# A Look Back...

## DEVELOPMENT OF PARACHUTES TO 1945

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As aviation began to play an important role in military tactics and methods of aerial warfare changed rapidly, a "vital need for the development and availability of suitable parachutes" arose with major changes and developments between World War I and the end of World War II. With this, the parachute experienced many developments even before World War I for the use with military balloons and during exhibition functions with aircraft. Parachutes utilized during World War II owe the extensive experimentation and testing conducted in Dayton post-World War I that led to the fundamental principles in the construction and operation of the large majority of parachutes used by military forces during World War II.[1]

The first use of a parachute seems probable traced to Chinese acrobat performances in the emperor's palaces as early as 1306. In Europe, the first parachutes were constructed and tested with the ideas of escaping burning towers and tall buildings with Sebastian Le Normans jumping from the Montepellier Observatory in 1783 to demonstrate this possibility. A number of years later, on 22 October 1797, it is believed that Jacques Garnerain during a public exhibit in Paris made the first successful use of a parachute from anything higher than a building when he descended from a balloon; five years later over London for British royalty and nobility he performed an exhibition jump from a balloon.[2]

The first recorded parachute jump from an airplane was made by Captain Albert Berry over St. Louis Army Barracks in March 1912 from an altitude of 4,000 feet from a Wright Brothers biplane. After 1912, professional stunt airplane jumpers became the principle designers and builders of parachutes with balloonists continuing to influence the development. The most noted woman parachutists of the period is "Tiny" Broadwick, credited with as many as 600 jumps.[3]

With the opening of World War I, all balloons were equipped with parachutes as with the introduction of the airplane, the balloons, especially those filled with hydrogen, became excellent targets for machine gun and incendiary bullet fire. It is estimated that more than 800 Allied balloonists were saved by the use of parachutes. However, even though each of the Allied partners had successfully invented and developed parachutes, it was the Germans who first successfully utilized a parachute in a military aircraft. Development and testing of parachutes during World War I continued but at a slow pace by the French and the Instrument and Testing Division of the US Air Service located in France.[4]

Within days following the Armistice, the Airplane Instrument and Testing Division reported of a conference on parachutes held in Paris with all Allies present. It was learned during the conference that both England and France had placed parachutes in production after extensive tests and experiments with a few deployed to the front. American representatives reported that experimental work had occurred in France since September 1918, looking at ten different parachute types of English, French, and German designs with two evolving into American makes from the best features of all ten. The American representatives reported that "some parachutes had been sent to the front…and that large orders had been placed for production, but that these had been cancelled after the signing of the Armistice." During the autumn of 1918, tests were being conducted in France and tests of the similar nature were also being conducted on all available parachutes in Dayton, Ohio, first at Wilbur Wright Field and later at McCook Field.[5]

During the Interwar Period, testing on various types of parachutes were conducted to help reduce oscillation and speed of descent, steerability, comfort of the harness, "springless" pilot, rip cord handles, quick release harnesses, and various suitable materials.[6]

With tensions in 1938 and 1939 increasing in Europe, interest in the development of synthetic substitute materials grew, with tests showing that it would not only serve as an acceptable substitute but had several characteristics that made it superior to the best grade of silk with the first test of nylon fabric conducted by the Materials Laboratory at Wright Field in 1939. Continuous efforts were made to improve the quality and to increase quantity of nylon available for parachute material. By the autumn of 1941, one thousand all-nylon parachutes were procured with a survey of production facilities revealing that a maximum of 16,000 nylon parachutes per month could be produced at that time. The last silk parachutes procured for the Air Force were completed during the spring of 1943, and during the fiscal year ending 30 June 1944, approximately 228,500 man-carrying nylon parachutes were on procurement.[7]

Other parachutes for "non-man carrying" items were developed as early as 1920 through 1945. For a further look at the development of parachutes during this period, see Dr. Edward O. Purtee, *Development of AAF Clothing and Other Personal Equipment Peculiar to Air Operations, Vol. III: Parachutes* (22 May 1945).

Endnotes

1. Maj Charles M. Thomas, *Development of AAF Clothing And Other Personal Equipment Peculiar to Air Operations: Vol. III: Parachutes*, (22 May 1945), x.

2. Thomas, *Parachutes*, 1-2.

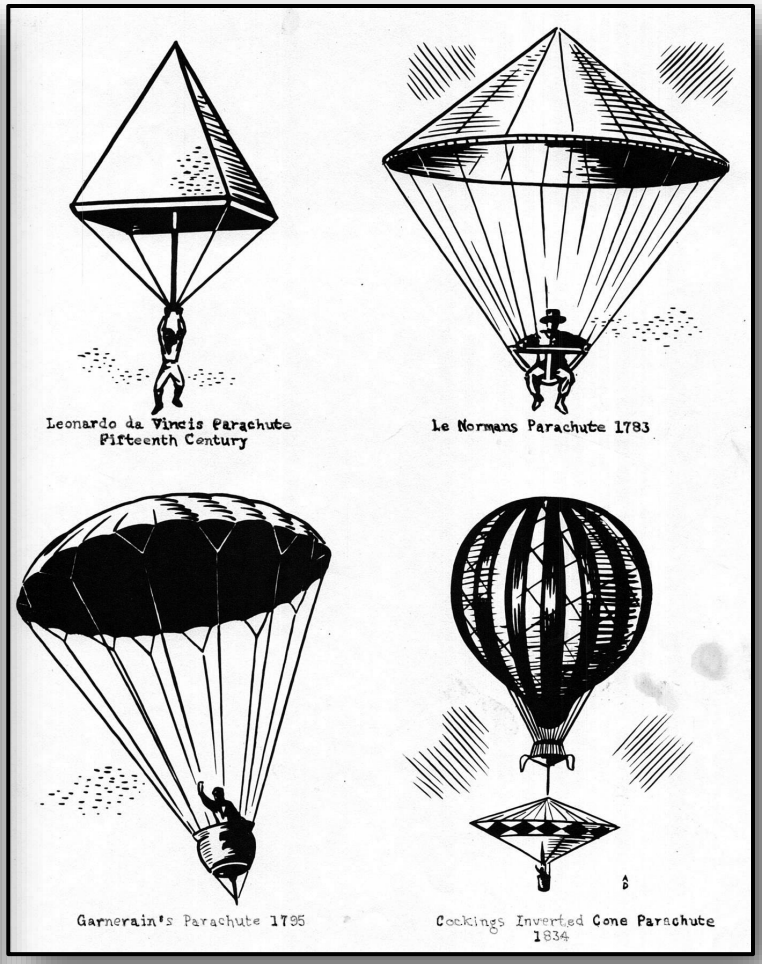
3. Thomas, *Parachutes*, 3-5.

4. Thomas, *Parachutes*, 7-10.

5. Thomas, *Parachutes*, 11-12.

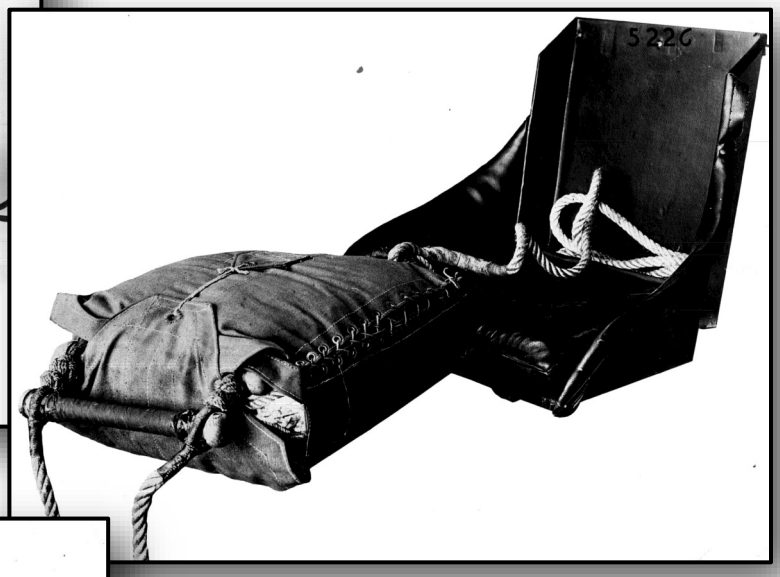
6. Thomas, *Parachutes*, 23-28.

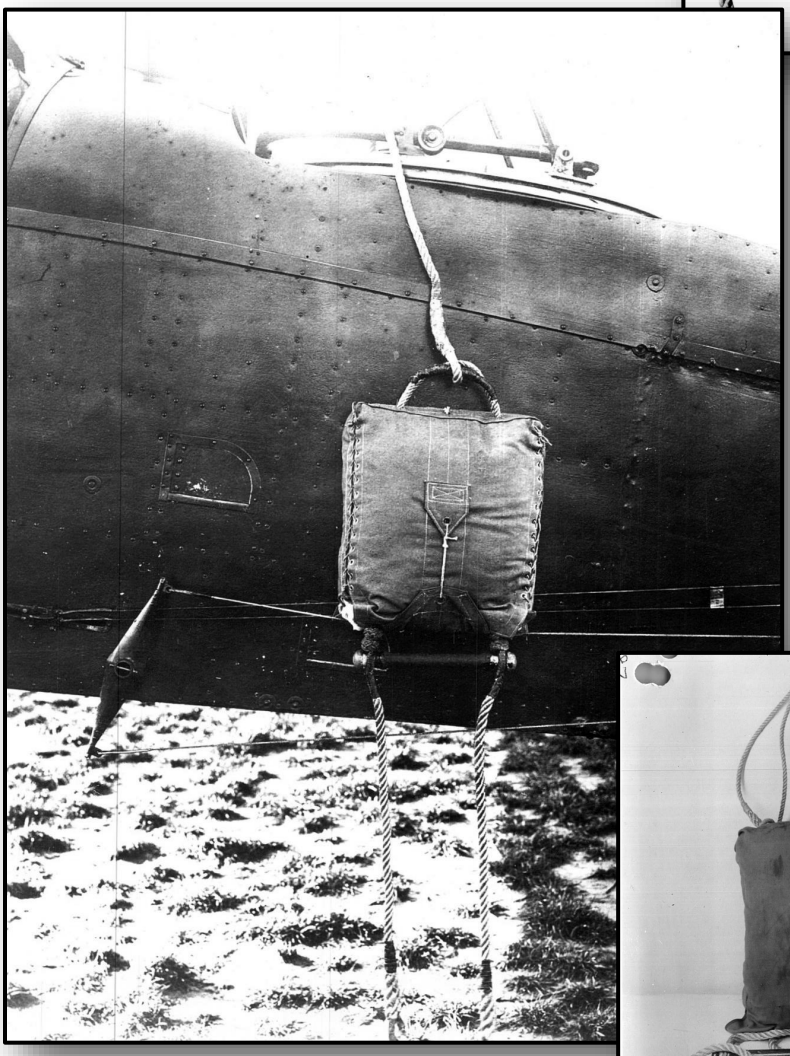
7. Thomas *Parachutes*, 29-30.




Top: The versatile Leonardo da Vinci prepared drawings and notes on the construction of a rigid, pyramid-shaped parachute but no record is available of it being constructed.

Left and Below: “Tiny” Broadwick’s, the noted woman parachutists with a credited 600 jumps, father , a well-known balloonist, designed and built the parachutes utilized by he and his daughter—Broadwick’s “Life Pack” ca 1915.



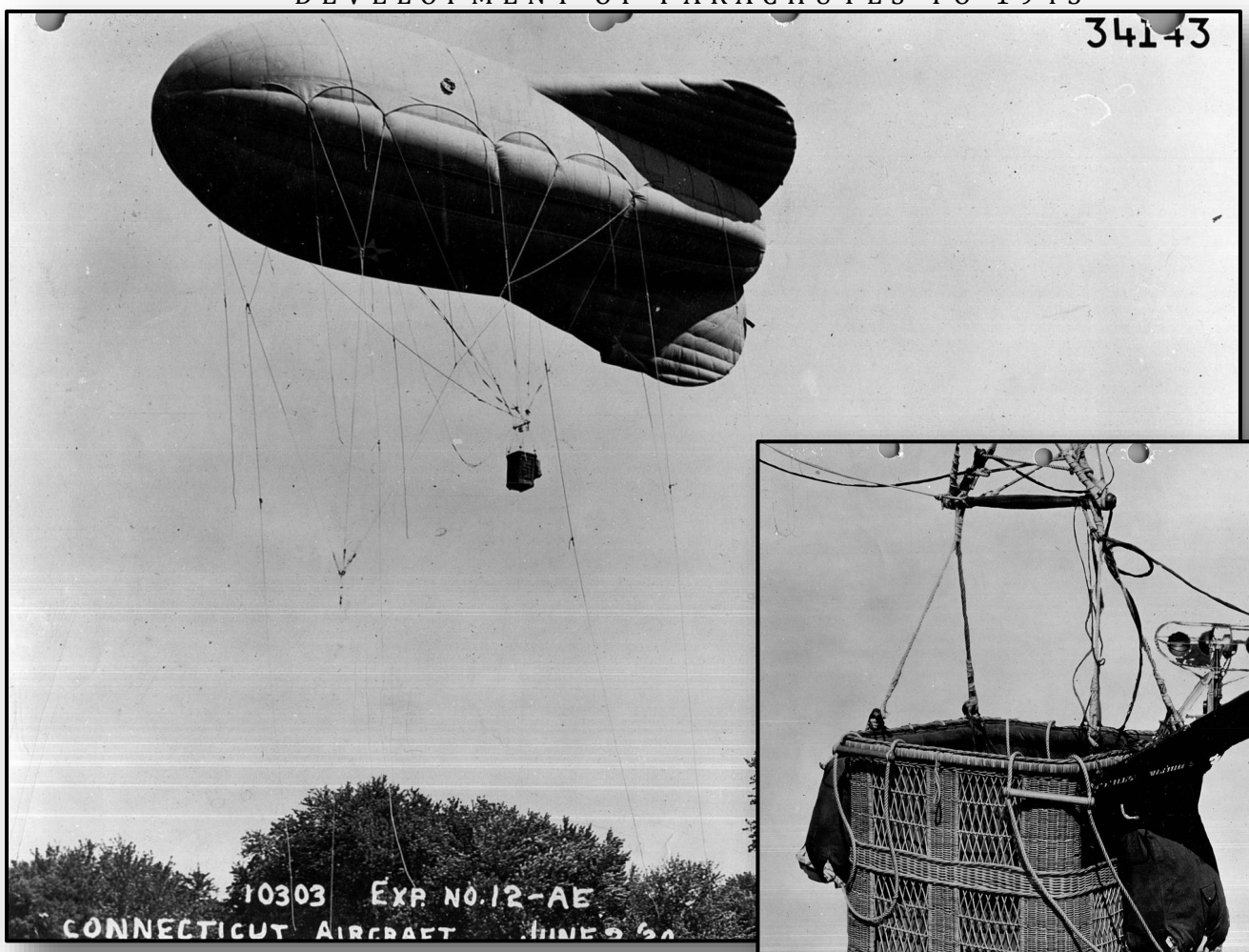
Top Left: The Goodyear Balloon-type parachute.

Top Right, Middle, Bottom: Leo Stevens Parachute. Balloonist who developed in 1908 probably the first free or manually operated parachute. Stevens' "free fall" type parachute was contained in an X-shaped piece of heavy cloth, rounded on edges and folded in from the sides. The canopy was of cotton and linen cloth, 16-feet in diameter, and had 16 hemp ropes as shroud or suspension lines.

Stevens himself manufactured and used this type of parachute during World War I.

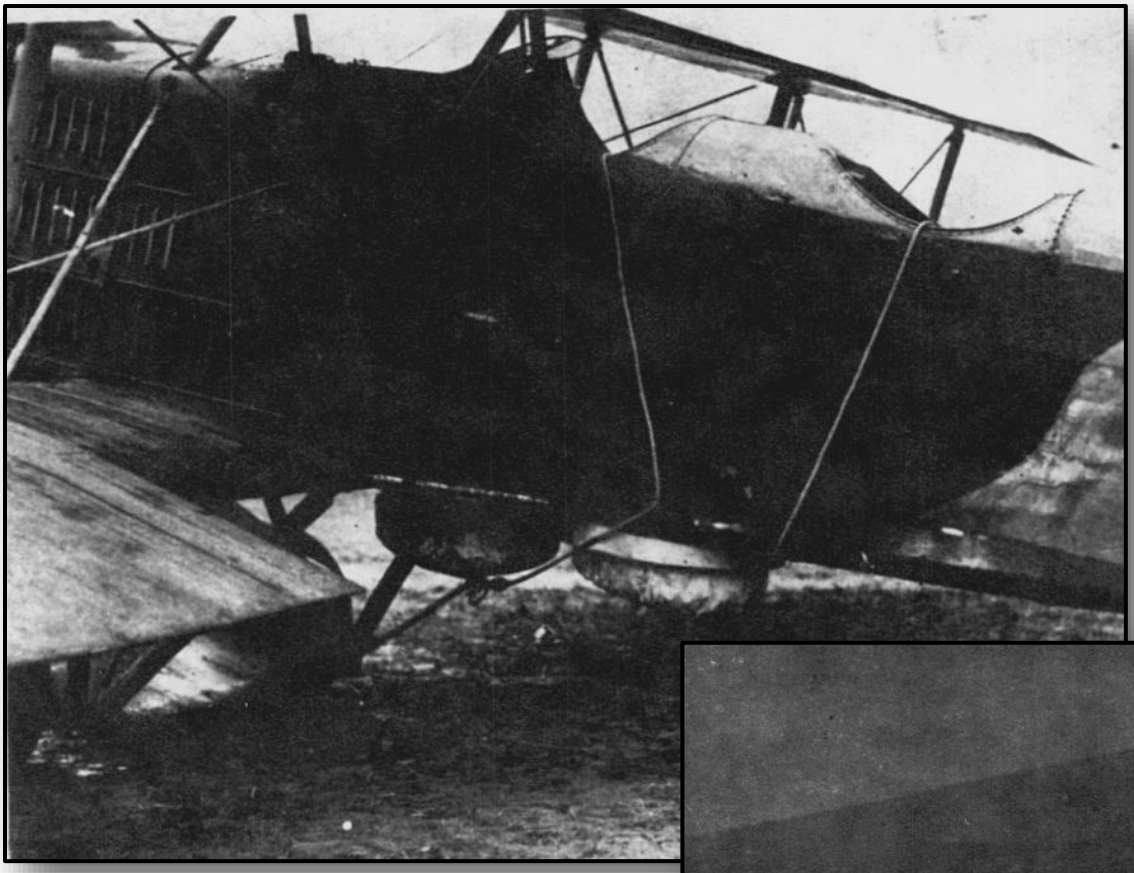

Top: Patented in 1911 by an Italian inventor named Pino, this backpack or knapsack type parachute introduced the idea of a pilot parachute. A small pilot chute was worn fully opened, and mounted on top of his hat or cap. When he jumped, the small parachute jerked off his hat and at the same time released his main parachute.

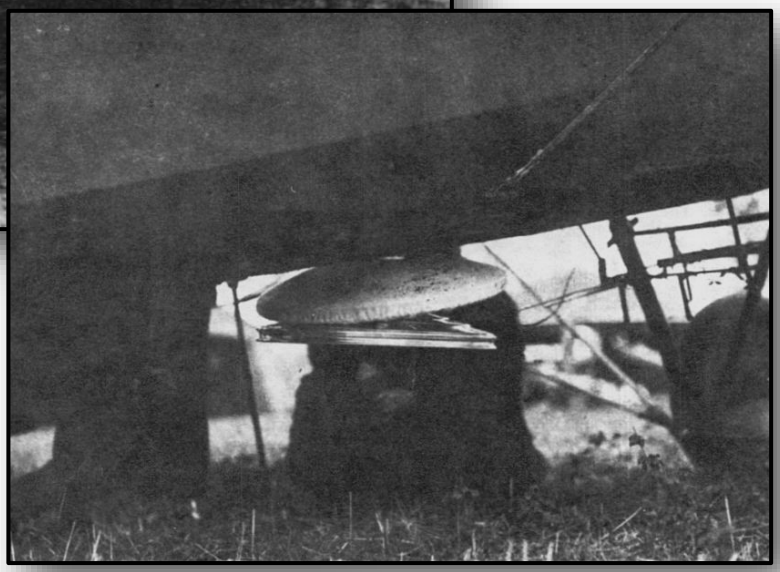
Right: During this period of design, parachutes were stowed in a container as seen to the right. They were normally attached to the basket of observation balloons or to some part of the fuselage or wings of the planes with a strong line or rope (“life line”) connecting the shroud lines of the parachute to a belt or simple suspender-like harness worn by the parachutists.



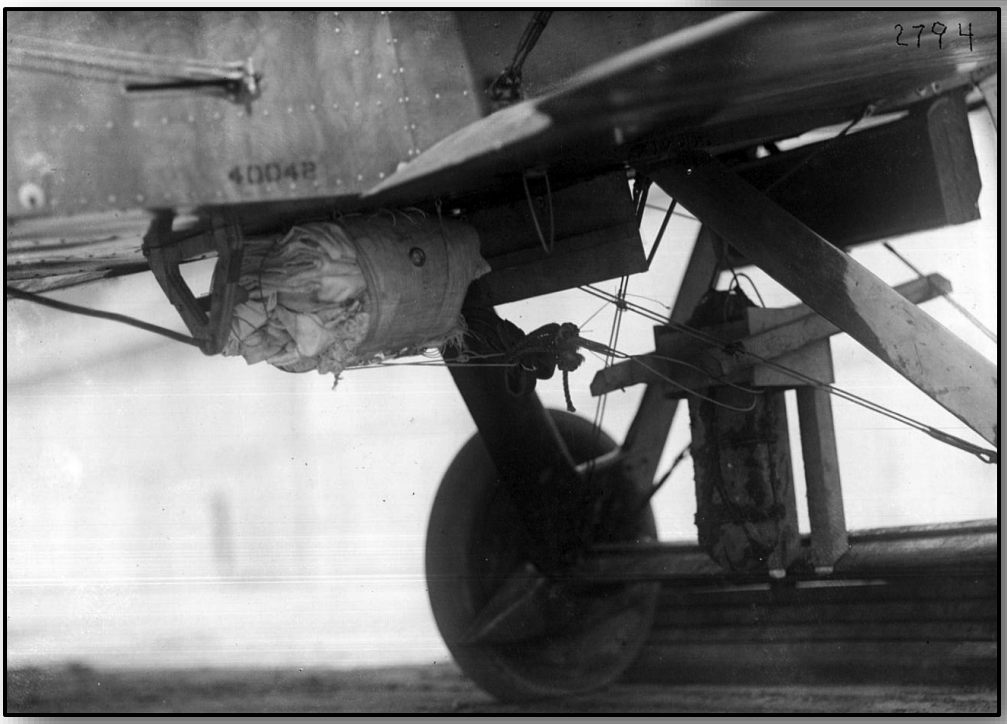

With the start of World War I, all balloons used for observation and other military purposes were equipped with parachutes (pictured above). With the introduction of the airplane as a combat weapon, balloons, especially those filled with hydrogen, became prime targets for machine guns and incendiary bullet fire. It was reported that lives of more than 800 Allied balloonists were saved by the use of parachutes.

The Royal Air Force utilized the "Guardian Angel" (pictured left), a British-type parachute within their balloons, which the Technical Section of the A.E.F. showed interest in with the Instrument and Testing Division of the U.S. Air Service located in France experimenting and testing in the autumn of 1918.

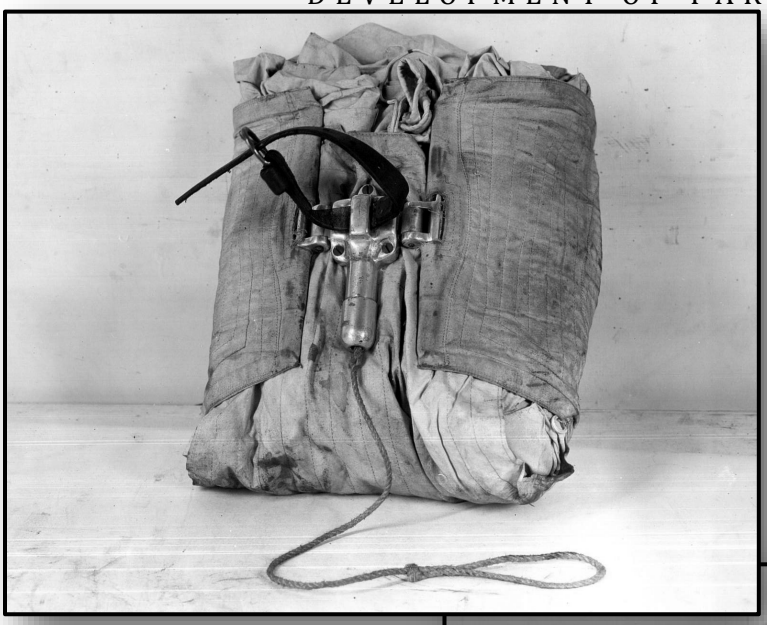




All types of parachutes had been tested with dummies and a wind tunnel at St. Cyr with tests showing the most serious problem involved in transferring parachutes from the balloon to an airplane was finding a suitable place to attach it. As shown here, normally attached to the under-side of the fuselage just to the rear of the seat with the "life line" extended from the shroud lines in the contained up and over the side to the fuselage to he harness worn by the pilot or



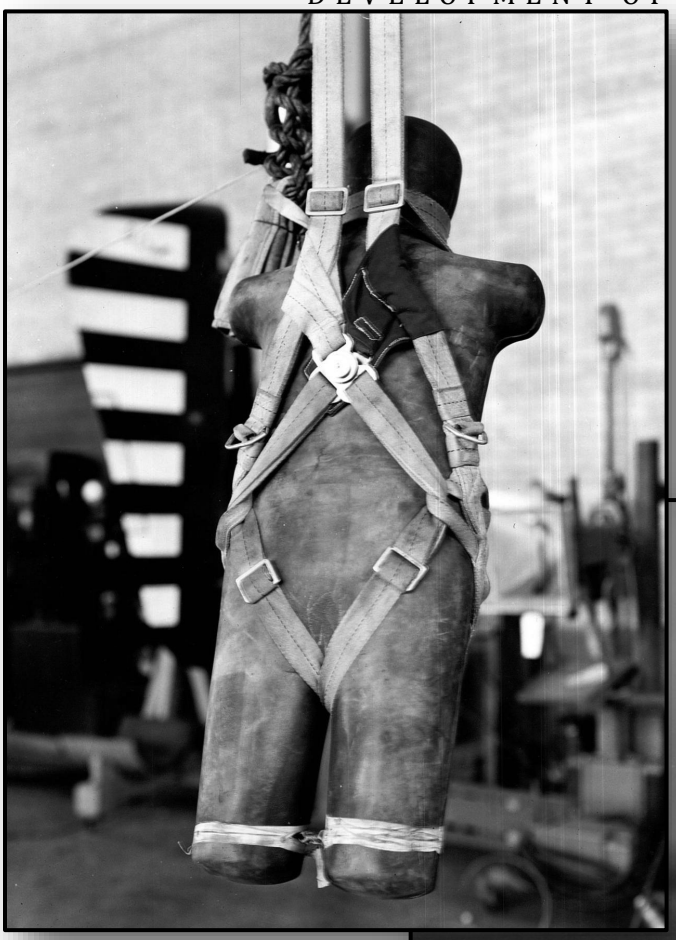

observer. Interviewed by the Technical Section during a trip to the fighting front, Captain Eddie Rickenbacker stated his beliefs that the container should be located "just behind the pilot and in the fuselage."



A few days after the Armistice, the Airplane Instrument and Testing Division of A.E.F. reported that a conference on parachutes was held in Paris of the same month, attended by France, England, Italy, and the United States. American representatives reported that experimental work had been ongoing in France since September 1918 with the Division looking at ten different parachute types of English, French, and German makes with two American types having been evolved from the best features of all the others. One such parachute was the Jahn parachute, picture at the left. It would later be tested at McCook Field during the Interwar Period.

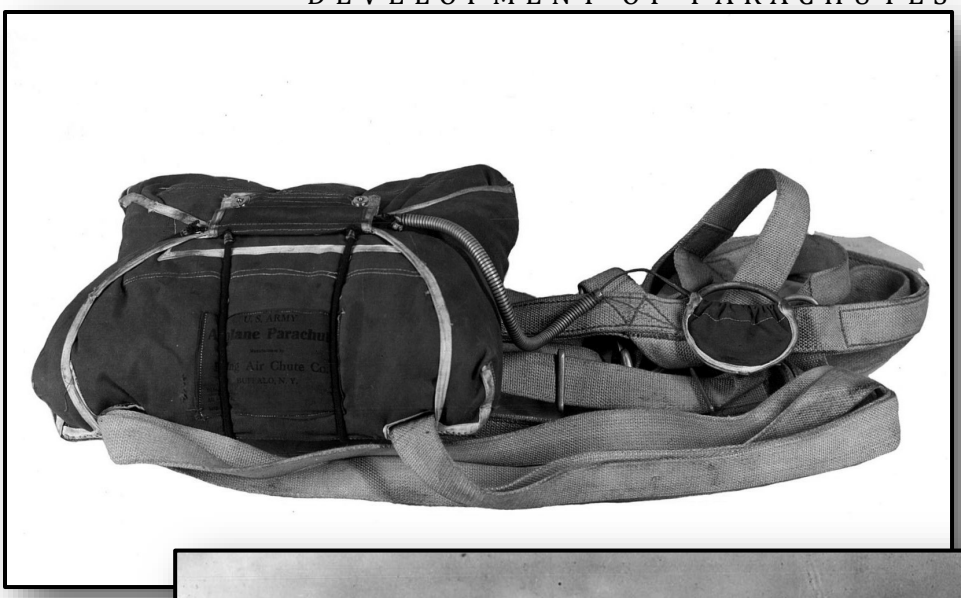
The British adherence to the use of attached type was partly based on the idea that a parachute must be entirely extended before it started to open.

The most popular British parachute, the "Guardian Angel" (right), by 1924 had been changed to a pack-type carried on the seat beside the pilot with a static line or rip cord, however, still attached to the plane.



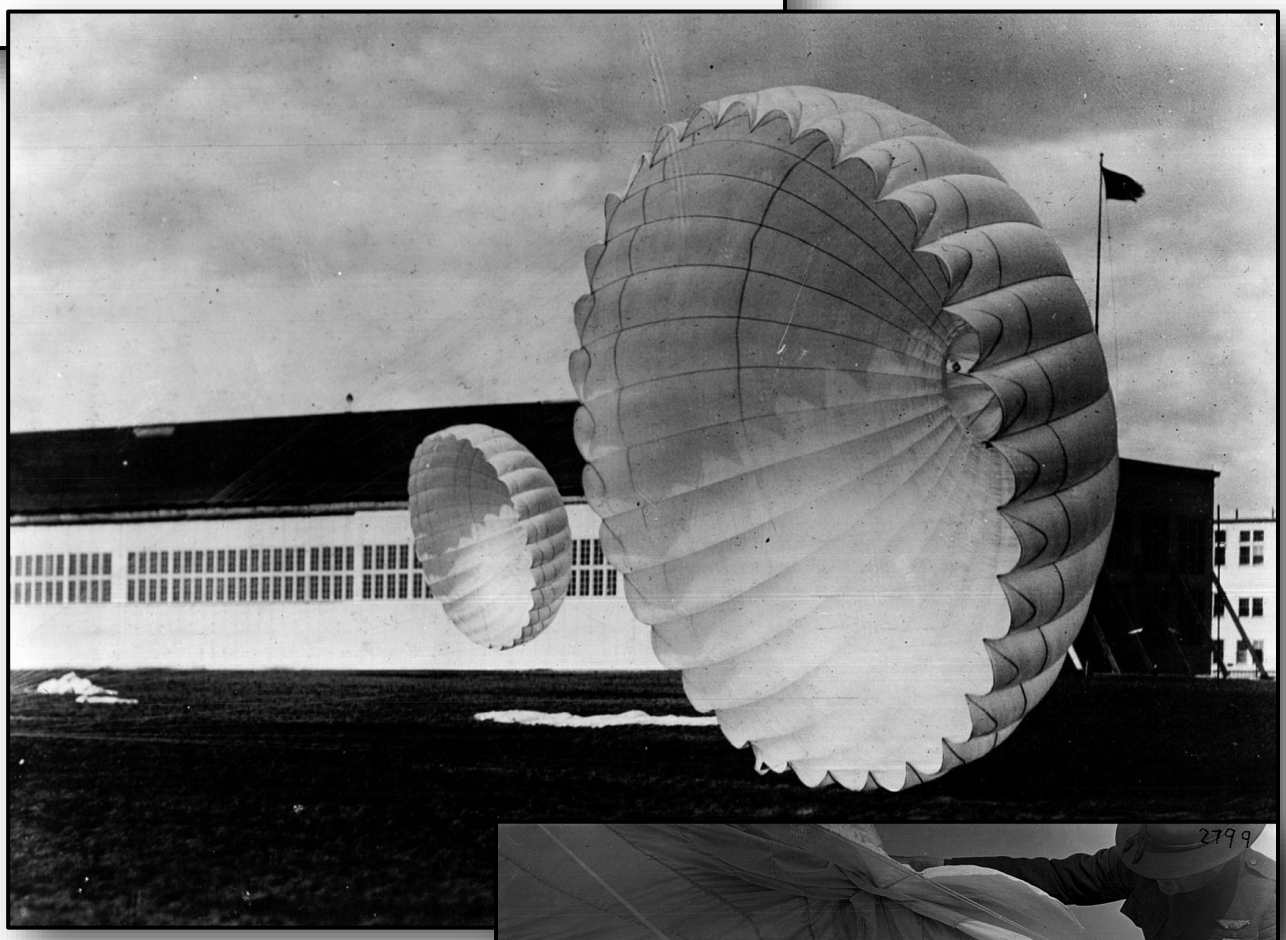
During the first few months of 1919, a free and manually operated parachute was designed, built, and tested with a dummy. “Dummy Sam” (pictured left) led a rugged and precarious “life” during those months.

Below, Floyd Smith, a former trapeze artist turned aviator, became interested in parachutes after surviving a near-fatal airplane accident as a test pilot. He soon realized that it was safer and more effective for aviators to carry the chute on their back than the static-line parachutes. He filed a patent for his “Type A” parachute in July 1918 at roughly the same time he was hired by the US Army Air Service to test and inspect planes in Dayton.

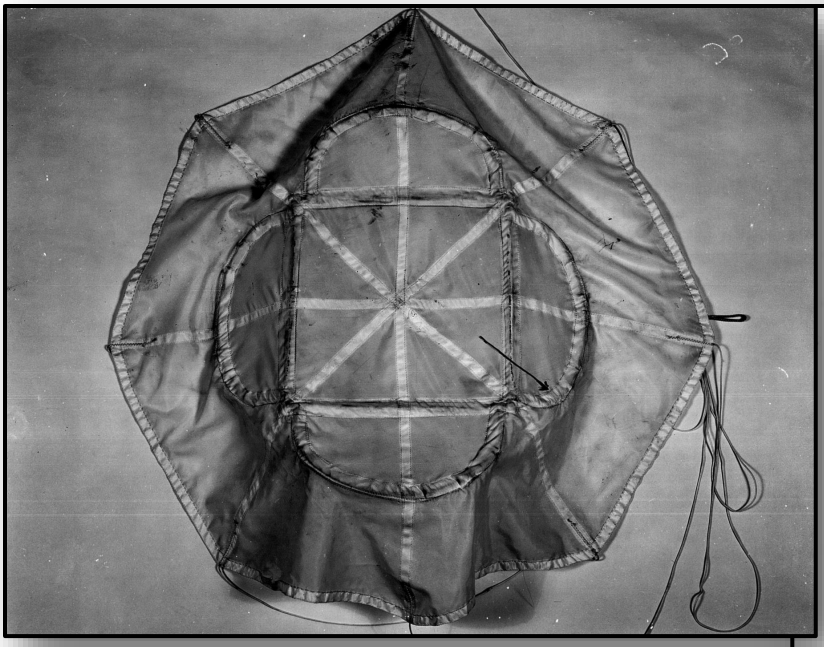


The Type-A, developed by Smith along with Leslie Irvin, had a canopy of 28 feet diameter, constructed of 40 straight cut panels of Japanese silk, which was attached to the wearer's harness by 40 braided silk shroud or suspension lines, of 250 pounds tensile strength.

Left: Packed Type-A parachute. Middle: Ground tests of the Type-A parachute. Below: Type-A parachute showing the vent partially closed by rubber bands.

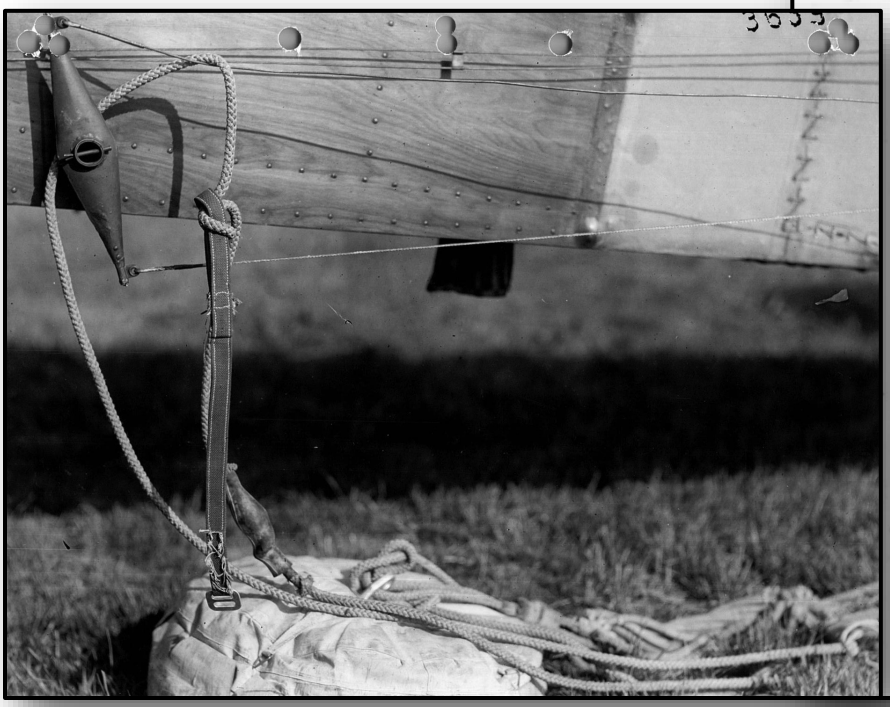



Further tests and experiments were made during the succeeding years with the Type A parachute. The U.S. Army made the wearing of parachutes by its aviators compulsory in 1921 (pictured above). This order was possibly hastened by the untimely death of Lieutenant F.W. Niedermeyer at McCook Field on 13 March 1922 when he failed to don his parachute when his plane went to pieces while performing acrobatics over the field. Below: Testing of the Type A parachute.



Above: Pilot chute with arrow indicating springs.

Right and Below: Lieutenant Robert A. Caldwell of the Royal Flying Corps arrived from England in July 1919 and demonstrated the Guardian Angel parachute during the time that the free type was being first tested. When he made a demonstration jump on 11 July, the “life line” which was attached to his plane (below) fouled in the elevator rocker arm in the tail of the de Havilland DH9 at a height of over a thousand feet, causing the harness to break, and hurling him to the ground where he died instantly.

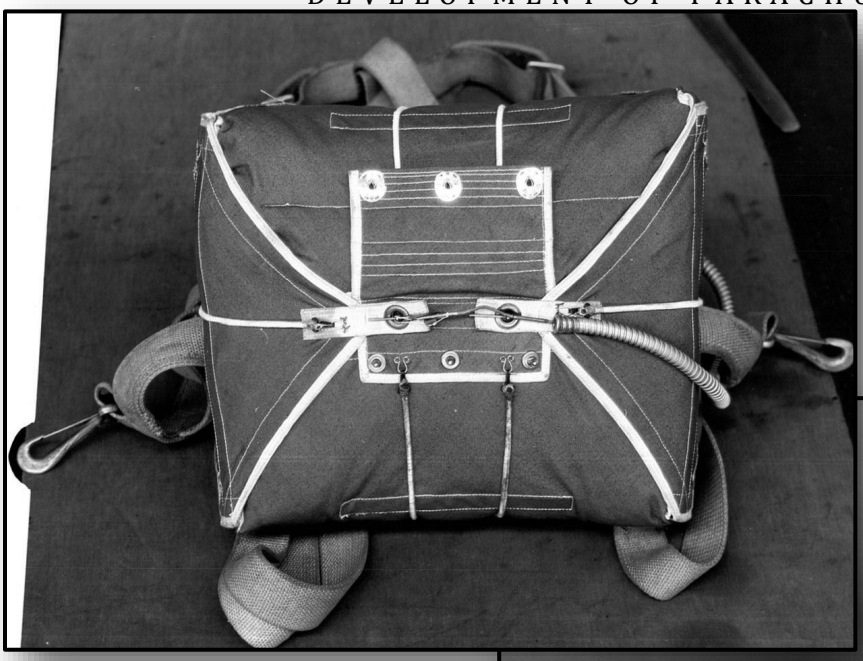


The first emergency use of the Type-A parachute came on 20 October 1922 at McCook Field when Lieutenant Harold R. Harris, Chief of the Flying Section, jumped out of his disabled Loening PW-2A high-wing monoplane over the city of Dayton and landed safely in a grape arbor (pictured). Harris fell nearly 2500 feet from his plane to the ground before opening his parachute as he mistook a D ring in his harness for the rip cord handle. Lieutenant Harris became the first member of the "Caterpillar Club," and his experience removed doubts about the ability of a pilot to "keep his head" or remain conscious long enough to manipulate a free or manually operated parachute. The "Caterpillar Club" was an informal association of individuals that had successfully used a parachute to bail out of a disabled aircraft. The name referred to the silk threads that made up the parachutes.

Above: The use of the seat pack parachute made it necessary to lower the seat of the plane a distance equivalent to the thickness of the pack (gentleman on the right). Pictured to the left, the lap pack type for Observers, was worn by Lieutenant "Jimmie" Doolittle. (ca. 1923)

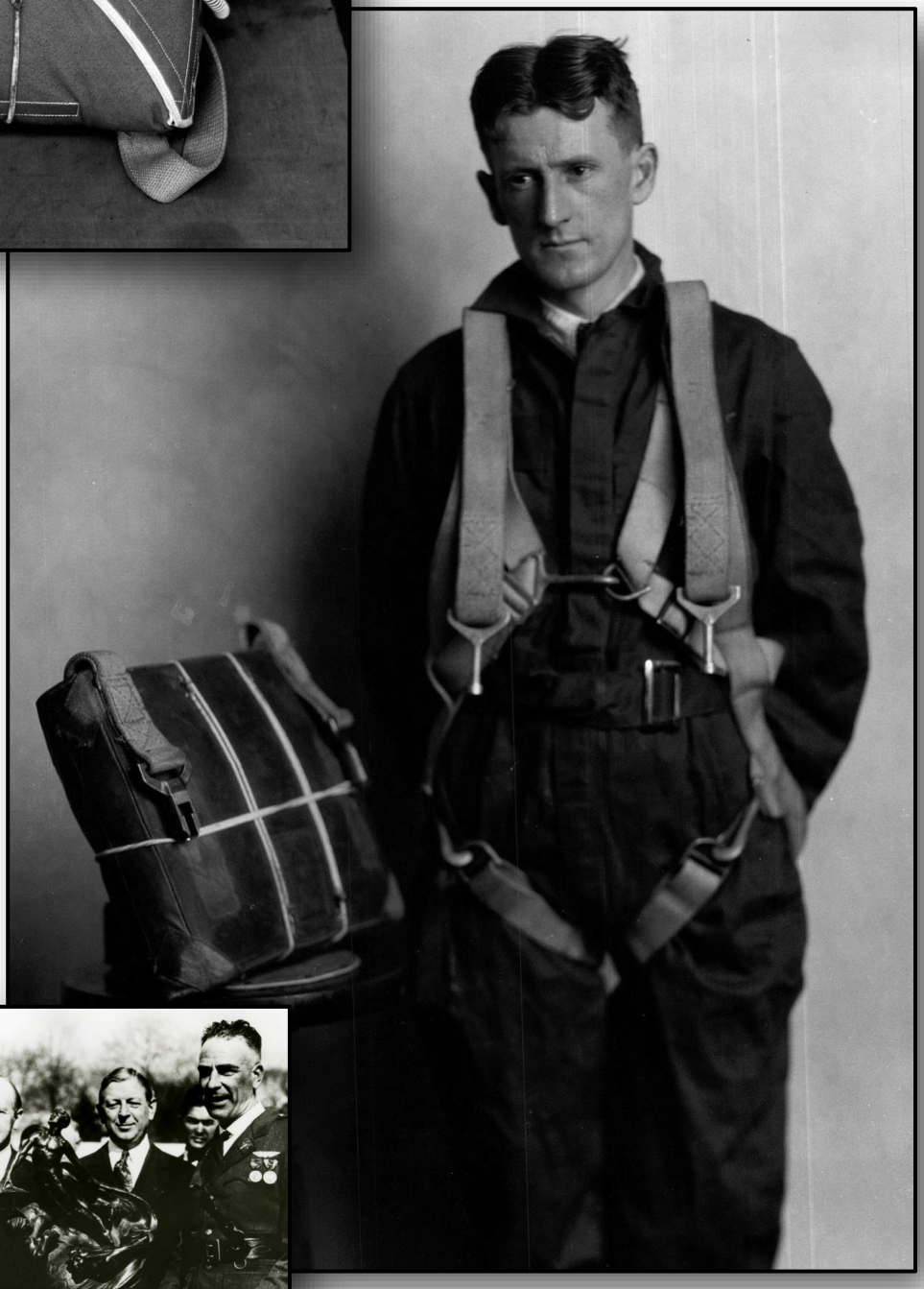
Opposite Page

Top Left: When needed, the parachute was attached to chest harness by means of a couple of heavy snaps. This lap pack type worn by observers (ca. 1923). Top Middle: A Bustle-type parachute, note the location of the rip cord ring handle (ca. 1925). Top Right: Soon after its development of the backpack they were found unsuitable to use by observers and photographers who rode in the rear cockpits of planes as several accidents occurred when the packs caught on projections in the rear cockpit and opened in error. Thin, form-fitting, pad-like packs, which would have removed this danger had been built and tested but were not in production at this time (ca. 1925). Bottom: Numerous new ideas in canopy shapes, automatic releases, harness design, and fabrics were tested at McCook Field in the end years following World War I. Some of these new ideas originated within the Parachute Branch while others were submitted by inventors and others. The Russell Lobe parachute (pictured) was designed to reduce speed of descent and oscillation, was thoroughly tested but not accepted (ca.1926).



The covers or cases of folded parachutes were held shut by a series of brass cones and grommets, through which a steel wire rip cord passed (ca. 1928).

When reviewing the work of the Parachute Branch, Major Leslie MacDill, Chief of the Experimental Engineering Section, stated in 1928 that the "Air Corps' standard parachute [had] been adopted by nearly all of the military services of the world."



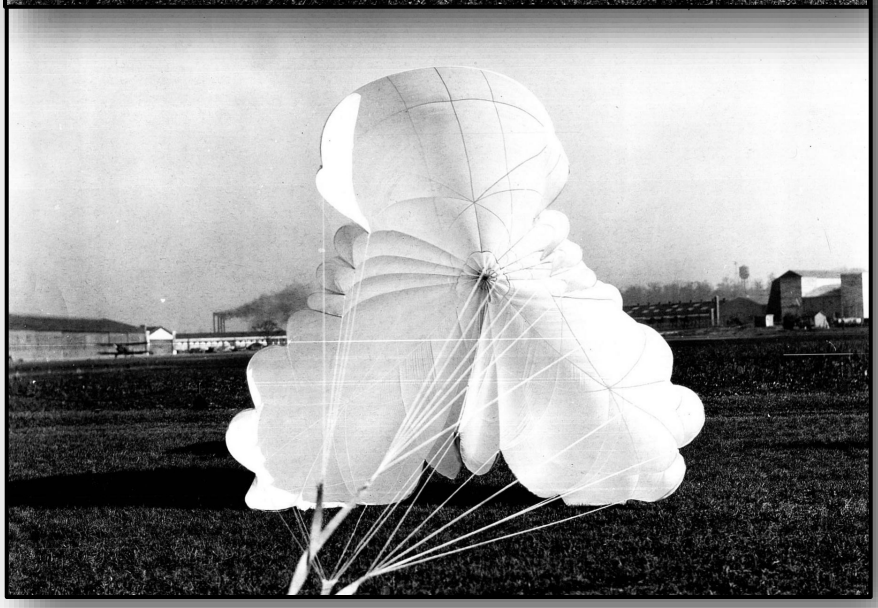
After the Materiel Division moved from McCook Field to Wright Field in 1927, the parachute development work continued at the new site under the direction of the Experimental Engineering Section. Major Edward L. Hoffman, continue to run the Parachute Unit, wrote in August 1929 that he considered the following to be the greatest needs in parachute development:

- A new canopy designed to reduce oscillation and speed in descent.
- Greater steerability.
- More comfortable harness.
- A springless pilot 'chute.
- Better rip cord handles.
- New quick release harness (pictured at the right, ca. 1927).

In 1926, the Collier Trophy was awarded to Major Hoffman for the "development of a practical parachute" (pictured right).

Pictured is the seat type parachute circa 1928, note the back pad pictured to the left.

It was found in 1928 that many of the 1922 parachutes tested were no longer safe by the Parachute Branch; this discovery resulted in the retirement of many of the parachutes as soon as new procurements could be made. Climatical conditions in the tropics reduced the dependability period to two years. The 236 parachutes procured from the Irving Airchute Company of Buffalo, New York, to replace the 1922 series cost approximately $260 each.



As stated on earlier, Major Hoffman highlighted six areas needed in parachute development with his deep personal conviction that the triangle type parachute would meet those requirements (pictured here). Sometimes referred to as the Hoffman parachute due to his interest into its development, it had some characteristics of a glider. Two of the corners were slightly rounded, while the third corner was shaped to resemble the small end of a funnel—the escaping of the entrapped air through this funnel-like exit caused the gliding parachute to move forward and slightly to the right or left at the rate of roughly three miles per hour, depending on how it was guided into the wind.

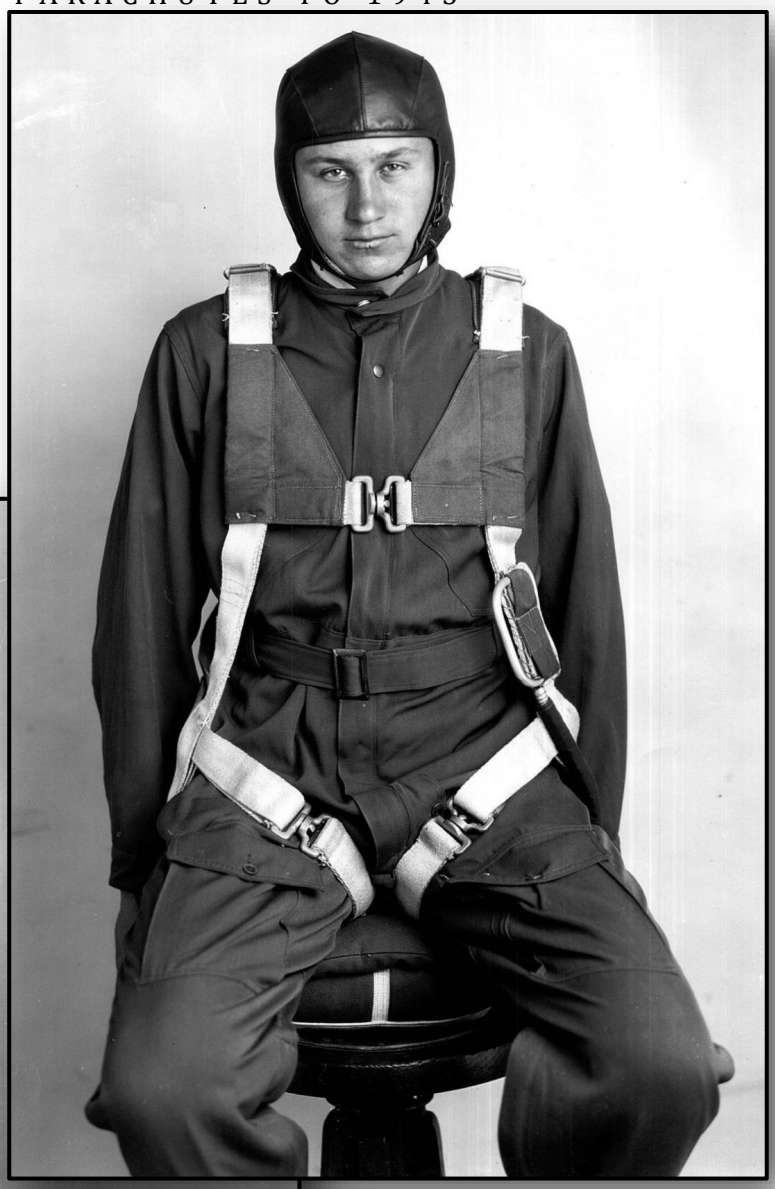
Major Hoffman claimed the parachute had the advantages of steerability, slower rate of descent, reduced oscillation, and a more comfortable harness. In addition, it did not require springs to eject the parachute (pilot) from the pack as did the standard type.

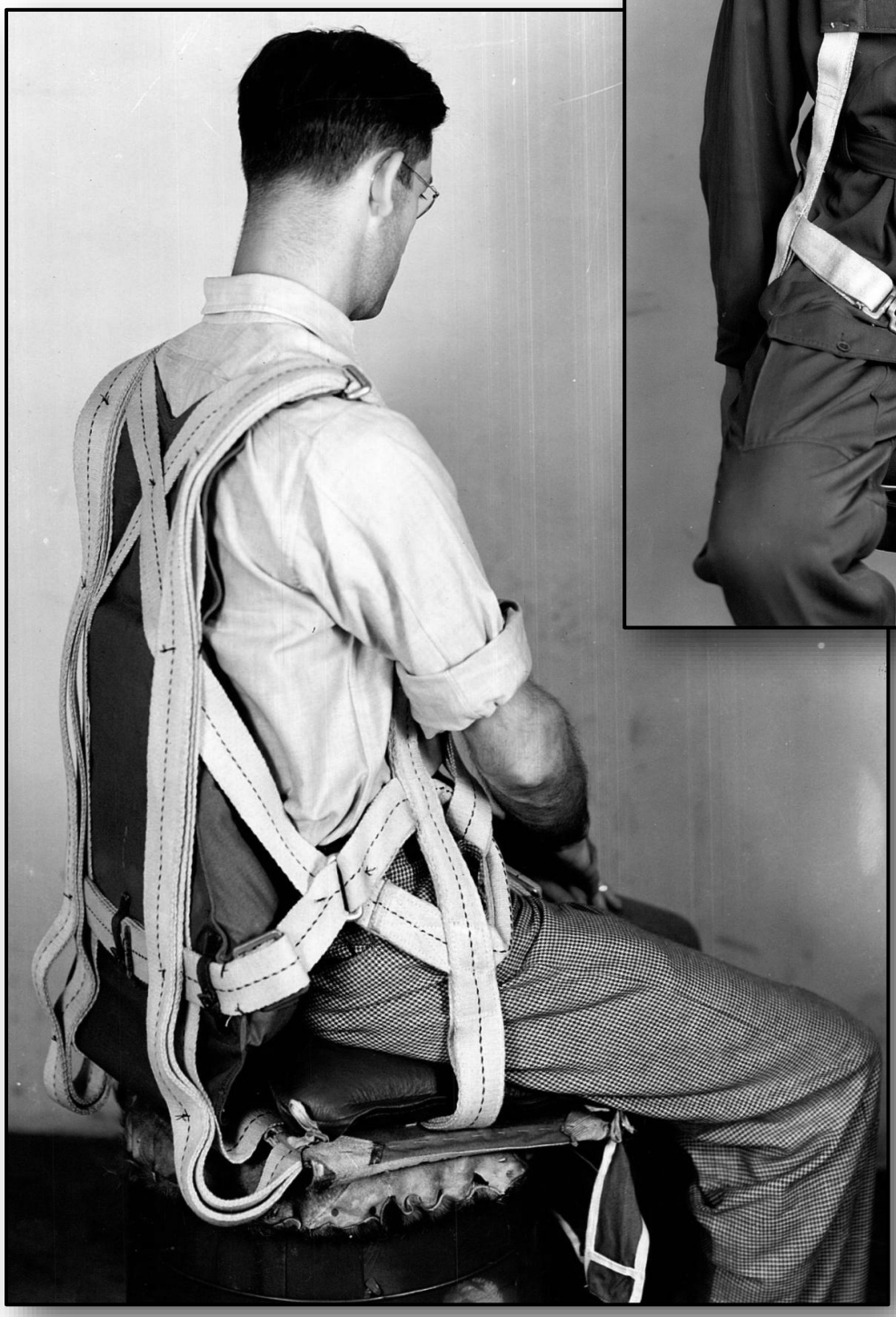
The triangle parachutes were three years in development with the first one procured in 1931 (pictured here). They were standardized as Type S-3 with a limited number procured and put in service during 1932.

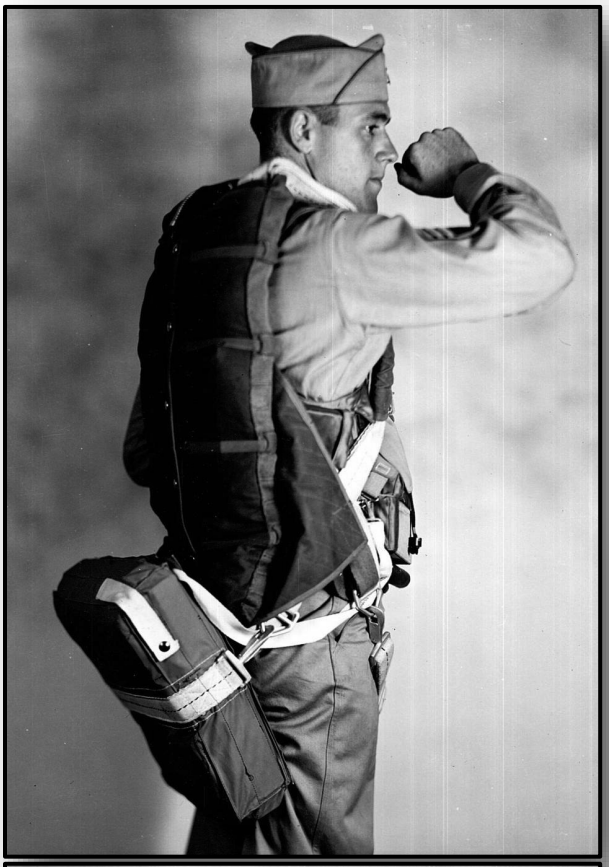
The majority of the service test reports were unfavorable to this type of parachute. Mitchel Field reported before the end of 1931 that it was hard to pack and that it was not recommended for adoption over the standard S-1, then in use. Lieutenant Colonel James Mars, Commander of Chanute Field, pointed out its faults: difficulty in packing, difficulty in adjusting harness, harness was uncomfortable, rip cord hard to reach, slower than standard type in opening, and a dangerous sidewise drift.

The triangle type parachute was also more difficult to construct and, consequently, more expensive in production. These objections, together with the unfamiliarity of the pilots and other users with this new type of parachute as well as the difficulties in maintenance, caused the discontinuation of the procurement of triangle parachutes in the spring of 1936. Those on hand were to utilized for quick attachable service (pictured here) and placed under Limited Standard Classification.

With the lengthening of the period of time during which a parachute might have to be worn, cushions and pads of various types were devised. A back pad which could be made a part of the parachute harness was developed in 1936. A pneumatic cushion which had been developed at an earlier date was superseded in January 1939 by a cushion constructed of light sponge rubber material. These cushions were in turn superseded in 1943 because of the rubber situation by cushions filled with curled hair.

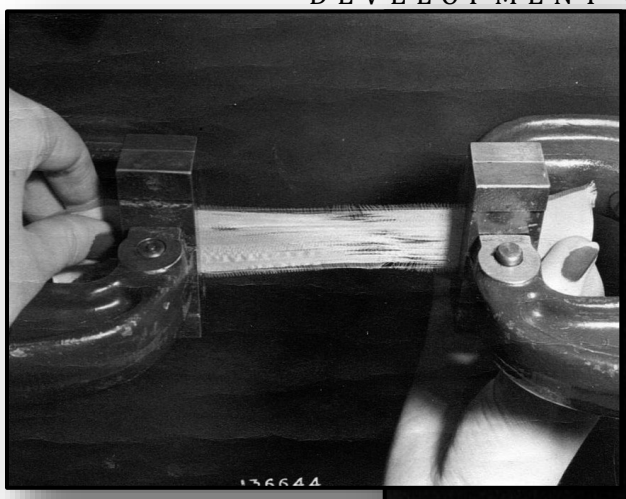


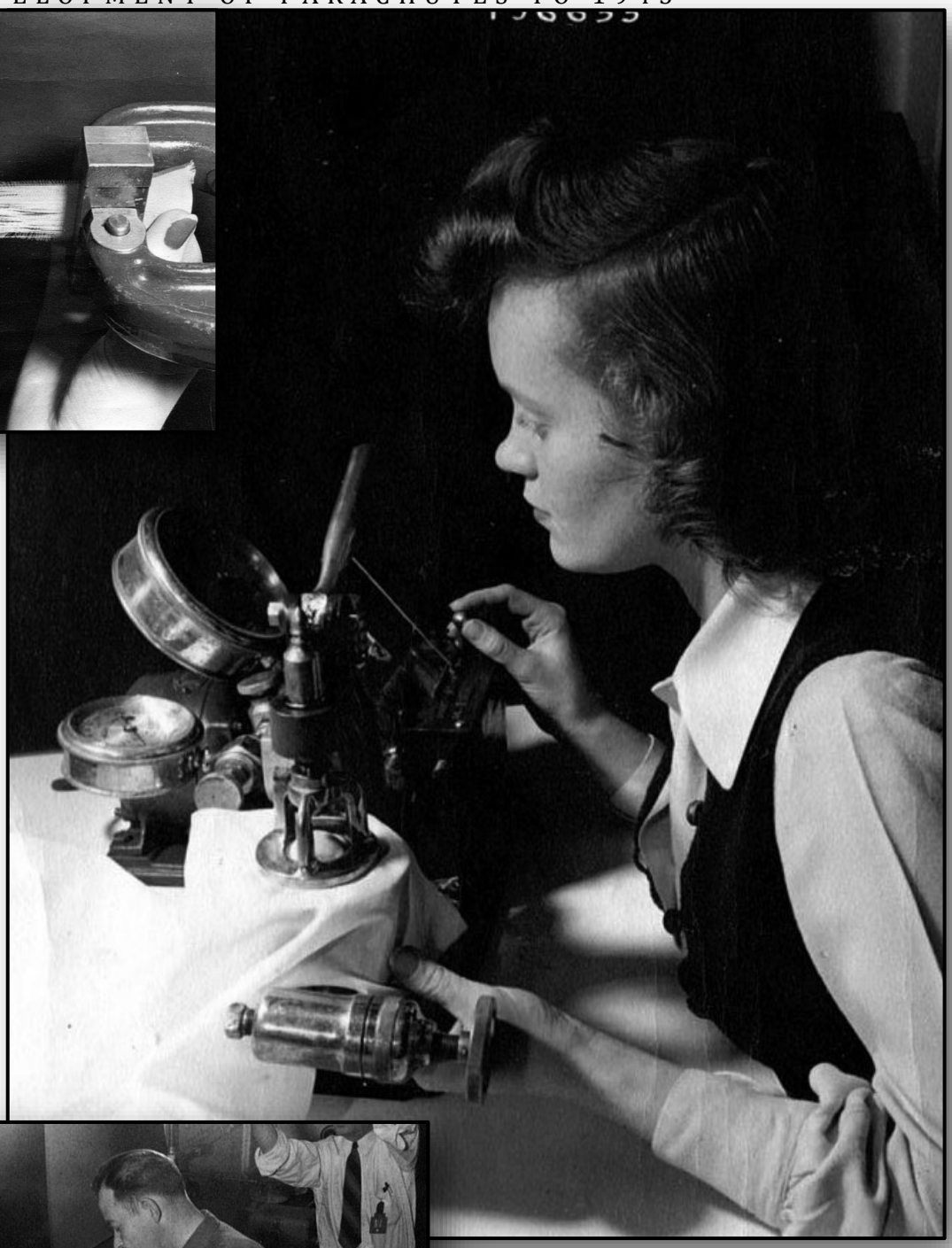




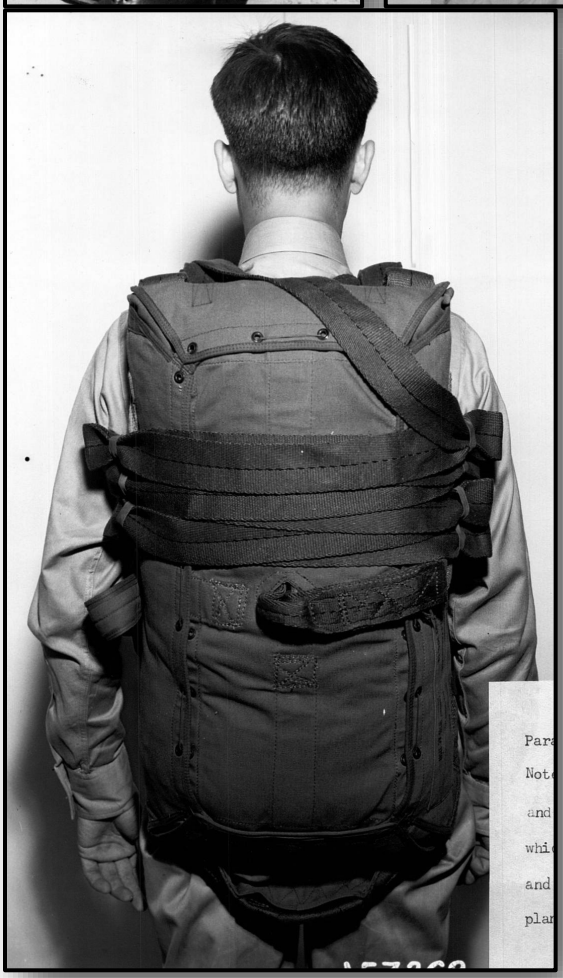
The development of a satisfactory back-type parachute was again attempted in 1937. The appearance of the modern bomber with its possibilities for long combat missions made the need for combat and compactness paramount in parachute construction.

Left: B-9 parachute with life vest and life raft (1943); Bottom left: Emergency Kit Vest under parachute harness (1943); Bottom right: Seat Pack Chute and Life Raft with Back Pad and Emergency Kit (1943).





A continuous effort was made to improve the quality and increase the quantity of nylon available for parachute material. Tensile strength tests conducted by the Materials Laboratory in 1941 indicated that the strength-weight ratio of nylon was 40-45, as compared with 33-38 for the best silk. The elasticity or elongation properties of nylon were found to be approximately twice those of silk and three times that of linen. In the case of suspension (or shroud) lines and harness webbing, this property was of prime importance since it tended to absorb the opening shock load and minimize its transmission to the wearer.



The attached or static line type of parachute was once more brought into use with the development of airborne troop tactics. The use of the static line, which served as a rip cord, assured a uniform opening and spacing of the parachutes in the air. Since the airborne troops were usually heavily laden with equipment and the planes from which they were jumping may not be flying at a very high altitude, the opening of the chute must occur within a minimum length of time after the jump. The static lines used at the time allowed for a drop of fifteen feet before it opened.

Top left: Soft Pack Type; Top middle: Paratroop Type, T-5 (center panel pulls out); Top right: Paratroop Type, T-5; Bottom left: Paratroop, T-5. Note static lien and center panel.

Opposite page: Type T-5 for paratrooper with quick attachable and back pack.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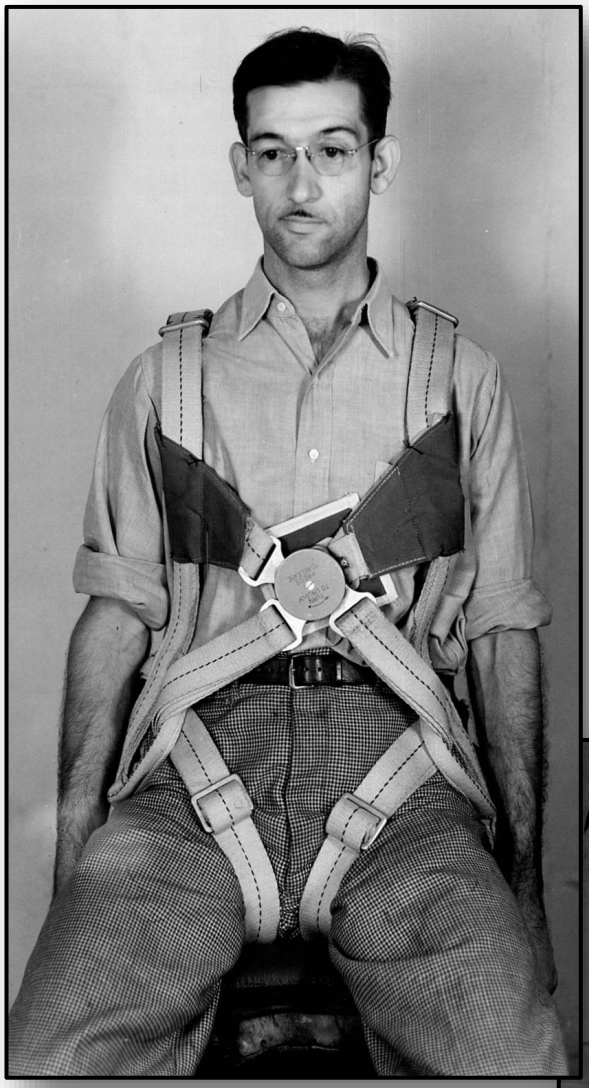
Opposite page: A pack type parachute was carried by the paratrooper on his chest harness for emergency use. Top: Static line pulling canopy from back pack of paratrooper after exiting aircraft. Bottom: Successive steps in opening of paratrooper parachutes.

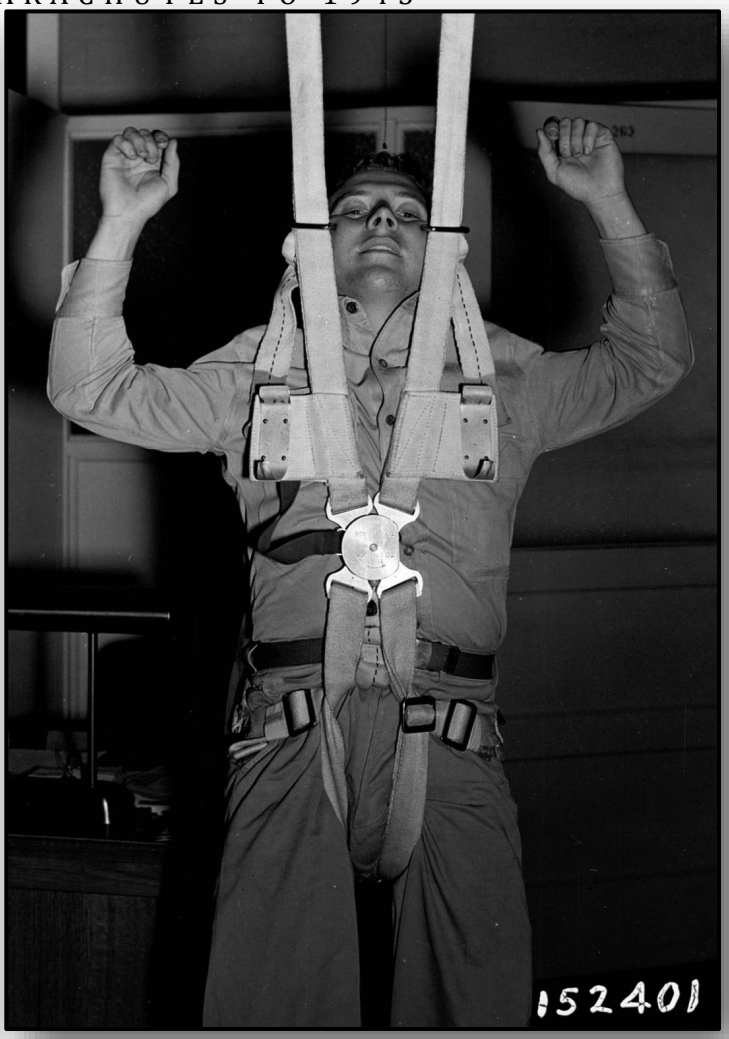


Left: S-4, Quick release-type Harness; Bottom left: Irving-type Quick Release Box; Bottom right: Comparing three-point and one-point release types.

Opposite

Top left: Quick release-type with safety key or fork; Top right: A-4 with British quick release type harness; Bottom left: Modified quick release harness for A-5 and B-10 parachutes; Bottom middle: Model showing how released harness will still hold individual; Bottom right: Test model, modified quick release harness.

This design of harness also enabled the wearer to open the quick release mechanism at any time before landing while still remaining seated, as in a swing; and in landing on either ground, water, or even in a tree top, all that remained necessary was the straightening of the legs and lifting of the arms, and the wearer's body would slide out of the harness.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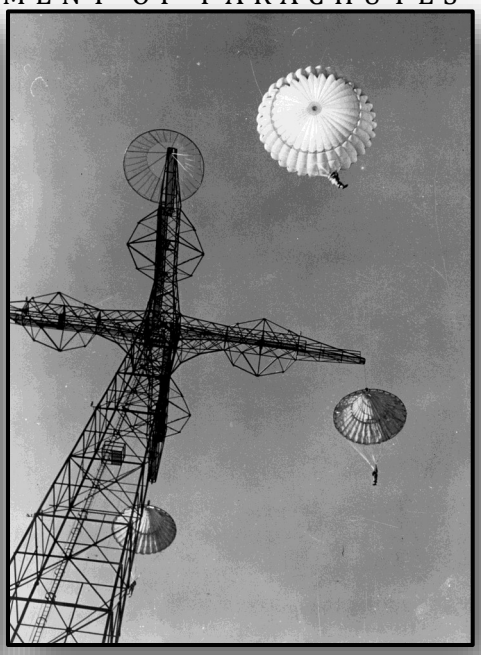
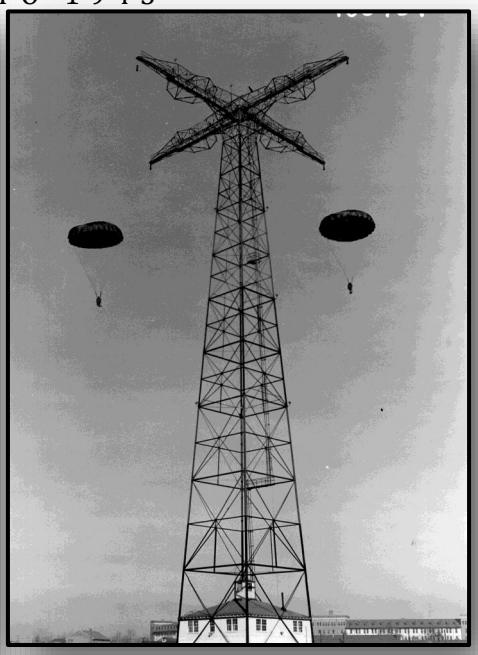


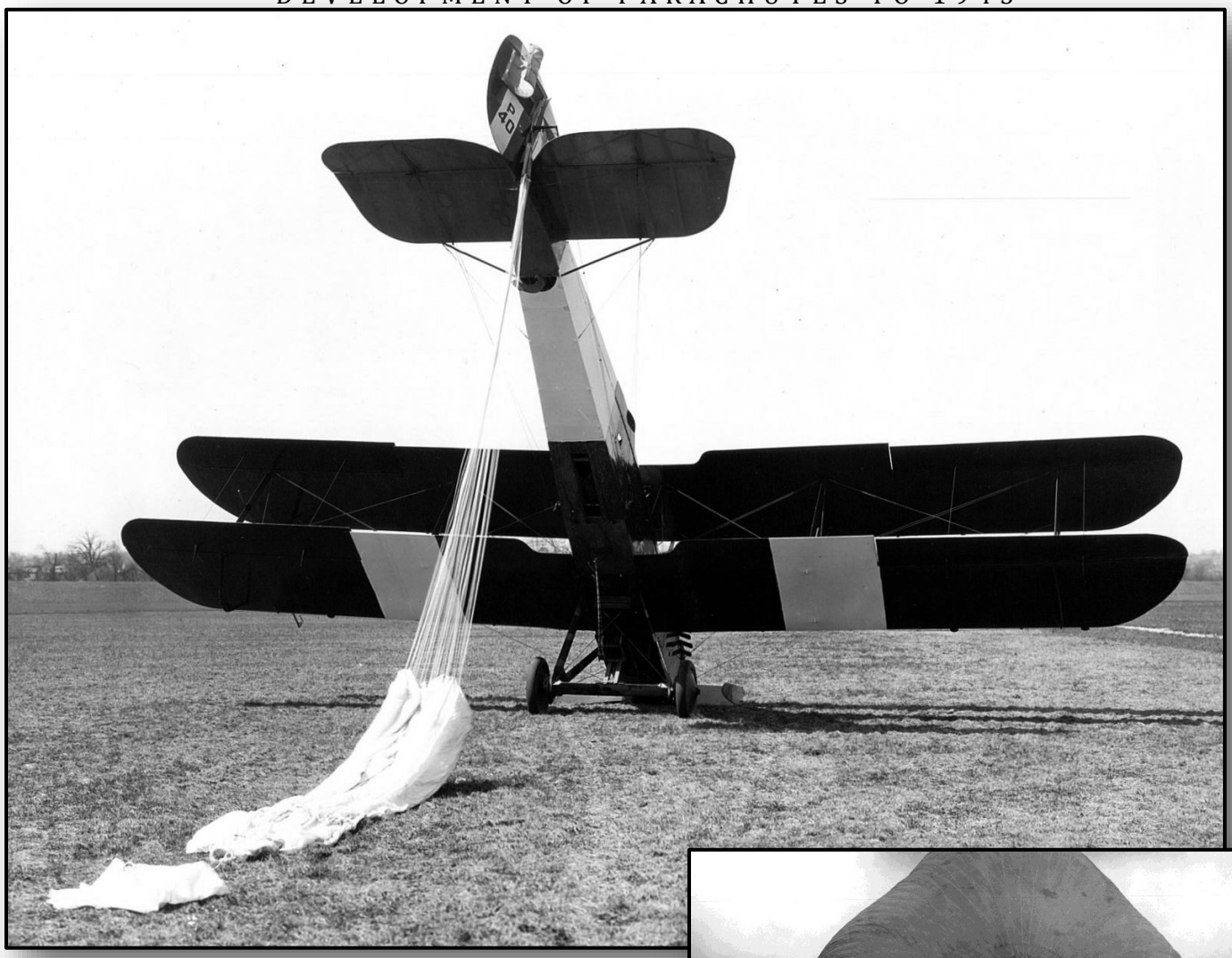


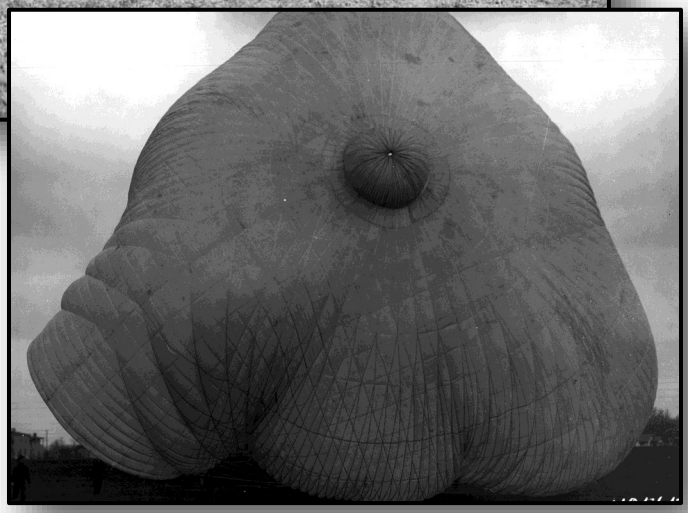
Russia led the way in the use of jump towers in the training of paratroopers. Parachute jumping became a nation-wide sport for young men and women as early as 1933, and these towers were used, with especially constructed parachutes, for their training. Similar structures, of 250-feet in height, were built at Fort Benning, Georgia.

Two types of parachutes were used in conjunction with these towers. The controlled type (J-2) was 32 feet in diameter and fabricated of cotton cloth. A suspension cable for hoisting the parachute to the top of the tower was attached to the center vent. Guide wires to insure vertical descent, regardless of ground wing, were run through metal rings fastened to the edge of the canopy (top left).

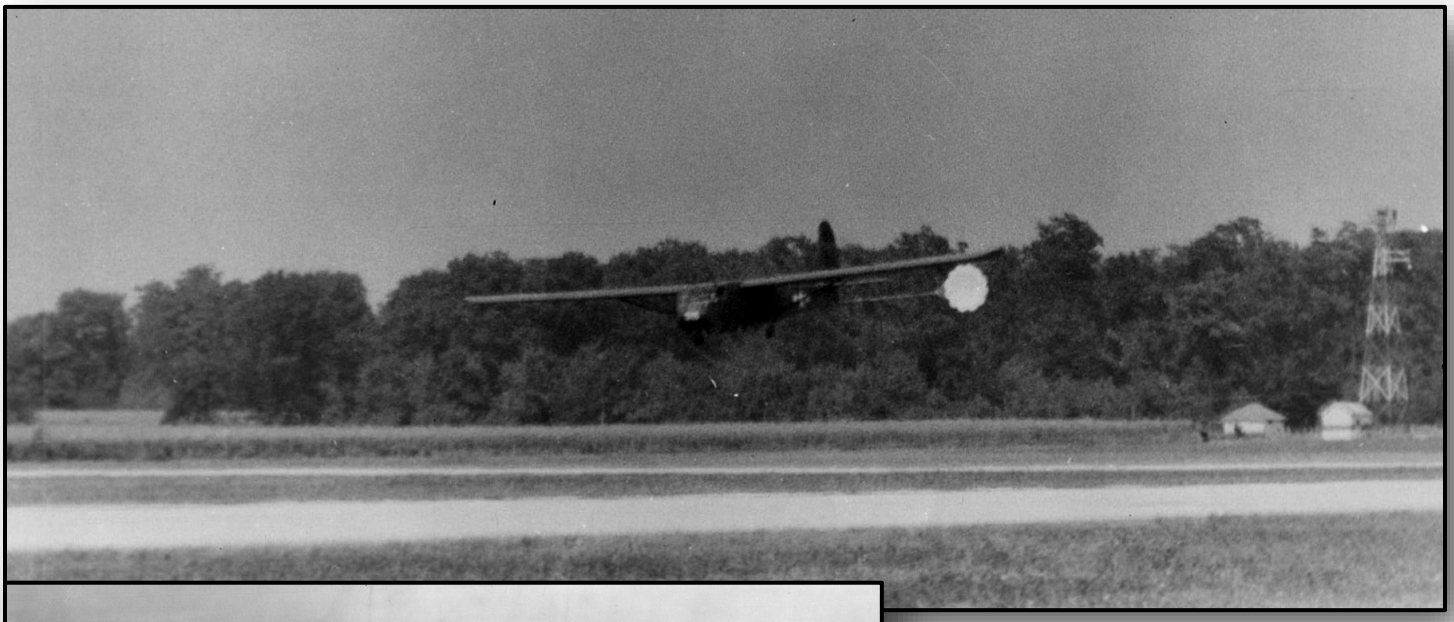
Type J-1 parachute was especially designed for the training of paratroopers on free fall jump towers. The canopy was 32 feet in diameter and made of nylon fabric with silk suspension lines (top middle and right).

Right: Training type parachute.



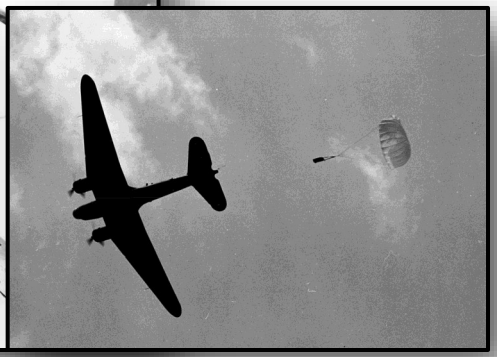


While in charge of parachute development at McCook Field, Major Hoffman and other members of the Parachute Branch gave consideration to the construction of a parachute of sufficient size and strength to lower a disabled plan or at least to minimize the shock of its landing (pictured top). Pictured at the right and below left is the test on 18 November 1930 on a plane weighing 2,500-lbs piloted by Major Hoffman with a triangular shaped parachute. Chute pictures bottom right is a 32-foot parachute that was attached to a 260 pound target plane capable of speeds of 200 mph.

During the summer of 1943, the Parachute Branch at Wright Field developed a special strength 10-foot nylon glider drag shoot. When attached to the tail of transport gliders, the parachute materially reduced the required length of landing strips (picture above and left).

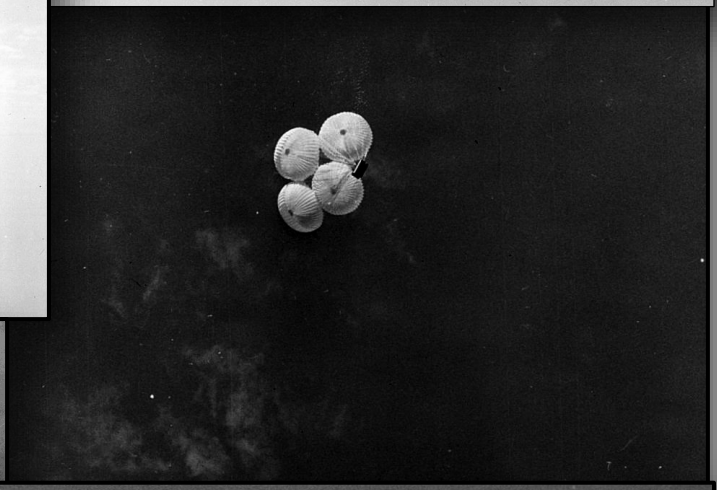
The first Army Air Forces employment of parachutes for the aerial delivery of military supplies and equipment came with the use of silk fabric salvaged from discarded man carrying parachutes in 1932. The parachutes made from this salvaged material, like all others used for cargo and aerial delivery, were of the static line type. They were attached to a cylindrical shaped bag constructed of duck fabric which contained a five gallon commercial milk can.

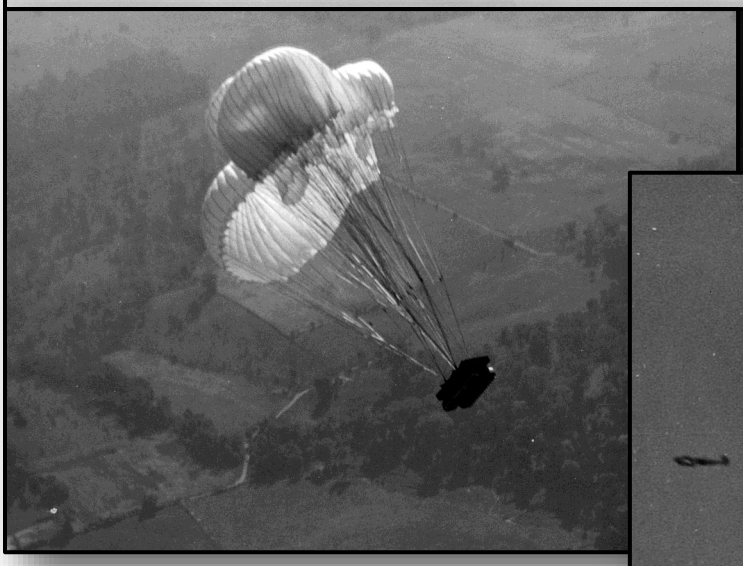


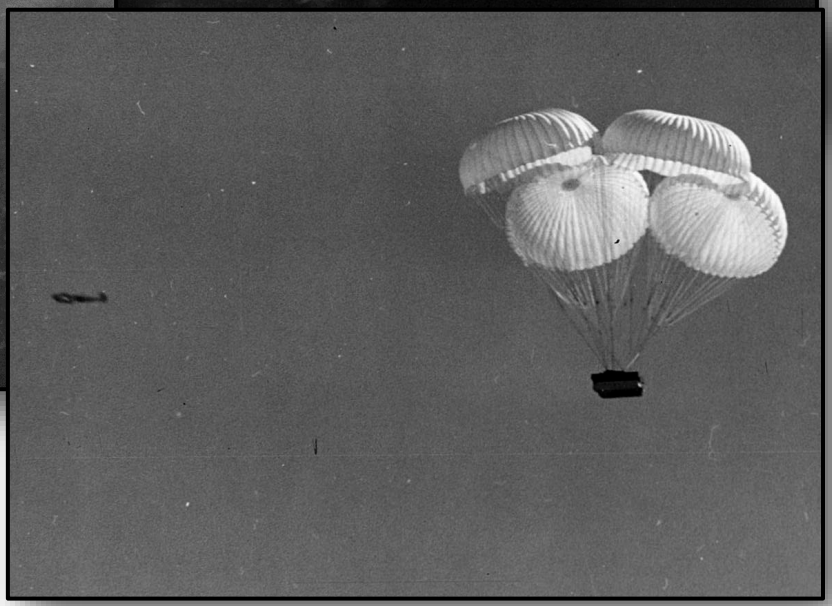
Parachute canopies for use with these containers were constructed of rayon and classified into “Aerial Delivery” and “Cargo” on the basis of size. The aerial delivery type for weights up to 300 pounds was 24 feet in diameter and the cargo types were 24, 28, 36, and 48 feet (see above). The large cargo types were to be used in dropping heavy munitions up to a weight of 3,000 pounds. One hundred and eight thousand rayon cargo and aerial delivery parachutes were procured in 1942, and this number was increased to 277,000 for the fiscal year 1943.

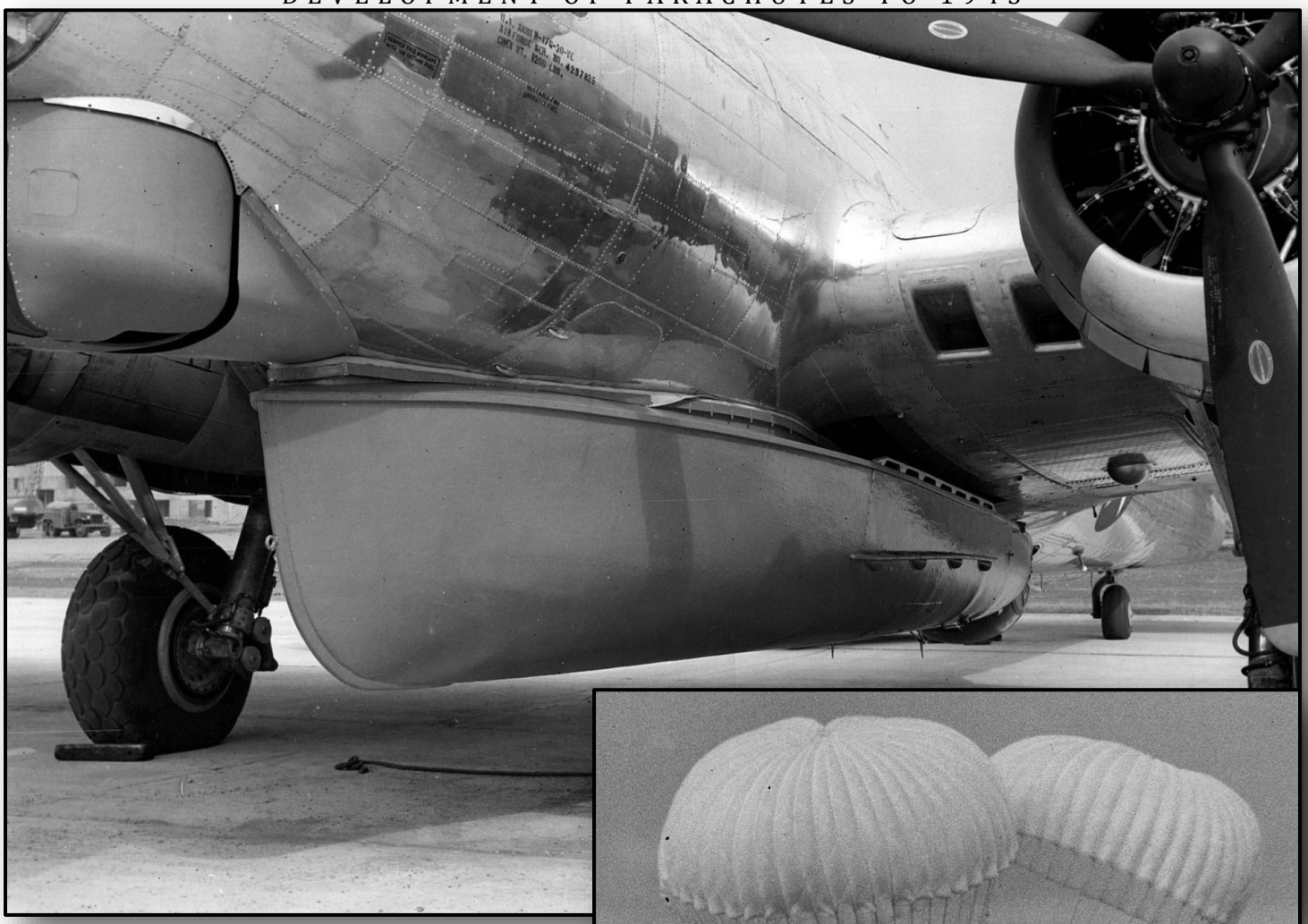
Acetate rayon fabrics were tested and accepted as substitute material for the construction of aerial delivery parachutes, and nylon was substituted for rayon in the larger cargo types, with the intent of reducing their excessive bulk. The high strength rayon fabrics used in 1942 weighed 8 ounces per square yard and the nylon, 3 to 4 ounces per square yard. A 48 foot cargo parachute of nylon cost $40 more than one constructed of rayon. The suspension of shroud lines of the larger cargo types were made of nylon tube webbing of 3,000 pounds tensile strength.

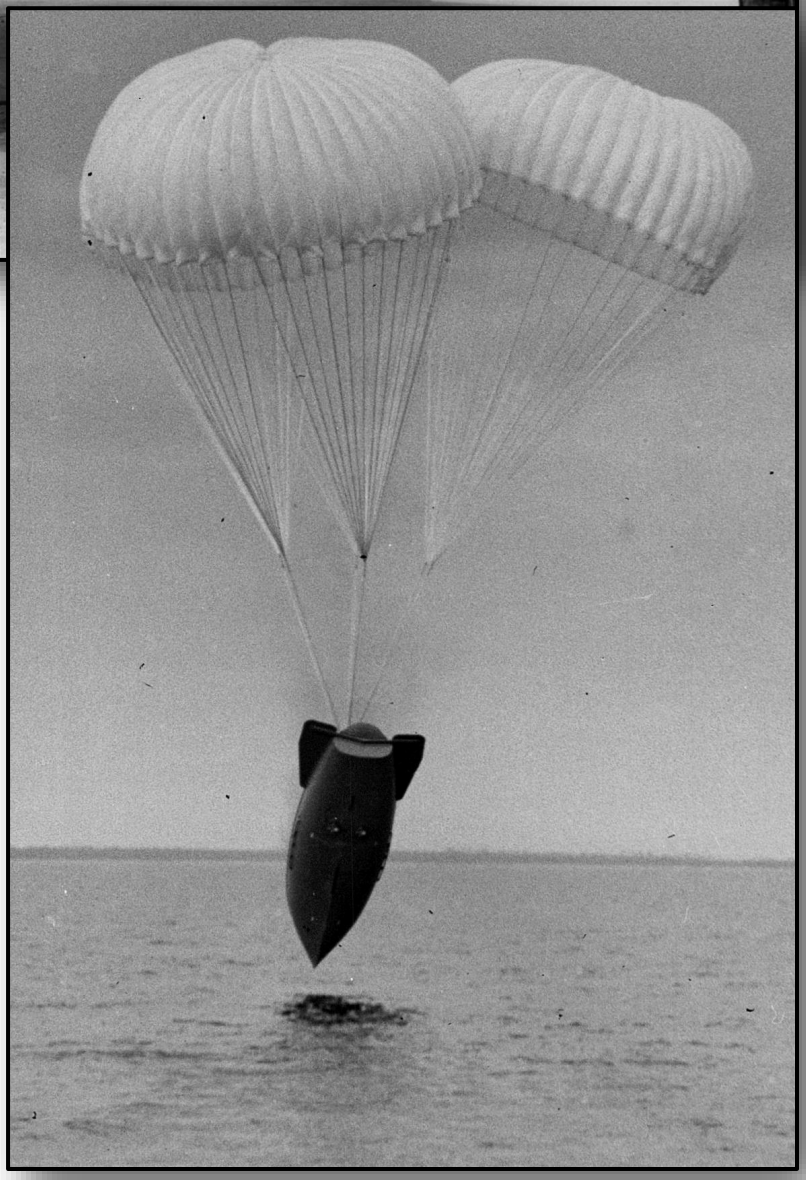

In order to handle heavy equipment and munitions in excess of 3,000 pounds, an ingenious arrangement of clustering parachutes was successfully tested and used. In the autumn of 1941 a cluster of three 22 foot parachutes were used in dropping a 75-mm pack howitzers.





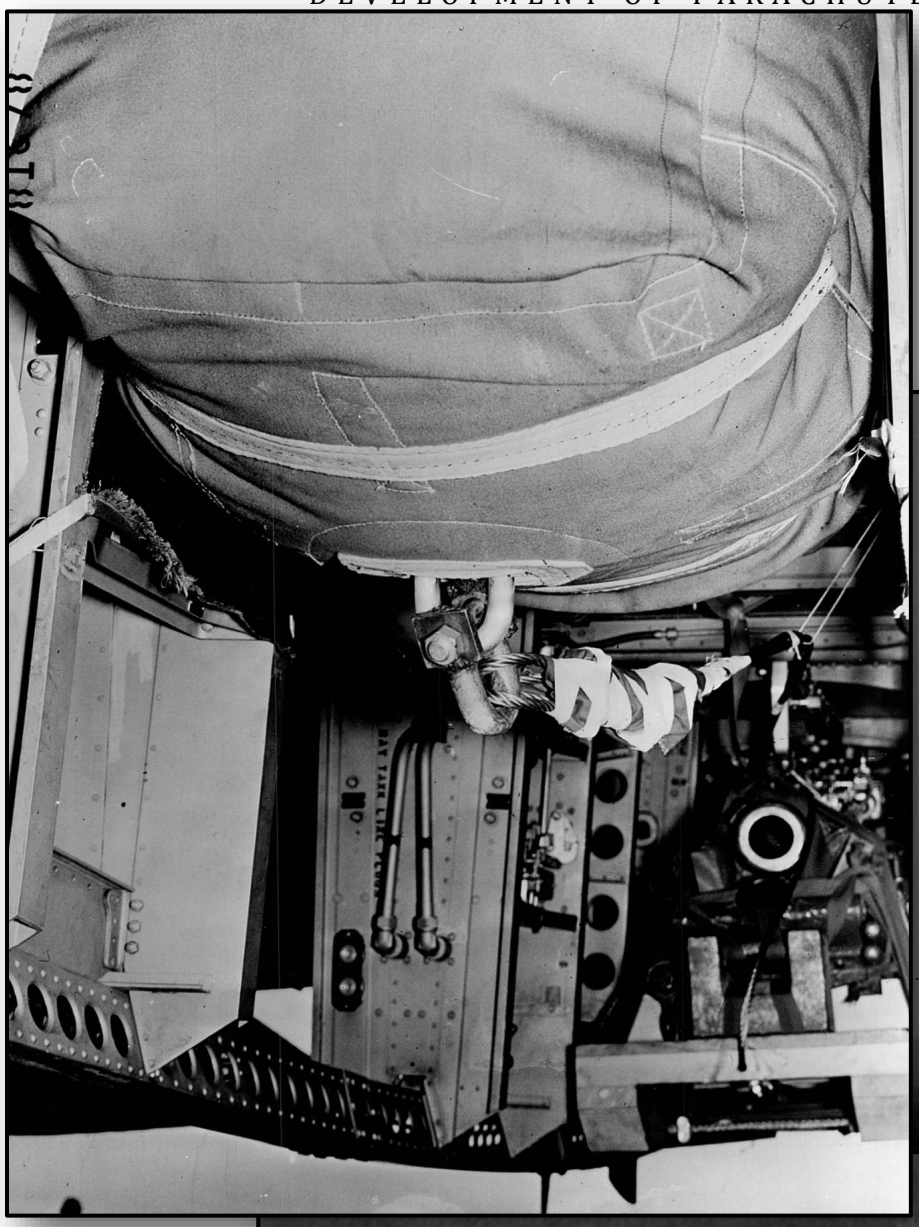




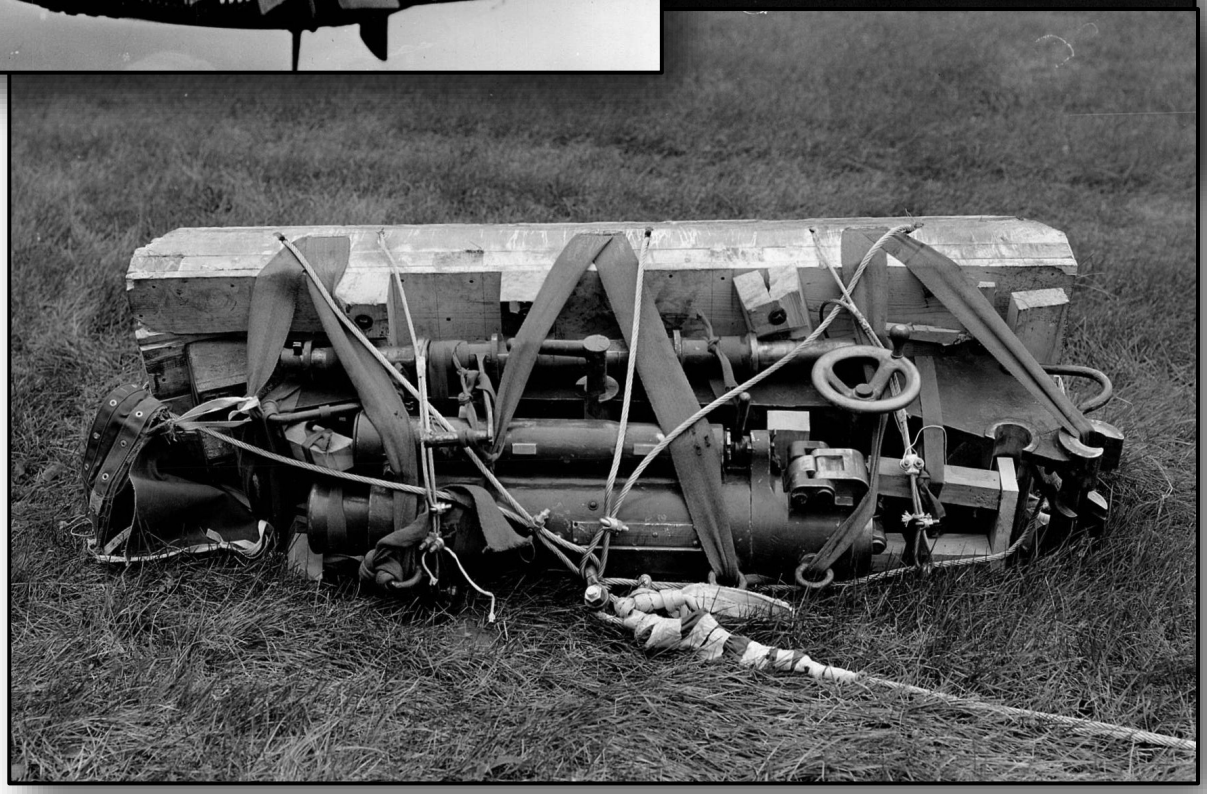


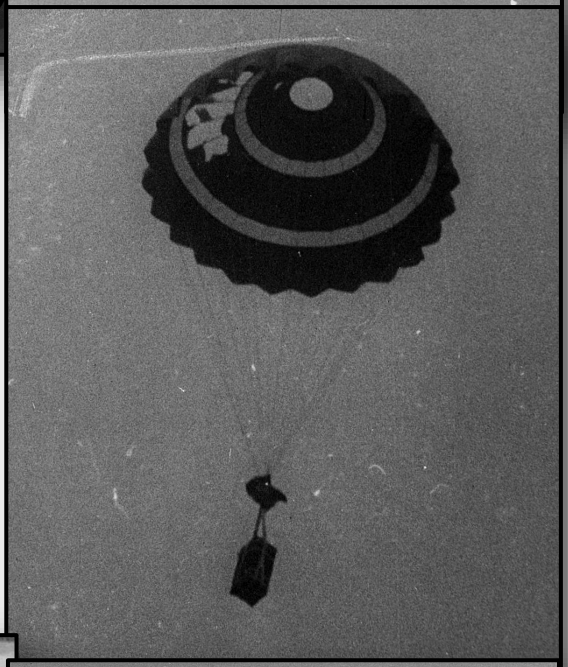
Tractor-like carriers, boats (sea rescue units), and radio transmitters were lowered by using four or more of the 48-foot parachutes.

Top: Life boat in place beneath B-17 bomber. Right: Parachute cluster used to lower life boat.



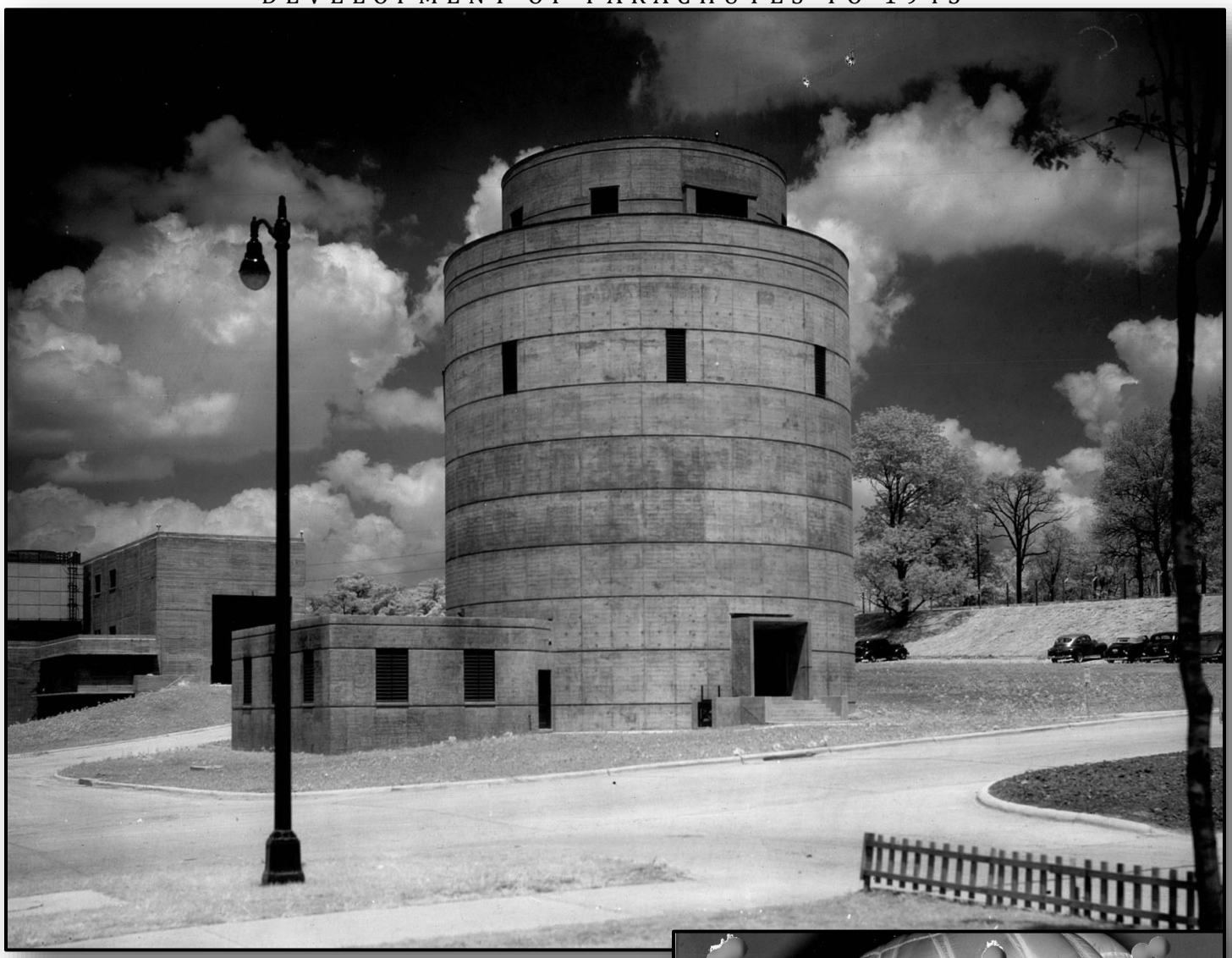
Left: Howitzer with 48-foot parachute in bomb-bay of airplane. Bottom middle: 48-foot cargo parachute with Howitzer. Bottom: Howitzer after drop by 48-foot cargo parachute.



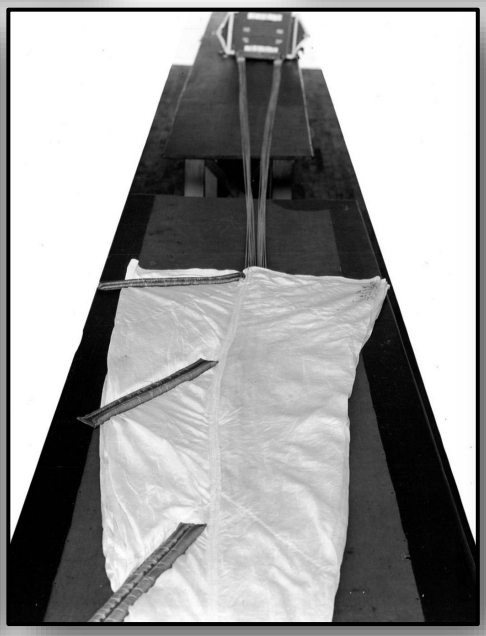


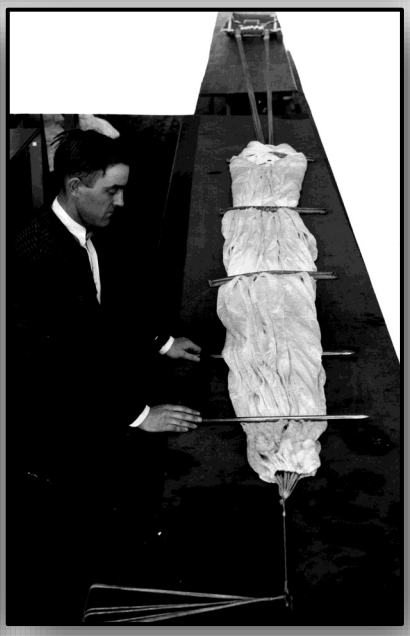
Cargo parachutes made of paper were tested in 1943 and 1944 but were found to be unsatisfactory due to their bulk and great relation to their strength and that if sufficient cotton tape were used for reinforcement, the cost would be approximately the same as for those made from fabrics (see photo right). Eight and twelve foot aerial delivery parachutes for the delivery of emergency sustenance kits were developed and standardized by the Parachute Branch. Tests were conducted with an 18-foot rayon aerial delivery type in response to an expressed need from the China-India-Burma theater for a parachute to handle loads sufficiently small (roughly 150 pounds) that they could be handled by one man (top right, bottom two photographs).

Above left is a parachute and “Gibson Girl” Radio Sending Set for life boats.



Top: Vertical Wind Tunnel at Wright Field . Bottom Left: Special parachute harness for St. Bernard Dog. Bottom Right: Parachute model being tested in Vertical Wind Tunnel.

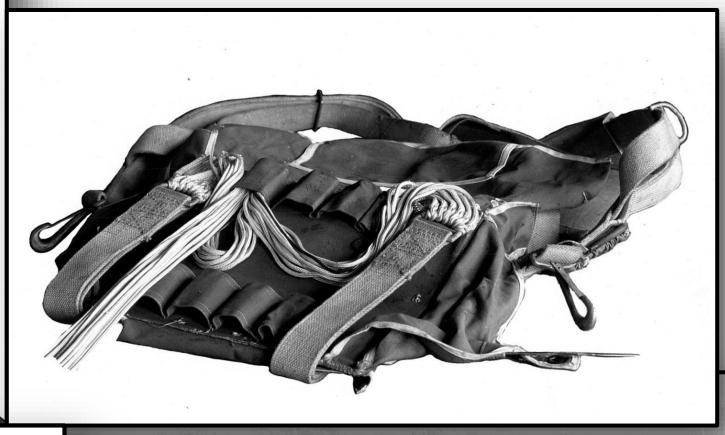



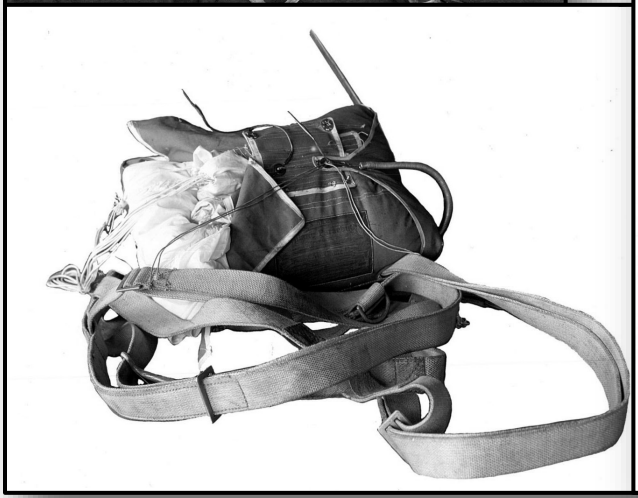


Various peacetime activities continued to profit materially from the multitude of experiments and tests in parachute design instigated for the purpose of military advancement. Parachutes available for private and commercial aviation, rescue work, forest fire fighting, and air mail pick up and delivery service for small communities continued to improve in the future as a result of these activities, as they have in the past.

This page: The major steps in folding a parachute canopy. Opposite page: Packing a canopy in cover.

**NOTE:** Text and captions utilize within this Look Back taken from the Air Technical Service Command study by Maj Charles M. Thomas, *Development of AAF Clothing And Other Personal Equipment Peculiar to Air Operations: Vol. III: Parachutes*, (22 May 1945).







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