as the CARIMET, etc., with the time of such reports staggered, for example, northbound on the hour and southbound on the half hour. Weather at Cape Mala is valuable on flights from south into the Canal Zone."

1st Lt. A. W. Luce: "A study of these many reports covering a period of time, and a constant and careful reporting by pilots flying routes. I'm sure pilots would appreciate a more careful and accurate report on weather conditions within Panama Bay and off Cape Mala coming up into the Zone. Many times it is necessary to fly low thru the front as one approaches land or Cape Mala. It would help if a pilot knew his ceiling and visibility at that point."

1st Lt. H. B. McMullon: "As to improving forecasts, the only answer is

to establish more stations with trained weather personnel along the route. However, since that is impossible or improbable, my suggestion is to make more positive use of available forecasts. Since most of our flights take off from PAD, it would seem logical to set up a weather briefing section over there. And since it has been proven time and again that visual information is the most easily absorbed, why not have a weather officer at PAD, along with a map on the wall, similar to the one in Base Operations, with the current weather drawn on it. A short discussion by the weather officer, connected with the visual map, would work wonders. I base my opinion of the front upon the strength and direction of the winds from the north and south. And whether they have been steady, increasing or decreasing, and the direction of their shift, if any, is important. Information of this nature for the previous 24 hours is usually an accurate method of judging the intensity of the front."

1st Lt. T. L. Ruddy: "Pay more attention to wind forecast."

1st Lt. H. C. Sachs: "Better pilots' reports from men who fly the front at regular and frequent intervals with a more satisfactory form."

1st Lt. T. V. Sawyer: "More accurate and frequent reports from pilots."

1st Lt. H. R. Schlesinger: "If we could have a weather form to fill out periodically which would take little time to do, so you could have more information. The present form you have takes at least a half hour of each hour and we can't spend that much time. The weather map you give pilots, I think, is excellent. It gives us a picture and we in turn can draw in or make notations and corrections at various positions. That, I believe, is the best type of report for pilots to give you. I have flown through fronts at all altitudes up to 12,000 ft. and have never encountered icing conditions, but would like to know the possible freezing level of a front if any exists, and have it down on the picture map in colored crayon."

1st Lt. J. E. Shelton, Jr.: "Under conditions, improvement would be hard."

1st Lt. T. B. Small: "I have no suggestions for improving forecasts because in my estimation it is very unpredictable since it changes so much and so rapidly. On flights sometimes two ships fly routes thirty miles or so apart; one ship will hit a lot of instruments and the other may have fairly clear weather. One day the front may be severe and the next day it may be very weak. The position of front does not move very fast;however height and intensity changes rapidly. My statements may contradict each other a good deal, but

the frontal area is different nearly every trip through."

1st Lt. H. B. Stone: "More comprehensive pilot report."

1st Lt. K. C. Sumnicht: "Do not believe improvement possible without daily flights through the frontal area."

1st Lt. D. E. Whittenberg: "Weather report from every pilot flying thru the area, although such averaging is not too good."

2nd Lt. I. A. Ailara: "More detailed reports made more often from planes traveling through frontal area."

2nd Lt. R. L. Fleming: "If possible, the isolation and position of the most turbulent part of the front to a greater degree."

2nd Lt. R. A. Klussendorf: "Forecasts are good, considering the number of observation stations."

2nd Lt. A. P. Lundberg: "Only the use of a weather ship. Question pilots who have flown through the front in the twenty-four hours prior to your flight."

2nd Lt. J. O. Meeks: "None. Weather plane is the only thing that could give definite weather. Would like to get weather and information concerning weather from pilots who have flown front in the past twenty-four hours."

2nd Lt. R. M. Richberger: "If possible, forecast the position more accurately."

2nd Lt. J. E. Rinks: "Have each pilot write a paragraph on conditions, giving altitude of flight and what he considers weather above and below would be. Weather forms that are filled out in flight hardly give a true picture."

2nd Lt. W. C. Touchton, Jr.: "Particularly like the grading of the forecast, i.e., percentage of accuracy the forecaster expects. Statement as to how recent the information is and how obtained."

CWO L. M. Sympson: "The best suggestion I can offer is to increase the number of observing stations in the area, adding boats to cover the usual routes taken by aircraft in the airplanes. It is my opinion that accurate forecasts cannot be made based on the present method of obtaining meteorological information because most pilots have little or no weather observation experience. Unless a forecast is

12. What suggestions can you make for improving forecasts?

accurate and reliable, a pilot cannot give it much credence, nor can he navigate his aircraft satisfactorily along a predetermined flight path. I fully understand the difficulties facing weather personnel attempting to forecast weather in an area from which reports are meager and sketchy at best. There is no more information I would like. I believe less, but more accurate information would be better. Also it would be presented a little less technically so it would be more easily understood by pilots and navigators."

13. Are there any general comments you would care to make regarding weather in this area.

Col. E. M. Day: "I believe all new pilots in this area should receive a short weather course of instruction from a Weather Officer especially responsible for this. The same officer to give the course to all. There are prevalent many erroneous ideas regarding weather in this area. Further, there is a tendency by pilots to belittle weather forecasts in this area due to the fact that pilots do not understand the problems and difficulties of a forecaster in this area. Nor do they understand the value of their giving accurate and detailed pilot reports as they do not appreciate the weather research being conducted in tropical weather."

Col. P. B. Griffith: "In my opinion, the flying weather in this area is infinitely better than it is in some parts of the United States, particularly in the southeast, where you will encounter fronts as wide as 400 miles, which will build up in practically no time and shut down airdromes for hundreds of miles. Furthermore, I have seen cumulus clouds that must have gone to 50,000 ft. in the southeast, at this time of the year. The weather down here is generally predictable. After a person has flown in this weather a year or so, he knows about what to expect. With the exception of the equatorial front between here and the Rock (Galapagos Island) and between here and Salinas, when it is at its most intense, and except for a small stretch between Puntarenas and David, I have never known instrument conditions to be exceptionally rough.

"I have flown the Caribbean about 25 times, and have never run into anything bad there. Generally, the flying conditions across the Caribbean are superb, except at night when there is considerable rain and lightning. There is one thing that you can almost be sure of flying either from here to Jamaica or from Curacao to Puerto Rico, there will be a wind varying from 15 to 50 miles an hour and it will almost always be from about 90°.

"During the hurricane season you are liable to run into some pretty bad instrument conditions in the Eastern Antilles, especially around Santa Marguerita and Trinidad. Normally, however, a trip from Trinidad around the chain to Cuba has delightful weather."

Col. J. E. Roberts: "I think the weather section is to be commended for its hard work and untiring effort to predict the tropical weather with so little data with which to make its forecasts. I personally, and I believe most other four engine pilots in this area, rely greatly on your terminal forecasts, but as for route forecasts I always expect anything to happen and do not count on the forecast to be completely accurate. So long as there is not a hurricane to contend with the weather in this area never becomes so intense that it is un-

safe to fly through."

Lt. Col. J. G. O'Brien: "When pilots are briefed a more general condition could be given in addition to the actual route forecast. Also, new personnel might be given a history of the equatorial front and general weather conditions throughout the whole area and to include terminals usually visited and their respective routes."

Lt. Col. A. F. Tucker: "(1) The weather is good, fairly consistent, and predictable. (2) The navigation aids, field and instrument approach precedures are inadequate. (3) Do not believe the weather should stop instrument or night operation at all, but lack of navigation aids and reliable maps definitely limits such flying now."

Maj. J. A. Irwin: "The pilots rely greatly on terminal forecasts, but it makes little difference in between points."

Maj. D. L. Roberts: "I doubt if there is any general rule to follow flying through this front. Only experience is necessary. Each flight is different, at times it's advisable to fly low, other times high. Then at times you can fly through the front and other times it's best to go around the thing."

Maj. O. G. Stephens: "I have probably made from one to two hundred passages through the equatorial front in this area and in the Trinidad to Belem sector. Conditions are very much the same in the two areas.

"As a general rule when the front is active I fly from 3000 ft. to 10,000 ft. altitude, lowering depending upon the intensity of precipitation and turbulence.

"Upon several occasions I have encountered extreme turbulence and more often very heavy rain; however as a general rule both are moderate.

"I would strongly recommend that pilots with quite a bit of instrument flying experience be encouraged to fly through the front and that inexperienced pilots stay out entirely."

Capt. J. W. Adair: "Weather in this area is usually of mild turbulence over water. Over land, due to convection currents, extreme turbulence may be encountered. Therefore, if instrument conditions prevail, as much of the flight should be made over water as is practicable. If extreme turbulence is encountered over water smoother air can always be found at lower altitudes (800 to 1000 ft.)."

Capt. L. W. Cunningham: "Damned nasty at times, hard to predict from a

pilot's standpoint because it's always changing."

Lt. H. Dickerson, USNR: "I believe the cold prevailing winds from the Humboldt Current which is cold water coming up from the Antarctic, strikes the warm northeast trades and forms this particular front."

Capt. C. V. Eld: "During certain seasons a small very active front (seemingly separate) lies just south of Guatemala City."

Capt. C. P. Felice: "In regard to flying thru the front, I cannot state that any altitude is better than any other in flying thru it. Sometimes flying low is better and sometimes flying high (7,000') is better. It all depends on the existing situations and the pilots' judgment of them. With a lot of build-ups and cumulonimbus clouds, I do not care to fly lower than 3000' or so, because of the fact that the cloud bases are so low, that it would be easy to hit unseen roll clouds or scud clouds of the cumulonimbus clouds, which might be too turbulent to handle. Flying high until it is impossible to do so, gives the added advantage of greater visibility above cloud tops, and between clouds and saddlebacks, making penetrations and circumnavigation easier. Also, by staying up as long as possible, instrument flying in the low stuff is avoided as long as possible.

"Instrument flying in this area in general, is not too difficult, over land or water. However, when instrument conditions are encountered over land, it is almost always impossible to fly underneath the stuff, as it usually sits well below the level of the tops of peaks and mountain ranges. Cumulonimbus clouds too, seem to be more isolated over land and generally can be circumnavigated, but when hit, are usually more turbulent than those over the water."

Capt. W. R. Hansen: "Although there is quite a bit of instrument weather, if a person studies weather forecasts and clouds along the flight path he has little to fear. Just don't enter a heavy cumulus or cumulonimbus over 6000 to 7000 ft."

Capt. W. R. Knight: "Weather seems to increase more during the day over the Canal itself than over any other part of the Republic. Probably a normal condition, due to drop in the terrain at that point.

"Intense layers of haze have been noted during winter months, which extend from Panama to the front, the definite top being about 8000 ft. Instrument conditions prevail in this haze, due to blending of sky and sea. No horizon is available."

Capt. C. A. Neel: "Weather in this area is never too rough over water

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Capt. C. A. Neel: "Weather in this area is never too rough over water

for heavy bombers. The weather over land does get dangerously rough in cumulonimbus clouds. Of course, I do not see the problem of fighter pilots, etc."

Capt. M. W. Williams: "I should only like to say that previous to coming to this area I had been instilled with the idea that any weather was bad weather, not to be flown through. I have found here that much of the weather which you encounter in flying through the front isn't half as bad as it looks. However, I do not mean to imply that one should not respect the severeness of any thunderhead. They can be plenty rough and should be avoided if possible. If it becomes necessary to fly through some portion of very heavy weather, the lower attitudes are the least turbulent, and I mean by that up to 2000 ft."

Lt. (jg) H. W. Barradale, USNR: "Weather is good!!"

1st Lt. B. L. Bergesen: "My only comment is to suggest all weather operations refuse permission to land in tropical downpours. Weather in general in Panama area is usually poor."

1st Lt. W. E. Christensen: "Weather at terminal is usually such that you can land shortly even though the field is closed at the time of arrival."

1st Lt. S. P. Easley: "When possible fly over water at low altitude thru front because of less turbulence. When flying thru front over land I would advise lowering landing gear so as to decrease air speed, air speed usually becomes excessive in fronts over land with severe turbulence, with landing gear down power may be added to prevent icing and still not have excessive air speed."

1st Lt. C. E. Hall: "Weather in this area is not a perilous hazard. However, a hurricane might be perilous."

1st Lt. W. J. Hastie: "It (the front) is extremely unpredictable and can change its total aspect in size, position, and intensity in a few short hours."

Lt. (jg) T. L. Healey, USNR: "This weather generally is not very turbulent but heavy rain is always encountered. The rain is usually quite cold, but have never encountered hail. It is my opinion that the Humboldt Current blowing from the Antarctic encountering warm air is the cause of the front and that the front moves either north or south according to path of the sun."

1st Lt. R. E. Henderson: "It is quite severe at times and care should be exercised in flying thru it."

1st Lt. F. W. Holer: "No. I think the weathermen in this area are doing a fine job insofar as the forecasts I have received to date are concerned."

1st Lt. E. E. Koken: "Prevent inexperienced pilots from flying through the front without sufficient experience in his airplane to guide, instruct, or take over if necessary."

1st Lt. H. B. McMullon: "Don't go into the clouds above 5000 ft."

1st Lt. T. V. Sawyer: "Weather in this area varies rapidly, always very moderate."

1st Lt. H. R. Schlesinger: "I think forecasters are doing a remarkable job considering the information you have at hand. With the exception of winds aloft, the predictions I receive are accurate enough for general purposes; weather men have gone out of their way to give me information, resulting in very little deviation from course and the use of an alternate field only once."

1st Lt. S. K. Thompson: "I do not believe that weather can be accurately forecasted over such a vast and uncharted section of country. It definitely does not follow any certain cycle, and I don't blame the weatherman when I receive a bum forecast."

2nd Lt. I. A. Ailara: "Weather over land more intense than weather over sea."

2nd Lt. C. G. Beard: "No, too hot and wet, though."

2nd Lt. R. J. Cherkauer: "I don't believe it can ever be forecasted with much more accuracy. The front is never the same twice, nor ever too severe to warrant much worry for heavy aircraft. Front does not seem to be as severe as those in temperate zones."

2nd Lt. D. S. Gurman: "Weather seems very unpredictable."

2nd Lt. J. O. Meeks: "The weather in this area can make extreme changes in a very short period of time. Weather forecasts therefore are difficult to make."

2nd Lt. R. M. Richberger: "No danger if pilot uses common sense."

2nd Lt. J. E. Rinks: "Unpredictable. Two planes taking off 15 minutes apart from same point of departure going to same destination encounter extremes in weather at same altitude. A variation of [illegible] to [illegible]