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The case for parachute landing of materiel and personnel as opposed to flider and air landing, by Lt Col L. D. Buttolph. Command and General Staff College. 31 May 49.

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THE CASE FOR PARACHUTE LANDING OF MATERIEL AND PERSONNEL AS OPPOSED TO GLIDER AND AIR LANDING

LOREN D. BUTTOLPH
LT. COL. O-42053

31 MAY 1949

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Fort Leavenworth, Kansas

May 31, 1949

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2. ASSUMPTION--That improvement and development of planes and equipment for parachuting personnel and materiel, and that of gliders and planes for glider and air landing, will be equal.

3. FACTS BEARING ON THE PROBLEM--a. That some military operations will necessitate certain types of operation due to mission, training, time of mounting, distance to airhead, terrain, or surprise.

   b. Although helicopters are being developed that will have an important role in future airborne operations, they will not be considered in this problem.

4. DISCUSSION--a. Training time.--(1) Parachutists.--One of the essential elements in any planning, and especially to be considered in troop training plans, is time. It is a safe assumption that time will be especially critical in any future mobilization for a national war. Therefore, a comparison should be made between the time of training necessary for paratroopers and for air-transported[1] personnel.

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1. Air-transported, as used in this paper, will include both glider and powered aircraft transportation of personnel, equipment, and supplies.

The present schedule for paratrooper training at the Basic Airborne Course of the Infantry School at Fort Benning, Georgia is six weeks (Annex A). This, of course, does not include such travel time as may be necessary from the paratrooper's home station to Fort Benning and return to home station. During the recent mobilization, the Basic Airborne Course was condensed to five weeks duration, for well conditioned personnel. It is expected that a five weeks course could be inaugurated again in case a speeded-up training program should become necessary. The time lost from individuals volunteering and commencing parachute training and then dropping out due to physical unfitness or unadaptability for jumping, is a considerable loss in man days of training time in a large group of applicants. Also, the time for frequent training jumps in the interval between qualifying as a paratrooper and the entry into combat will be considerable.

(2) Air-transported.--The Air-transported course that was given by the Infantry School was of three weeks duration, but with the present trend of thought, this can be reduced (Annex B). Staff study by the Armed Force College and officers who have commanded troops and have taken the Air-transported Course, consider that one week's training time added onto the normal mobilization schedule will qualify a division for air-transportability if used in the near future after the completion of training. This assumption is made due to the fact that under the stress of mobilization, personnel will absorb knowledge faster and take more intensified interest in

instruction than will the normal peace trained unit. It is also considered that knowledge to be used in the near future will not need to have the repetition and review training that is necessary when the personnel is not expected to use this knowledge for some length of time. With a well organized instructor group going to the home stations of the troops to receive air-transported training, considerable time will be saved in the troop travel that would be necessary where troops go to Fort Benning for the training course.

Current thinking is that the same length of time is necessary for training troops for glider or powered aircraft transportation. In comparison with paratrooper training, the injury lost time rate will be negligible for air-transport training.

b. Costs.--(1) Training. Another factor that must be considered, especially in peace time training, is the budgetary limitations. One of the items of expense in training paratroopers is the requirement of the sizeable overhead, or school troops at the Basic Airborne Course. The school overhead is practically the size of each weekly class that goes through the training instruction (Annex C). It can be seen that in a mobilization it would be necessary to have those school troops in the zone of interior, when they could probably be very profitably used in the combat zone. This is especially pertinent, in case of a surprise attack, as it would tie up at the school a sizeable percentage of our small number of peace time trained paratroopers that would be critically needed in our striking force.

The school troops required for air-transport training would be,relatively, a small percentage of parachutist school troops, and would be capable of training many times the number of air-transported divisions in the same length of time. Housing of equipment--that is, parachute drying and storage warehouses, and materiel for training towers, --is a sizeable factor in parachutist training.

In a mobilization the labor and materiel of constructing the necessary installations will be using our two most critical items, man-power and material. Although we have the Infantry School training center at the present time, it would not have the capacity for a large mobilization expansion.

The equipment for training air-transported troops would be very limited and could be taken from partially used or war weary equipment that would be satisfactory for training and demonstrating the loading of personnel and equipment. Wear and tear and depreciation will be far less on planes used for air-transported instruction than it will be on parachutes and equipment of parachutists. Parachute material will undoubtedly be a critical item in any mobilization of this country. The cost of extra pay, which is now authorized to paratroopers, will not be required with air-transported troops.

(2) Combat.--The cost of equipment replacement required for parachuting personnel and equipment in the combat area is necessarily high, due to the salvage or loss of parachutes for both personnel and material and supply containers. Past experience shows that from fifteen to ninety per cent of this

equipment was salvageable. An average of approximately fifty per cent was salvaged in World War II operations. This, of course, means that the supplies were lost along with the materiel, parachutes, and containers.

Gliders will be an expensive item in any mobilization. The man-power and critical material needed to construct gliders, plus the transportation required to the combat zone for a sizeable operation, will increase the strain on our national economy. As gliders must be disassembled and shipped from one theater or area of operation to another, it causes a laborious and time-consuming factor in preparing for an airborne operation. Past experiences show that at least fifty per cent of the gliders in an airborne assault were unusable for further operation without considerable rehabilitation. Gliders must be classed as a specialized type of equipment, making them expensive for the number of times used (Annex D). In World War II, over 15,000 gliders were built for the U. S. Army.[1] If, in the future, Corps and Army sized airborne assaults are made, a greater number of gliders and aircraft will necessarily be required.

Aircraft will be manufactured and used for many types of duty besides airborne assaults. They can be marshalled rapidly in one locality for mounting an airborne operation, making their use an economical and efficient method of transporting troops into the airhead. In fact, supporting an

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1. U. S. Air Force, Air Force Statistical Digest, Washington D.C., 1946.

airborne operation will be only a minor role of military planes, which will make the cost of their use per airborne assault appreciably less than the use of gliders.

c. Mounting airborne assaults.--(1) Parachutists--In making comparisons for mounting an airborne operation there are a number of factors to be included. One advantage of parachute operation is that troops can be marshalled at a distance from the airhead, then assembled while in the air and taken into the drop zone. It can be visualized that paratroopers can be marshalled in the Zone of Interior and flown in stages to the theater of operation, making the necessary stops for refueling and exercise, with the last leg of the flight being to the drop zone. Increased security due to distance from the enemy, and marshalling areas that may be used for several or all airborne assaults, will increase mounting efficiency. The radius distance for planes carrying parachute loads is greater than for either those towing gliders or carrying air-transported loads (Annex E). The take-off time, the serial grouping, and the time of flight, and the ability for evasive action is favorable to planes without glider tow (Annex F). In case of daytime landing in any occupied areas, the parachutist is not as vunerable on the descent, and has the advantage of destroying enemy morale and equipment due to the initial shock and individual action upon landing. In night drops, units may have difficulty assembling with the resulting loss of control.

(2) Gliders.--When personnel and equipment are transported by glider, marshalling and mounting areas must be within aircraft radius distance of the drop zone, as it is not advisable to land gliders, other than in the airhead, after they are combat loaded. The marshalling area must be expanded for gliders, as well as the length of the runway, for take-off. The time of grouping air serials after being airborne, and the air speed to the airhead, are all increased appreciably. Gliders and tow planes are vunerable to enemy air and ground fire, as they can take little evasive action and are a concentrated loss of equipment and personnel when either are hit. An advantage to glider transportation is that units are grouped and have their equipment, and therefore can go into action as a team in the minimum of time after landing in the airhead.

(3) Air-transported.--Assault aircraft has the same advantage as a parachute transported force, in that they can be marshalled and mounted at a distance from the drop zone and can land for refueling and exercise enroute. The radius distance of the assault aircraft, although not as great as parachute loaded aircraft, is considerably more than aircraft towing gliders. The length of runways, time of serial assembling, and speed of flight will approximate that for the parachute loaded aircraft, as will their ability to take evasive action from enemy air and ground fire. The approach to the air drop, and the landing in the airhead, will have lower percentages of accidents due to better control

of the powered aircraft as compared to the glider. The grouping and control of troops and materiel on landing will be better than with gliders, in that the aircraft can taxi to a desired concentration area when the enemy situation will permit.

d. Missions. Missions that airborne troops may be assigned may be divided into the following types of operations:

> "a. A deep penetration into hostile territory involving the seizure of an airhead from which to initiate further land or air operations.--This invasion type operation is a major landing assault of extensive forces and resources and involves continued operations against the enemy. Logistical support initially will be entirely by air. An eventual link-up with ground or naval forces is made. This is a concept of future employment of airborne forces.
>
> "b. The seizure of an area, for use in connection with other military ground operations, in such a manner that an early link-up between the airborne and other forces is practical.--This early link-up type operation involves landings in rear of the enemy lines in which:
>
> (1) Important tactical localities are seized and held in conjunction with or pending early arrival of military or naval forces. (Example--the airborne attack in Holland by the First Allied Airborne Army on 17 September 1944.)
>
> (2) The enemy rear is attacked to assist a breakthrough or landing by the main force. (Examples--The airborne attack during the Normandy invasion on 6 June 1944, and the airborne assault during the crossing of the Rhine on 24 March 1945.)
>
> (3) Movement of enemy reserves is blocked or delayed by capturing and holding critical terrain features thereby isolating the immediate battle area. (Example--The airborne operations in Southern France on 14 August 1944.)
>
> "c. An area is seized for use as an airbase from which to initiate further air, or airborne operations or both.--(Example--The German airborne attack on the Island of Crete.)
>
> "d. An area is seized to deny its use to the enemy.--(Example--The German airborne attack of Crete which, in addition to accomplishing the mission outlined in the preceding paragraph, denied the use of the island to the Allies for air operations and in any plans projected for naval and ground operations in the Balkans.)

"e. Enemy forces, installations, and facilities are destroyed, after which the force is withdrawn by air or returns to friendly lines by infiltration.--(Example--British attack on Pont Du Fahs, North Africa, on 30 November 1942.)

"f. Threatened or surrounded units are reinforced.--(Example--The reinforcement of the threatened beachhead at Salerno, Italy in the summer of 1943.)

"g. An island or isolated area which cannot easily be reinforced by the enemy is seized by an airborne force independently or in conjunction with amphibious or other ground troops.--(Example--Seizure of Corregidor, 16 February 1945, Wingate Force operations in Burma, Spring-Summer 1944.)"[1]

The above listed operations can be a combination of parachute, glider, and air-landed. For operations as listed in (e) the forces at times may be landed with glider or plane, but for safety, surprise, and secrecy, will probably be parachuted. They may be withdrawn by plane.

e. Landing in airheads. Paratroops can jump and materiels be dropped anywhere, if the rate of loss will be accepted. This is proven by the U. S. A. F. Pararescue teams now in service, and the parachutist forest rangers who use this method for rapid transportation into isolated areas to fight forest fires.

Difficult terrain, either due to natural or man-made obstacles, will not eliminate parachute operations. In fact, it may be of assistance, as parachutists can assault any area within plane radius distance and therefore cause the enemy to disperse his forces. They can also use the surprise element to advantage by dropping on less

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1. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Page 4, paragraph 4.

desirable terrain where the enemy will not be expecting, or be prepared, for combat operation. In most, if not all airborne operations where the enemy is prepared, parachutists must be in the first assault to seize and secure landing strips for air-landed troops.

Glider and powered planes must have a landing strip. The size and condition will differ only as required by the equipment used.

The time of day will also dictate the type of assault. "Parachutists can make day or night jumps, gliders can be landed at night with only sufficient light to discern terrain features, but airplanes require lighted runway markers."[1]

5. CONCLUSIONS--a. That the present concept of future airborne operations will dictate the use of parachute drops of personnel and equipment. The use of paratroops will be necessary, when small detachments are transported to a distance into enemy territory to perform raids on communication centers or sabotage on vital enemy installations. Paratroops must be used to gain surprise at enemy held points and to clear an airhead for later air-landed troops. Night assaults will demand parachute drops as will drops in terrain where it is not feasible to land gliders or powered aircraft.

b. Glider landed troops can be transported into combat with less specialized training. They will also be in a more grouped, controlled unit,

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1. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Page 5, paragraph 5-c-(2).

which can be employed as an assault team in a minimum of time after landing.

The marshalling of gliders, the slower air speed, and the vulnerability to enemy action by air and ground fire make gliders a less desirable method of carrying personnel and materiel to combat.

The original cost of gliders, coupled with the high salvage rate per combat operation makes each operation monetarily expensive. Normal warfare requires few airborne attacks, therefore gliders will be an item of special equipment that will use critical materials and labor to construct.

c. Assault aircraft can be used to transport personnel and materiel to the airhead after the same training, as can gliders. The assault aircraft can be marshalled and the operation mounted with equal efficiency as with parachute operation. The time from take-off to landing zone will approximate parachute operation while the grouping and control of personnel on landing will be more efficient than with gliders. The aircraft will be available for evacuation of personnel and materiel from the airhead and can be re-used in the same operation.

Aircraft equipment will not be specialized for assault operation but can be used whenever air transportation is needed. Assault aircraft can readily be moved from one theater or area to another, thereby receiving maximum use from it by grouping the required aircraft for airborne operations.

d. Although parachuting of personnel and materiel will be necessary in present day combat operations, it should be held to a minimum. Glider transportation to the airhead can be replaced by the more efficient and economical assault type aircraft. Future airborne operations should be planned so that powered aircraft will be used to the maximum.

6. ACTION RECOMMENDED--a. That the development and training in parachuting personnel and materiel be continued, to obtain the highest standard possible.

b. That the development and use of assault aircraft be exploited to the maximum as being the most efficient and economical method, at present, of transportation in an airborne attack.

D I R E C T I V E

COMMAND AND GENERAL STAFF COLLEGE

DEPARTMENT OF OPERATIONS AND TRAINING

Fort Leavenworth, Kansas

22 November 1948

MONOGRAPH SUBJECT NUMBER 2-130

Regular Course, Phase V, 1948-49

STUDENT Buttolph, Loren D., Lt. Col, Cav 042053
(Name) (Rank) (ASN)

FACULTY ADVISOR Harold K. Johnson, Lt Col 213 Sheridan
(Name) (Bldg & Rm No) (Tel No)

SUBJECT: The Case for Parachute Landing of Materiel and Personnel as Opposed to Glider and Air Landing.

REFERENCES: "Air Infantry Training," Coast Artillery Journal, July-Aug 1940; Ayling, They Fly to Fight; Bassenge, Air Infantry; 82nd Airborne Division, Action in Central Europe April, May 1945; Freri, "The Employment of the Parachute in Wars of the Future", Royal Air Force Quarterly, July 1932; Gavin, "Air borne Armies of the Future", Infantry Journal, Dec 1946 and Jan 1947, and "Airborne Warfare", Infantry Journal Press, 1947; Carey, "Hawkmen", Infantry Journal, Jan-Feb 1937; Lee, "Air-Landing Divisions", Infantry Journal, April 1941; Rathbone, He's in the Paratroops Now; Devers, "Air Transportability of the Infantry Division", Infantry Journal, Sept 1947; "New Airborne Division", Army-Navy Journal, 14 June 1947; Slessor, "Some Reflections on Airborne Forces", The Army Quarterly, July 1948.

NOTE TO STUDENTS:

1. The references above are furnished to give the student enough material with which to begin his research. It is anticipated that the student will make use of all other available sources in order to give adequate scope to his subject and, when appropriate, to complete development of the subject to date.

2. The scope suggested below is intended as a guide only, and is not to be construed as a limitation on the student's perusal of the subject.

SCOPE:

1. Secrecy and element of surprise.

2. Independence of landing facilities; may be dropped in places inaccessible to gliders and planes.

3. Use of a forerunner of and protection for, other types of landings.

4. Relative cost of equipment and training.

5. Special problems.

B R I E F

Fort Leavenworth, Kansas

May 31, 1949

THE CASE FOR PARACHUTE LANDING OF MATERIEL AND PERSONNEL AS OPPOSED TO GLIDER AND AIR LANDING

1. PROBLEM--To make a comparison of parachute landing of materiel and personnel, to that of glider and air landing of materiel and personnel.

2. ASSUMPTION--That improvement and development of planes and equipment for parachuting personnel and materiel, and that of gliders and planes for glider and air landing, will be equal.

3. FACTS BEARING ON THE PROBLEM--a. That some military operations will necessitate certain types of operation due to mission, training, time of mounting, distance to airhead, terrain, or surprise.

b. Although helicopters are being developed that will have an important role in future airborne operations, they will not be considered in this problem.

4. DISCUSSION--a. Training time.--One of the essential elements in any planning, and especially to be considered in troop training plans, is time. It is a safe assumption that time will be critical in any future mobilization for a national war. Therefore, a comparison should be made between the time of training necessary for paratroopers and that for air-transported personnel.

(1) Paratroopers.--The present schedule for paratrooper training at the Basic Airborne Course at the Infantry School at Fort Benning,

Georgia is six weeks. It is expected that a five weeks course could be inaugurated again in case of a speeded up training program. Considerable time is lost when candidates start paratroop training and then drop out due to physical unfitness or unadaptability for jumping. Also, after the soldier is qualified considerable training time is used up before he goes into combat, due to the frequent refresher training jumps that are necessary.

(2) Air-transported.--The air-transported course that was given by the Infantry School was of three weeks duration. It is believed that sufficient air-transportability instruction can be given an infantry division in one week's time to have them qualified for an airborne assault.

b. Costs.--(1) Training.--Another factor that must be considered, especially in peace time training, is the budgetary limitations. The large overhead or school troops at the Basic Airborne Course is approximately the size of each weekly class that receives training. This ties up a large per cent of our peace time trained paratroopers for training overhead that may be critically needed in our striking force. Only a few school troops are necessary to give an infantry division air-transport training.

(2) Combat.--It costs approximately two million dollars to equip the paratroop echelon of a division for a combat jump, including the auxiliary equipment that the air force must furnish for the operation. Due to the high rate of salvage, approximately fifty per cent, an airborne operation is extremely expensive. For the same transportation,

it would cost $1,750,000 to build gliders to transport the parachute echelon into the airhead, with approximately fifty per cent loss in each assault. As the only time gliders are used is in an assault landing, it makes them a special item of equipment, therefore; expensive for the use received. During World War II over 15,000 gliders were manufactured for the United States Army, and yet glider troops performed a very small percentage of the fighting.

c. Mounting airborne assaults.--In making comparisons for airborne operations, the mounting area between aircraft without gliders and aircraft with glider tow has a large spread. Aircraft can be assembled quickly from a wide area for a planned airborne assault. It is feasible that the marshalling area might even be in the Zone of Interior, or at least a considerable distance from the airhead, thereby furnishing maximum security and economy of operations. Gliders must be marshalled within radius distance of the airhead, for when they are once airborne, it is not practical for them to land other than in the airhead. The parking area required for gliders and the longer runways will require a larger marshalling area. The time of take-off between planes, grouping of serial, and the air speed of planes without gliders, are very unfavorable to glider operations. (Chart 1)

d. Missions.--Missions of airborne troops can be grouped as follows:

(1) Seizure of an airhead from which to further land or air operations or to link-up with ground troops.

(2) To seize an area to deny its use to the enemy.

(3) To reinforce and supply friendly troops that have been isolated from reinforcement and supplies.

(4) To land deep into enemy territory to disrupt communications, sabotage installations, or cause confusion and dispersal among enemy forces.

e. Landing in airheads.--Parachute operations can be instigated in practically any location. This is proven by the missions performed by the U. S. A. F. Pararescue teams and the parachutist forest rangers who have operated in practically all types of terrain and over a great variety of climatic conditions. Also, paratroopers can gain the initiative through surprise, by making assault landings at night or in unexpected areas.

5. CONCLUSIONS--a. Although parachuting of personnel and materiel will be necessary in present day combat operations due to surprise, distance, terrain or mission, it should be held to a minimum.

b. Glider transportation to the airhead can be replaced by the more efficient and economical assault type aircraft.

c. Future airborne operations should be planned so that powered aircraft will be used to the maximum.

6. ACTION RECOMMENDED--a. That the development and training in parachuting personnel and materiel be continued, to obtain the highest standard possible.

b. That the development and use of assault aircraft be exploited to the maximum as being the

most efficient and economical method, at present, of transportation in an airborne attack.

CHART 1

Marshalling Area and Time Elements

Space per glider[1] $\frac{262' \times 5985'}{144}$ = 10,896 sq. ft.

	Planes	Planes with Glider tow
Length of runway	3500 ft.	5000 ft.
Interval for take-off	10 sec.	20 sec.
Speed in flight	180 knots	130 knots
Size of serial	60	30 w. double tow
Length of serial	900 yds.[2]	2600 yds.[3]

The above figures are for the C-119 plane and CG-18 glider under normal conditions. All figures are variable to some degree to meet the situation. Each type of plane, glider, or situation, will require corrected data.

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1. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 18, Chart 27.

2. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 20, Chart 29.

3. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 21, Chart 30.

MASTER TRAINING SCHEDULE

BASIC AIRBORNE COURSE — THE INFANTRY SCHOOL

SUBJECT OF INSTRUCTION	1st week							2nd week							3rd week							4th week							5th week							6th week							
	M	T	W	T	F	S		M	T	W	T	F	S		M	T	W	T	F	S		M	T	W	T	F	S		M	T	W	T	F	S		M	T	W	T	F	S		
AERIAL DELIVERY KITS																																				3	4		3	4			14
ASSEMBLY TRAINING											2	2																															4
COMPUTATION OF LOADS		3																																									3
CONTROL TOWER																						1																					1
DISMOUNTED DRILL		½	½	½	½																																						2
FAMILIARIZATION W/CARGO AIRCRAFT	2																																										2
FLIGHT SAFETY	2																																										2
FREE TOWER																						2	3	2												*2							9
GLIDER FLIGHT (ORIENTATION)		2																																									2
GLIDER PROBLEM																																				5			5				10
HISTORICAL ACCOUNTS ABN UNITS								2																																			2
INTRODUCTION AND ORIENTATION	2																																										2
INTRODUCTION TO PRCHT TNG								1																																			1
LOADING-LASHING HEAVY EQUIP.			2	6	6																																					14
MOCK-UP TOWER								1	2	1	2	2			1	1		1	1						2	1										*1							13
MOCK-UP DOOR								2	2	1	2				1	1			1						1	1										*1							16
NIGHT JUMP																																					6							6
NOVICE JUMP																														4	4	4	4	4										20
PARACHUTE LANDING FALLS								1	1	1	1	1			1			1																									7
PARACHUTE PACK TNG															4	4	4	4	4			4	4		4	4			4	4	4	4											52
PHYSICAL TRAINING		½	½	½	½			1	1	1	1	1			1	1		1	1			1	1	2	1	1																19
RESERVED FOR COMDT						3							3							3							3						3							2	3		20
ROPES-KNOTS	2	1																																									3
SUSPENDED HARNESS																1		1	1																									3
TIE-DOWN DEVICES		1	1																																								2
TROOP INFORMATION HOUR						1						1								1							1						1							1			6
WIND CHARGER									2			2																																4
RESERVED PRCHT TNG																										1																		1
*NIGHT TRAINING																																												
	8	8	4	8	8	4	40	8	8	4	8	8	4	40	8	8	4	8	8	4	40	8	8	4	8	8	4	40	8	8	8	8	4	4	40	12	10	0	8	6	4		240

ANNEX A

ANNEX A

ANNEX B

883-2
(18 Oct 47)

General Subjects Section
ACADEMIC DEPARTMENT
THE INFANTRY SCHOOL
Fort Benning, Georgia

TRAINING PROGRAM AIR TRANSPORTED UNIT

Conference

A SUGGESTED LIST OF SUBJECTS FOR TRAINING UNIT STAFFS AND COMPANY OFFICERS

SUBJECT	HOURS*
Employment of Air Transported Forces	1
Characteristics of Cargo Aircraft	1
Weight and Balance	6
Preparation of Ropes, Knots	1
Tie-down Devices	1
Loading and Lashing	3
Supply by Air	1
Air Movement Tables	3
Review	3
Regimental CPX	4

* Total 24 hours - 1 week

ANNEX B

ANNEX B

883-3
(18 Oct 47)

General Subjects Section
ACADEMIC DEPARTMENT
THE INFANTRY SCHOOL
Fort Benning, Georgia

TRAINING PROGRAM AIR TRANSPORTED UNIT

Conference

A SUGGESTED LIST OF SUBJECTS FOR UNIT TRAINING

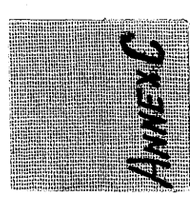
SUBJECT	HOURS*
Introduction	1
Characteristics of Cargo Aircraft	1
Orientation with other Aircraft	1
Airfields, Departure and Arrival	1
Flight Safety	½
Orientation Flight	2
Weight and Balance	6½
Theory of Safe Loading	1
Preparation of Ropes	2
Knots and Lashings	2
Tie-down Devices	3
TF 31-1254 and TF 31-1255	1
Loading and Lashing	40
Organization for Air Movement	1
Administrative preparation	4
Flight with Equipment	13

* Total 80 hours - 2 weeks

ANNEX C

Training Overhead and Equipment

1. Basic Airborne Course at the Infantry School	
(a) Number of school troops	500 overhead
(b) Number of troops receiving training	800 per week
(c) Cost of equipment	
Packing, drying, storage warehouses	$1,000,000
Towers, training parachutes	$250,000
Planes as required	
2. Air transport training	
(a) Number of school troops	80 overhead
(b) Number of troops receiving training	1 division per week
(c) Cost of equipment	
Films, training aids, charts, mockups	Cost unknown
Planes as required	



ANNEX D

Cost of Equipment

a. Parachute equipment for putting the parachute echelon in the airhead.

Personnel parachutes, equipment parachutes and containers, rigging equipment, etc.	$1,250,000
Special air force equipment required for parachute operations	$ 750,000
Total cost of equipment	$2,000,000

b. Gliders to transport parachute echelon into airhead (CG-18s) $1,780,000

The cost of the CG-18 and CG-20 must be estimated as they have not been in mass production. The cost of a glider per pound can be approximated from the CG-4, which costs $27,500 and weighs 3700 lbs, or 27500/3700 equals $7.70 per lb. of glider. Therefore:

CG-18 weight 6,000 lbs.[1] x $7.70 = $4,700 per glider ?

CG-20 weight 12,000 lbs.[1] x $7.70 = $9,400 per glider ?

c. Airplanes will be used in all types of operation weather; they will carry parachutists, tow gliders, or air land their loads.

The cost of the new model planes cannot be accurately estimated for a future mobilization because of the variable cost of labor, material, and method of contracting.

The following cost, in round figures, may be found by using commercial costs of similar planes to compute the cost per pound of plane.

Annex D

1. Air Materiel Command, Aircraft Characteristics, Wright Field.

ANNEX D

TYPE	WEIGHT	COST	COST PER LB
DC-6[2]	50,600#	$ 720,000	$14.20
Lockheed Constellation[2]	58,971#	950,000	15.30
Boling Stratocruiser[2]	78,920#	1,250,000	15.90

Average cost per pound of plane $15.10

C-119 weight 37,174 lbs.[1] x $15.10 = $56,200

C-120 weight 38,174 lbs.[1] x $15.10 = $57,600

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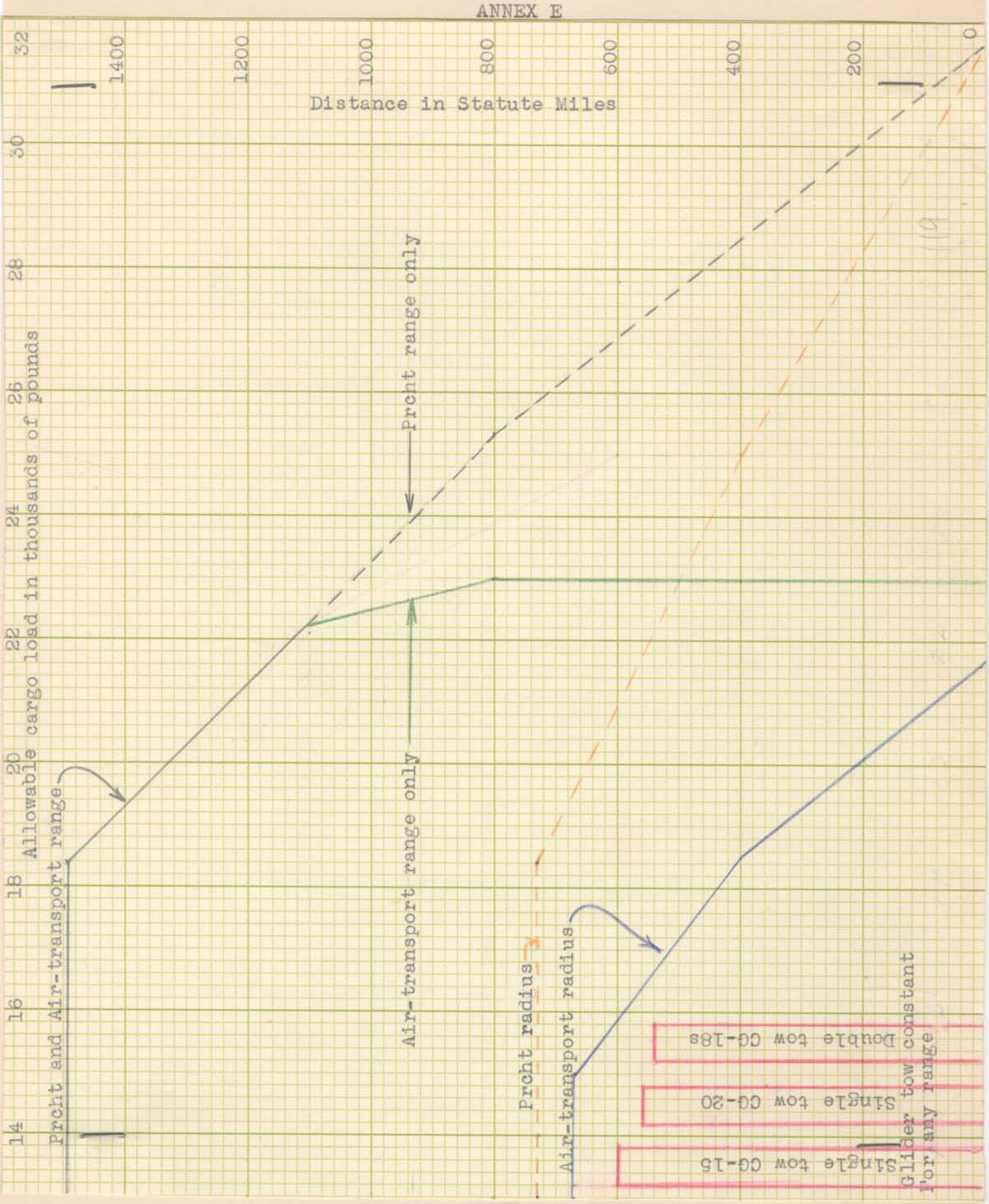
1. Air Materiel Command, Aircraft Characteristics, Wright Field.

2. Tichenor, Frank A., Annual Digest Aero Digest, March 1948.

ANNEX E



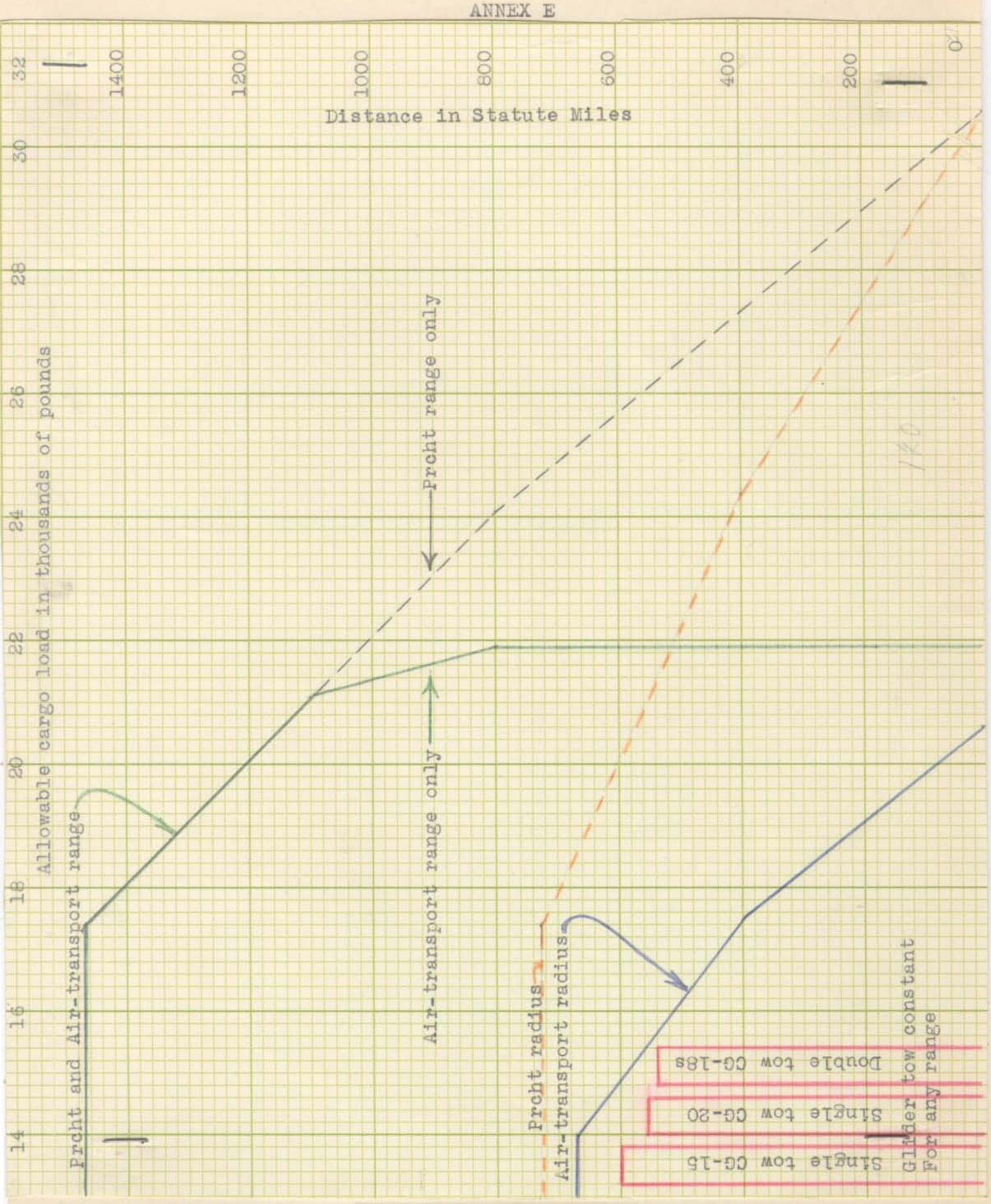
C-119

CARGO LOAD vs. DISTANCE GRAPH[1]

1. C&GSC, Airborne Operations Manual, Draft, Fort Leavenworth, Kansas, Dec. 1947, Appendix 52, page 175.

ANNEX E

ANNEX E



C-120

CARGO LOAD vs. DISTANCE GRAPH[1]

1. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 52, page 175.

ANNEX F

Marshalling Area and Time Elements

Space per glider[1] $\frac{262' \times 5985'}{144}$ = 10,896 sq. ft.

	Planes	Planes with Glider tow
Length of runway	3500 ft.	5000 ft.
Interval for take-off	10 sec.	20 sec.
Speed in flight	180 knots	130 knots
Size of serial	60	30 w. double tow
Length of serial	900 yds.[2]	2600 yds.[3]

The above figures are for the C-119 plane and CG-18 glider under normal conditions. All figures are variable to some degree to meet the situation. Each type of plane, glider, or situation, will require corrected data.

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1. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 18, Chart 27.

2. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 20, Chart 29.

3. C&GSC, Airborne Operations Manual, Draft, Kansas, December 1947, Appendix 21, Chart 30.

ANNEX F

B I B L I O G R A P H Y

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