

The Crossbow and the Bow in Modern Warfare

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Introduction

The crossbow was abandoned in Europe as a military weapon during the course of the 16th century and its place taken by the caliver and musket. It persisted, however, as a hunting weapon and in the form of a bow trap down to the last century. In the Low Countries and parts of France there has been a long tradition of target-shooting with the crossbow at both the popinjay and conventional marks. Many of the forms of target weapons which appeared in the 16th and 17th centuries have survived relatively unchanged and may be observed at the Kings shoots held periodically in Western Europe. At the event held at Peer (on the Holland-Belgium border) in 1979 the author observed old-style crossbows spanned by lever, others by windlass as well as modern crossbows drawn by hand (figure 1). The representatives of San Marino with their bench crossbows employed a cranequin unusual in the way it is applied to the stock. Instead of the more usual cord loop a pierced metal strap extending from the gear case is placed over a metal stud on the upper surface of the tiller.

Since the 1960s there has been a major revival of interest in the crossbow both in the United States, where it is a popular hunting weapon, and in Europe where there is increasing support for match-shooting on the 30 m range. Thus we can see that the crossbow has never been completely laid aside in Europe and its modern development has been given a new impetus in North America. It is in the Far East, amongst the tribes of India's north-east frontier and of Burma and Indo-China that this ancient arm has remained in continuous use for hunting and as an anti-personnel weapon. In China, where a crossbow with a sophisticated cast-bronze release mechanism was already in use in the Han dynasty, the repeating crossbow, a uniquely Chinese invention, lingers on in the remoter areas.¹ Here it is employed as a bird-scarer in the rice fields but it was still appearing in a more aggressive role during our great grandfather's day when they were observed in action during the China war of 1856–60. We have indisputable pictorial evidence in the photographs taken by Felice Angelo Beato after the surrender of the Taku forts in 1860.² The forts on the river Peiho guarded the approach to Tientsin (and ultimately Peking) and were reduced by



FIGURE 1 Flemish crossbow shooters at Peer, 1979.

Author's photograph

a joint assault by Anglo-French forces. Photographs record the devastation caused by the explosion of the magazine and clearly visible, lying on top of a wooden platform above the Haxo casement, is a repeating crossbow (figures 2 and 3).³ This weapon is able to discharge up to 10 or 12 arrows at a very rapid rate by the simple expedient of cranking a wooden handle up and down. The action draws back the string and cocks the bow which is released almost immediately when another arrow drops into place by gravity feed and is similarly expelled. To achieve a simple easy action the bow is inevitably rather weak and the arrows are propelled only a short distance. One can, however, well imagine the psychological effect of a swarm of arrows shot from close range at an advancing enemy from a row of such devices mounted on a parapet.

In the devising of silent weapons for clandestine warfare during the Second World War the European crossbow, with its pedigree stretching back to the early Middle Ages (and ultimately to the arcobalista of the Romans and gastraphetes (figure 4) of the ancient Greeks) as we shall see had little or no influence. In contrast the post 1939–45 war American development of target and hunting weapons, though using all the modern materials, fibre glass, duralumin, carbon fibre for bows and Dacron for strings, unmistakably draws its inspiration from the European heritage. Both the bow and crossbow were to make an unexpected contribution to the armoury of the Special Forces in Viet Nam.



FIGURE 2 The Taku forts, 1860; repeating crossbow on the battlements.

Felice Beato Courtesy of the Council of the National Army Museum, London

The two World Wars

There is a gap of some fifty years from the Chinese wars to the Great War but in the 18th century during the long and desperate siege of Gibraltar by the Spanish, 1779–83, the governor, Lord Heathfield (George Augustus Eliott, 1717–90), caused to be made a version of a Roman catapult, a torsion weapon. It was used to throw heavy stones over the edge of a precipice, so that they might fall on a ledge of rock occupied by the Spaniards⁴ (figure 5).

Two target crossbows in the Imperial War Museum, Lambeth, were captured by the British during the First World War. Both were target weapons of apparently Belgian origin (probably from the clubhouse of one of the many archery guilds) taken by the occupying German forces and pressed into service for trench combat. Indeed it was reported in Amsterdam, in neutral Holland, 24 December, 1914



FIGURE 3 Detail of crossbow in the Haxo casement; from another photograph of the Taku forts, 1860.

Courtesy of the Council of the National Army Museum, London

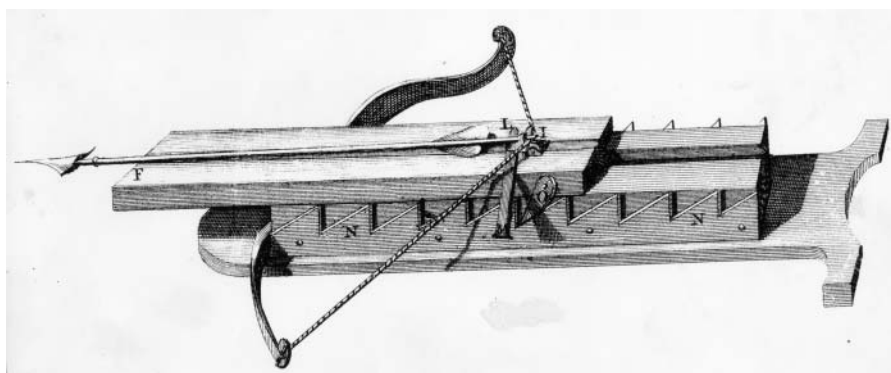


FIGURE 4 Greek gastraphetes, invented c. 399 BC.

‘According to our Sluis correspondent of the *Telegraaf*, bows and arrows have been commandeered in Belgium’. The Flemings have always been excellent archers, and Bruges still possesses its ancient Guild of St Sebastian, of which Charles II was a member during his exile on the Continent. His handwriting is still preserved in the Guild Book. In the frontier communes the archers have taken their bows and arrows to the Netherlands for safety.⁵ The older and more elaborate example is an 18th or possibly late 17th century weapon with hair trigger release (figure 6), described in official records as follows ‘Crossbow used by the Germans in the early days of trench

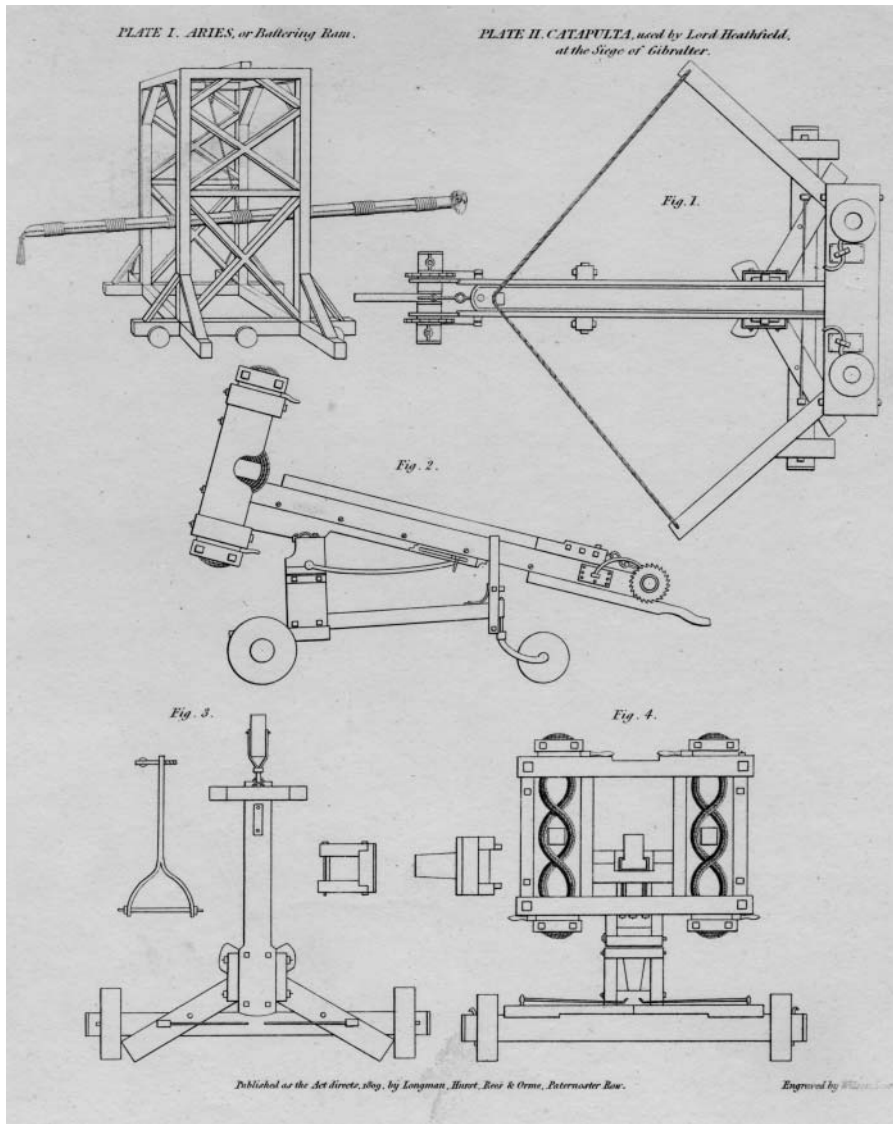


FIGURE 5 Lord Heathfield's catapult from the siege of Gibraltar, 1779–83.

From unidentified book

warfare to throw improvised percussion bombs to a greater distance than was possible by hand'. The bow was no doubt found in Belgium where archery was a fairly common pastime in peace time.⁶ The other crossbow, furnished with a gun stock, was taken 15 June 1915 during fighting at 'Hooge'; this is 'T Hoge, Poperinghe (figure 7).

At the outbreak of war there was a desperate shortage of trench mortars on both sides and the allies filled the gap with a variety of official and semi-official catapults (see below) and 'projectors' for bombs and grenades, but some of the French soldiery



FIGURE 6 Crossbow recovered from the trenches used by the Germans in 1914–18 war.
Imperial War Museum



FIGURE 7 Trench crossbow.
Imperial War Museum

pressed into service the crossbows which they had used before the war. A photograph shows a group of five ‘poilus’ each with a crossbow, some have stirrups to aid spanning others are clearly ‘balance bows’ with their long stocks which were aimed resting on the shoulder with the rear portion extending behind, terminating in a heavy pommel to counterbalance the steel bow.⁷

Clandestine and irregular warfare

As war seemed increasingly inevitable forward thinking individuals were outlining plans for irregular warfare and the concomitant weapons and equipment that might be needed. A report in 1938 by Maj. J. C. F. Holland, Royal Engineers was succeeded in the following year by the formation of MI (R) (Military Intelligence, Research) in the War Office. Maj. Laurence Grand, also of the Royal Engineers, seconded to the SIS produced a report entitled ‘Preliminary survey of possibilities of sabotage’ which resulted in the formation of a parallel organisation within SIS, known as Section IX or Section D.⁸ For a while the two units occupied a joint office in Caxton Street but at the outbreak of war Section D was transferred to Bletchley and MI (R) back to the War Office. Overcrowding at Bletchley Park as code-breaking activities expanded led to relocation at the Frythe (Station IX), a hotel near Welwyn in Hertfordshire and the experimental team to Aston Hall near Stevenage, Herts,

known as Station XII or Signals Development Branch, another cover name. By 1941 the research and development section had moved to the Frythe while production, packing and dispatch of stores remained at Station XII and the organisation became the chief supplier to the Special Operations Executive.⁹

Amongst the items being produced in large numbers by the middle of 1940 were time pencils, explosives and various incendiary devices, including 'incendiary arrows' which 'Resembled large safety matches about 18 in. long with a percussion fuze at the head. They weighed about 2½ oz and could be fired at a range of about 50 yards from a bow or a catapult, or dropped from aircraft'.¹⁰ The only indication as to where they found employment is a throwaway remark in a reminiscence by Lt. Cdr. A. J. G. Langley, the first commanding officer at Aston House, who arrived there from Bletchley in November 1939, 'No longer would our FRS¹¹ slip away early in the morning to supervise manufacture of the incendiary arrows we had devised and which were being used against the Italians in Abyssinia'.¹² These arrows do not appear in the *Descriptive catalogue of special devices and supplies* compiled in 1944.¹³

Lt. Col. L. J. C. Wood succeeded as commandant of Aston House and during his time Lt. Col. William Ewart Fairbairn and Capt. Eric Anthony Sykes (who gave their names to the Fairbairn-Sykes 'commando' knife) were instructing potential agents at Station XII, including 'the use of the knife, silent killing with sticks from four inches to six feet long; coshes, *longbows*, *crossbows*, catapults, garrotting etc.'. ¹⁴

Irregular warfare and the USA

Soon after the entry of the United States into the war, after the attack on Pearl Harbour in 1941, it became apparent there was a need for a specialist organisation for covert action against the enemy. The result was the formation of the OSS (Office of Strategic Services) headed by William J. Donovan. Its existence led quite naturally to the setting up of a research and development group to create weapons and devices suitable for sabotage and subversive warfare. Designated Division 19 (Department of Miscellaneous Weapons) of the National Defence Research Committee (NDRC) it came into being on the 9th April 1943 though it derived from the so-called Directors Committee which itself devolved from Division B-9-C formed in 1942.

Division 19 was largely created as a result of Donovan's special requirements though he maintained a small research and development branch directly within the OSS organisation headed by Stanley P. Lovell who was the OSS representative to the NDRC. The close links between Division 19 and the OSS are emphasized by the fact that their laboratory was set up near Washington in a wing of the Congressional Country Club which establishment had already been leased to the OSS for training purposes. The Maryland Research Laboratory (MRL), as it became known, also developed a broader liaison with the regular army and navy as well as with the Inter Services Research Bureau in Britain. The ISRB was in fact the cover name for the SOE which appeared on the plaque outside their headquarters at 64, Baker Street,

London. There was a two-way flow of personnel and information which had begun in the days of Division B-9-C and helped lay the foundation of American activities in this cloak-and-dagger activity. Contact also gave the British access to the manufacturing resources of the USA for the large scale production of such items as pencil time fuses.¹⁵

Against this background a predictable requirement placed before Division 19 was the creation of a silent, flashless, weapon suitable for the assassination of sentries up to a distance of about 50 yards. The result was a prototype pistol completed in March 1943 in which the propulsive power for an arrow-like missile was provided by a hollow helical spring. The pistol weighed just over 7 lb with an overall length of 14 in. and the spring generated a force of 3000 lb sufficient to eject a dart weighing 0.074 lb at 154 fps or one weighing .150 lb at 137 fps capable of penetrating a piece of ½ in. wood at 50 ft. It was abandoned because of serious recoil problems and the length of time, nearly 30 seconds, needed to rearm the weapon. Compressing the spring needed 27 turns of a winding handle which put the user in a vulnerable position between shots.¹⁶

Bows and arrows

Then it was suggested that bows and arrows might be the answer and Dr Paul E Klopsteg, a noted authority on archery as well as an experienced engineer was duly consulted.¹⁷ Klopsteg had graduated in physics at the University of Minnesota in 1916 and became a research and development engineer in army ordnance during the First World War. In 1921, he joined the Central Scientific Company of Chicago, Illinois, with responsibility for its research and development department, and eventually in 1930 became its president. The design of bows and the study of their ballistic problems was Klopsteg's recreational activity and with Dr Clarence Hickman¹⁸ he had analysed in detail their physical properties and behaviour; work which has made a significant contribution to modern bow design and manufacture.¹⁹ He was appointed in 1941 deputy chairman of the Division of Optical Instruments in the Special Services Department of the OSRD (Office of Scientific Research and Development), and two years later became a member of Division 19.²⁰

Klopsteg came to the conclusion that a conventional bow was unsuitable for use in covert missions: its overall size made it inconvenient to carry about; the archer was highly vulnerable at the moment when he stood up to draw the bow; and most serious of all a weapon of suitable strength required the user to be a well-trained and experienced archer to achieve the necessary accuracy.

It may be recorded here that Captain Jack Churchill of the Manchester regiment, and a member of the British team at the World Archery championship at Oslo in 1939, actually carried a bow on active service in France. The war diary of the 4th infantry Brigade tells us 'One of the reassuring sights of the embarkation was the sight of Captain Churchill passing down the beach with his bows and arrows!' Using a yew bow he created a certain amount of consternation on his section of the

Maginot Line and later, during the retreat to Dunkirk, 27 May 1940, he actually shot a German soldier from 30 yards with an arrow at the village of L'Épinette near Bethune. The arrow struck the man right through the chest and he and his four companions slumped to the ground as Churchill's two companions opened up with rapid fire' (figure 8) (See Appendix I).²¹

After the BEF retreat to Dunkirk the imminent threat of invasion from across the Channel led to the setting up of a network of 'Auxiliary Units', resistance groups intended as a guerrilla force to fight the Germans if they had succeeded in occupying Britain. Captain Peter Fleming (brother of Ian Fleming the author of the James Bond stories) was in charge of the Kent section, the first to be established: — 'Fleming had packed the big barn . . . from end to end and from floor to roof with explosives, ammunition and weapons — including half a dozen longbows for which he had indented through Auxiliary Units (cover name for the resistance organisation) supply channels. He hoped to teach his men to use the bows to hurl incendiary charges into German petrol dumps and to pick off sentries quietly. Fleming himself could kill a deer at a hundred yards with a bow and arrow, but his plan to train Resistance people to use such weapons never got very far'.²² A variety of accounts of the auxiliary units and their hideaways around the country exist and a good account of the East Yorkshire organisation is given by Williamson.²³



FIGURE 8 Hugh Soar, archery historian, with four of Jack Churchill's bows: l to r Yew backed yew, draw weight 48 lb; Self yew bow, 47 lb, no maker or draw weight inscribed; Self lancewood bow 40 lb; Self yew bow, 40 lb draw weight.

Though Fleming had anticipated silent means of sniping at any German who came in easy range his men never had the opportunity to engage the enemy 'but they did discover other uses for their bows and arrows — fitting the latter, for instance, with incendiary heads to set thatched roofs on fire, or strapping to them detonators and short lengths of safety fuse'. A missile thus equipped and shot over the heads of the outposts would cause a 'brisk and unexplained explosion' and a certain amount of confusion within enemy lines.²⁴ Though these were of course just night exercises.

Anders Lassen, a Dane recruited into the SAS in the 1939–45 war, was an enthusiastic exponent of the bow and arrow and persuaded the war office to supply him with two sets. During exercises in Scotland he managed to shoot everything from sparrows to stags but whether he ever employed his archery skills against the enemy is uncertain.²⁵

A friend described his 'ability to fire a bow so accurately on the run that he could drop a deer dead with one arrow from eighty metres'.²⁶ There was a considerable vogue for bow hunting in Denmark in the 1930s²⁷ but Lassen's interest in the bow as military weapon may have been inspired by reports from the Spanish Civil War of Carlist raiders 'all in black and armed with short black bows and arrows, [who] infiltrated Republican trenches on night raids and killed sentries silently on challenge'.²⁸

Another Dane, Thomas Sneum, working in occupied Denmark as an MI6 agent had planned to use a bow to assassinate Heinrich Himmler, Reichsführer of the SS, while visiting Copenhagen in 1941. He bought a take-apart steel longbow, no doubt a Seefab bow manufactured by See Fabriks Aktiebolag (Sandviken, Sweden) the firm which in the 1930s had developed bows made from flattened steel tubing, for target shooting,

'you could quickly assemble or fold away as you liked'.²⁹ It didn't take up too much room and I had used a long bow as a child to hunt birds and rabbits. But to draw back this bow required a force equivalent to lifting a twelve-stone man; and it weighed seventy-five pounds. The power it unleashed meant that the arrows, wooden with duck-feather flights, were lethal' [the biographer has clearly misunderstood Sneum's description; no doubt he was saying that the draw weight was 75lb and that he as a 12 stone man could handle this strength of bow].

The beauty of the longbow is that it can be a silent killer, and I felt confident that I could escape the scene before the Germans could pinpoint the source of the arrow. With luck, I would be able to carry out the perfect assassination. So I went into Copenhagen's Tivoli Gardens, and put targets up on trees. After a while, I could hit playing cards from 50 metres. Then I went back to Fanø and practised against moving targets. The seagulls gliding along had no chance against my steel longbow. I knew it would be a much harder challenge to hit a moving German while aiming downwards from an apartment window, but I believed that from fifty metres I could not only hit a man but strike whatever part of his body I was aiming for.

As part of my preparations, I even wrote '9 April 1940' — the day of the invasion — on my arrows.³⁰

As it turned out Himmler landed at Copenhagen airport 6 February 1941 but did not get off the plane before continuing onwards to Germany.

Allegedly, Accles and Pollock, precision tube makers of Birmingham, were approached to produce a bow for use by commandos and special forces but there is no record of any steel bows being issued for clandestine purposes. However, the company design engineer, Charles Bayliss, did work on a steel bow to 'incorporate optimum cast, steadiness, low vibration and durability' which came to fruition in 1946 when the Apollo series of bows was launched and soon became established among target archers.³¹ The material used was a high tensile chrome molybdenum steel, first developed in tubular form for use in aircraft.

In the realms of fiction, it is interesting to recall *Rogue Male* published in 1939 by Geoffrey Household. After a failed attempt to assassinate Hitler, with a rifle, the protagonist is cornered by his pursuers and he finally escapes by shooting his chief tormentor with a metal spit shot from an improvised torsion ballista using as the source of power the hide of his pet cat, killed by his enemies, cut into strips

The engine I now contrived was an extremely crude model of a hand-drawn ballista. — I made a square frame of which the uprights were two bricks and the horizontal bars two stout billets of ash fitting into roughly shaped grooves at the tops and bottoms of the bricks'. Parallel to the bricks and on the inner side of them I twisted two columns of rawhide. Through the centre of each column was driven a long peg, which projected three or four inches beyond the brick, A wide thong was attached to the tips of the two pegs as a bowstring joins the ends of a bow. The twisting and shrinkage of the strips of hide held the whole frame rigid and forced the pegs hard back against the bricks.

On the further side of the bricks and lashed to them by square lashings was a strip of wood from a packing-case, in the centre of which I cut a semi-circular aperture. The method of firing the ballista was to lie on my back with my feet on the outer edges of this wooden strip. The point of the spit passed through, and was supported by the aperture; the ring of the spit was gripped in the centre of the thong by the thumb and forefinger of the right hand.³²

Alf Webb an active member of the Society of Archer-Antiquaries in the 1970s and 1980s wrote a brief memoir which includes accounts of contact with the African Bushmen and a stint with the partisans in Yugoslavia. A radio specialist he is not explicit about his activities but says 'I may have killed a German or two when shooting the bow and arrow, but we always shot as a threesome, and thus any death would be down to one of the three of us'. As a youngster he had shot rabbits with a home-made bow, graduating to deer when the family moved to the neighbourhood of Epping Forest. Pheasant and partridges were shot with blunt arrows. A full size bow was difficult to hide so he 'experimented in making small crossbows, and eventually had a good working pistol crossbow that shot pellets'.³³

The power of elastic rubber

What was needed for good service efficiency was a compact weapon which could be held cocked and ready for shooting for an indeterminate length of time.

Experiments and calculations suggested that rubber might be a suitable means of propulsion for the arrow or dart. Preliminary work by Dr Klopsteg led to the demonstration of a device to Wing-Commander Bird, a British liaison officer, and Dr Chadwell (Chairman of the Directors Sub Committee and then Chief of Division 19) in October 1942 which led to a contract for the Central Scientific Company. British liaison officers were shown a model of the weapon, to be dubbed Little Joe (or Little Joe Penetrometer),³⁴ early in 1943, and in June 1943 Division 19 requested that 50 of them be fabricated, together with approximately one thousand darts.³⁵ The Donemayer Co. of Chicago and the Wilson Sporting Goods Co. were subcontractors to the Central Scientific Co. Dies were made and 27 units assembled, four of them sent to England at the request of Wing-Commander Bird, nine to MRL for the OSS and twelve to US Army Ordnance at the Aberdeen Proving Ground. Two were retained by Klopsteg for further development.

A contract was placed with the North Western University in March 1943 to develop a 'rifle' model and explore the possibilities of a mortar type capable of throwing a grenade or shell. Their work was partly indebted to a preliminary study by the Central Scientific Co. of Cleveland. The following year, North Western produced a series of fifteen laboratory models, four of which were considered suitable for evaluation; Little Joe Pedal 1, a pistol type crossbow; Big Joe 5 and Big Joe 6, rifle types; and E5 (Elmer 5) a mortar type.³⁶

The Engineering and Scientific Office was asked to find a subcontractor to produce these models and in February 1944 the New Products Co. of Benton Harbour, Michigan, was contracted for the manufacture of forty-two units of each type though the E5 was dropped because of poor performance. The others were delivered to North Western University in August 1944.

An example of the Central Scientific Co.'s Little Joe survives as part of the MoD Pattern Room collection now part of the National Firearms Centre, Leeds (inv. no.278/1), but formerly held at the Royal Ordnance Factory, Enfield, England (figure 9). The frame of heat-treated aluminium has two curved arms between which the two rubber propelling units, joined by a cord, are mounted under tension. Each unit is composed of forty or more rubber rings which are said to withstand 60 to 100 shots. A pin passes through each bunch of loops and rests in a slot at the end of the arm; the upper arm is hinged and is drawn back to cock the weapon, the user standing while placing the lower fixed arm on the ground, gripped between his feet. The pistol butt has wooden hand grips and the brass trigger can only be pulled when pressure is applied to the brass safety release catch at the back of the grip. The body of the pistol is 9 1/8 in. long and the span of the two arms, at rest, is 9 5/16 in. On the right-hand side of the body a serial number, R6728S2B, is cast into the metal and on the left is a brass back-sight (V-notch) at the rear which aligns with a hinged brass foresight. Overall weight is just over 2 lb measured on a spring balance. The birch wood arrows have three fletchings of natural feather, two trimmed close but the third a more prominent cock feather (figure 10). There are two types of feather profile, rounded and straight and the shafts are fitted with a four inch socketed steel head with leaf-shaped blade. A pair of small spring clips³⁷ on the butt of the arrow



FIGURE 9a Little Joe.
National Firearms Collection

(giving it an overall length of $9\frac{1}{4}$ in.) holds it firmly on the string even when the device is pointed downwards. Brunner records that the draw weight is 180lb propelling the arrow at 165 fps with a useful range up to thirty yards and a maximum range of 250 yards.³⁸

Preserved along with Little Joe are some of the accessories. Manila packets of spare rings bear the labels of the 'Central Scientific Company, Laboratory Supplies, Apparatus, Chemicals, New York, Boston, Chicago, Toronto, San Francisco. Trade mark CENCO, Reg. US Pat. Off'. Typed on the printed label is '100 extra rubber rings, 1 bail'.

Another packet is marked '2 extra strings, 2 extra hooks, 2 extra hook pins'. The rings, unstretched, are $1\frac{1}{16}$ in. diameter and made of square-section rubber, approx $1\frac{1}{16} \times 1\frac{1}{16}$ in. In addition there is a cardboard box containing seventeen aluminium and twenty-one wooden arrows and another box of wooden arrows packed in two batches (twenty-four and twenty-three) inserted between folds of corrugated cardboard.

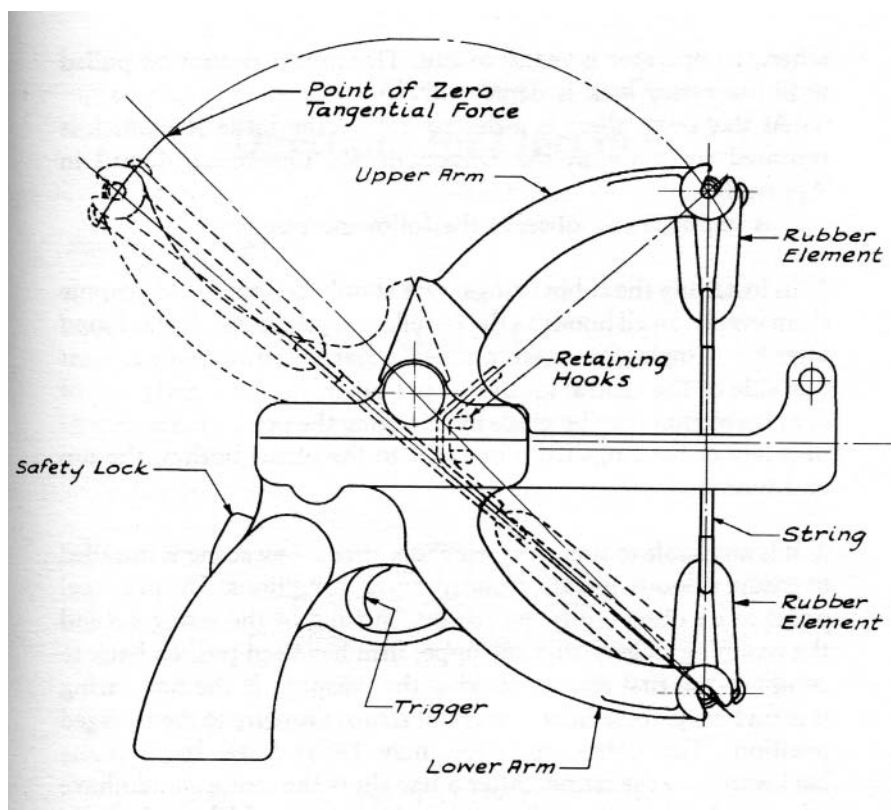


FIGURE 9b Diagram of Little Joe.



FIGURE 10 Birch wood arrows with natural feather fletching; note clips at the butt. Sample rubber rings below.

Private collection

Little Joe's accurate lethal range is said to be thirty yards with an extreme range of 250 yards. It was demonstrated to OSS personnel in Algiers, 27 January 1944, the reaction of those present being 'a loud snicker'. In September Leonard Sloma, an engineer with Northwestern University, took a variety of flashless weapons to

the Pacific area, 'nine assorted crossbows [i.e. the various elastic powered devices], a silenced Hi-Standard USA Model H-D pistol, a silenced M3 submachine gun, an experimental calibre .22 rifle and a spigot gun to Australia, to Goodenough Island and Finschafen in New Guinea, bases of the Sixth Army Headquarters and its Alamo Scouts, and then to fleet Headquarters in Hawaii'.³⁹ The pistol and sub-machine gun raised interest but not the crossbows. The Alamo Scouts who were employed in gathering intelligence in advance of amphibious landings wanted a weapon suitable for shooting game without attracting the attention of the enemy and as occasion required, for despatching sentries, requested shipment of 50 silenced machine guns. It has been reported that a B J 5 found its way into the hands of Carlson's raiders. In November 1943, earlier requests for 'crossbows' by Norwegian and Near Eastern agents had evaporated and the successful development of the Welrod pistol and silenced Sten gun meant that British interest had effectively ceased.

An enlarged version of Little Joe, the Little Joe 1½, scaled up by 50% with a collapsible rifle stock was abandoned because of mechanical problems and the power unit life was only five shots.⁴⁰

The Big Joe 5 and Big Joe 6 were designed as a 'rifle' equivalent of the pistol-sized Little Joe. They resemble a crossbow but, instead of a wooden or metal bow lath providing the propulsive power, the impetus to the missile comes from two bundles of rubber rings. Samples of the Big Joe devices and Little Joe Pedal 1, a pistol version and predecessor of William Tell, were sent to the Pacific theatre at the request of General MacArthur for field appraisal under the auspices of L.V. Sloane who had been associated with the North Western contract from the beginning. They were not well received and further requests were not forthcoming. Little Joe Pedal 1 designed by Northwestern University, weighing 3.1 lb, was cocked by a pedal action. The distal end of the stock was placed on the ground and the foot was applied to the crossbar which was pushed downwards until the elastic was engaged. When not in use the crossbar could be turned to lie against the side of the stock. A Little Joe Pedal 2, 12 in × 8 in × 5.5 in, open, and 15 in × 5.5 in. × 2.5 in., folded, had a pull of 170 lb and similar characteristics to the CSCs Little Joe but was much easier to cock. It shot a 10 in. and 0.8 oz aluminium dart at 170 fps up to 30 yards with accuracy.

A new contract for modified and improved versions of the BJ 5 and BJ 6 were placed by Division 19 with the New Products Co. in March 1944. The result was the William Tell model, a smaller and more compact version of Big Joe, which was distributed to a number of interested parties after a demonstration of all types of silent weapons to service personnel by MRL. In November 1944 one was sent to India as a result of a request by Col. A. Whiteside of the British General Staff and another to the Aberdeen Proving Ground for US Army Ordnance evaluation. The following year a sample was sent to ISRB in England at the request of Prof. Newitt⁴¹ and another to Dr C. E. Waring OSRD liaison officer with the (US) Airborne Command in the European theatre.

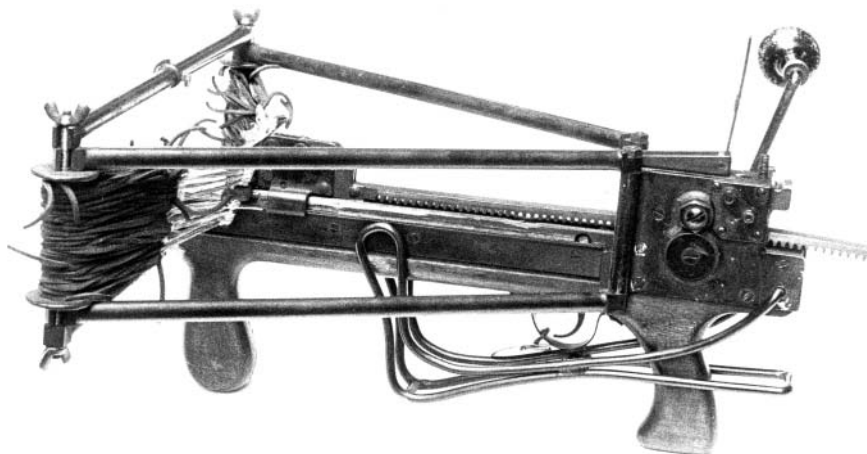


FIGURE 11 Big Joe 5.
National Firearms Collection

An example of Big Joe 5 forms part of the MoD Pattern Room collection formerly at Enfield, England, a copy of the operating and maintenance instructions is still kept on file (figure 11) and another BJ5 is in the Geoffrey P. Jenkinson collection of crossbows. Weighing about 9 lb the stock is plywood (the laminations vertical) stock $16\frac{1}{2}$ in. long with a folding skeleton butt. A rectangular metal plate held by a wing nut (furnished with a turning lever) holds the top bar of the butt securely in the extended position when the overall length is $25\frac{3}{4}$ in. There is a pistol grip and trigger release and a grip underneath the fore-end of the stock. On the right is a winder with a detachable lever. This enables the claw to be wound forward to pick up the cord connecting the two bunches of rubber rings and then wound back to engage the detent. Forward or backward movement is decided by a lever on the left; in the down position the ratchet bow advances and in the up position the weapon can be tensioned. The frame of steel tubing is 16 in across the front (upper and lower) and the other two sides of the triangle are each $14\frac{1}{4}$ in (upper and lower) while the overall height from top of upper to bottom of the lower frame is 5 in. The uprights of the frame pass through the rubber rings and are connected by strings to two short metal pillars which pass through the eyes at either end of a short ($2\frac{7}{8}$ in), horizontal bridging piece. The aluminium arrows $13\frac{7}{8}$ in. long with convex nocks weigh 1.5 oz and are made of lengths of aluminium tubing fitted with a steel leaf-shaped point. Two aluminium flights are set at a slight angle to the axis of the shaft to encourage a rotary movement in flight. There is a narrow folding rear sight on top of the metal body, with a sliding crosspiece to adjust elevation; the front sight is a small extension from a metal collar fitted to the centre of the upper horizontal component of the frame (figure 12).

The rubber pull is estimated at 550 lb which can throw a heavier incendiary dart (called a flare) at a velocity of 140 fps. An example of this variety of missile was

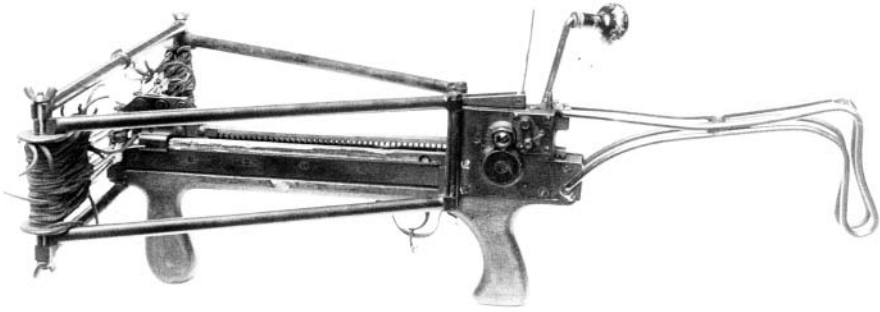


FIGURE 12 Big Joe 5, skeleton butt extended.

recovered from the Frythe when the war ended. Made of aluminium it is 17 in. long and 4.9 oz it could be shot up to 200 yards at 140 fps; the rear portion, provided with two vanes, is detachable from the expanded forward section which is designed to contain a special incendiary mixture prepared by Brocks the English manufacturers of fireworks. Immediately behind the dart-like point, $1\frac{1}{16}$ in. long, are four small radiating arms each about 1 in. long.⁴² An almost identical example of American manufacture is preserved in the Clandestine Forces Museum, Utah (figure 13). An example of Big Joe 6 is illustrated by Brunner; it is smaller and lighter than BJ 5 and with a similar folding butt is more easily concealed about the person. Instead of the triangular frame of its big brother the elastic loops and the string are set across a



FIGURE 13 'Flare' and aluminium arrows for Big Joe and William Tell. Wooden arrow for Little Joe, below.

Clandestine Forces Museum, Utah

simple horizontal frame or spreader. It weighed 5.8 lb and had a 300 lb pull, projecting the aluminium arrow to a useful range of 200 yards at 200 fps.⁴³ A smaller aluminium arrow, $9\frac{7}{8}$ in with a head tapering to a point, evidently belongs to one of the smaller weapons in the Big Joe series, probably William Tell (figure 13, third from top).

The William Tell was like a Little Joe Pedal 2 but with a folding stock. Weighing only 3.3 lb with a draw weight of 165 lb, it measured 25 in \times 8.5 in \times 6.5 in open and 16.5 in \times 8.5 in \times 6.5 in folded and shot an aluminium dart of 0.8 oz at 186 fps.⁴⁴ It came through vigorous trials at MRL in January and February 1945 with the co-operation of the OSS but the war ended before production could be started. Figure 14 shows an SOE operative test-shooting William Tell.

Joe Louis (or Elmer 5) named after the American heavyweight boxer was a collapsible rubber-powered weapon for throwing grenades and mortar bombs, available in 1944 but no one wanted it.⁴⁵ A table summarising performance of some of the Penetrometer series is reproduced from the North Western University's final report. The last column refers to a .22 Smith and Wesson pistol with 6 in. barrel for comparison (see Appendix III).

A conscious or unconscious inspiration behind the Big Joe series may well have been the elastic powered trench catapults developed by the British, French and Germans at the beginning of the 1914–18 war when there was a dearth of trench mortars.⁴⁶ Remove the front crossbars of the Big Joe and you have the characteristic Y-shape of every schoolboy's favourite weapon. The Leach catapult patented in 1915⁴⁷ has all the basic features of the OSS weapon except that it has a steel wire instead of a rigid metal arm to draw back the string; of course it is rather larger, some



FIGURE 14 SOE operative testing William Tell.

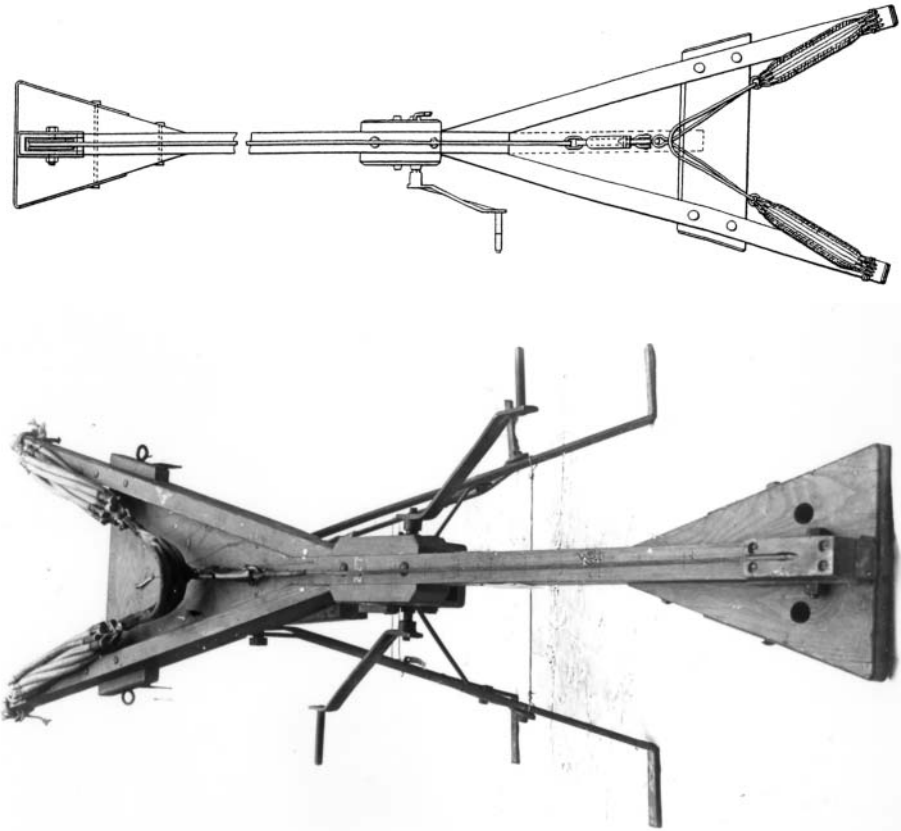


FIGURE 15 Leach trench catapult Imperial War Museum.

6–7 ft long (figure 15). There is a winder on the right hand side and a pawl on the left side locked the winding gears. Another catapult, which never entered service, invented by R. Glascodine replaced the wooden frame of the Leach design with a triangular one of tubular steel⁴⁸ (figure 16).

There were a number of drawbacks with these weapons the chief one being the nature of the propellant. Spare rubbers were packed in tins protected with Glydag, a glycerine/graphite mixture, and the adverse effects of deployment in a hot humid climate would not have been a problem, indeed rubber power is successfully employed in spearguns for use under water. It would, however, have been difficult in any theatre to ensure resupply under service conditions.

In retrospect it is easy to criticise the waste of time and effort on the ultimately abortive programme. Had members of the research team been equipped with knowledge of the performance and design of some of the varieties of antique crossbow, and the effectiveness of steel bow laths of relatively short span, the idea of a rubber-powered instrument must surely have been abandoned at an early stage. As it was this unique family of weapons evolved within the rarefied atmosphere of a research laboratory devoted to a strictly scientific approach to the solution of the problem

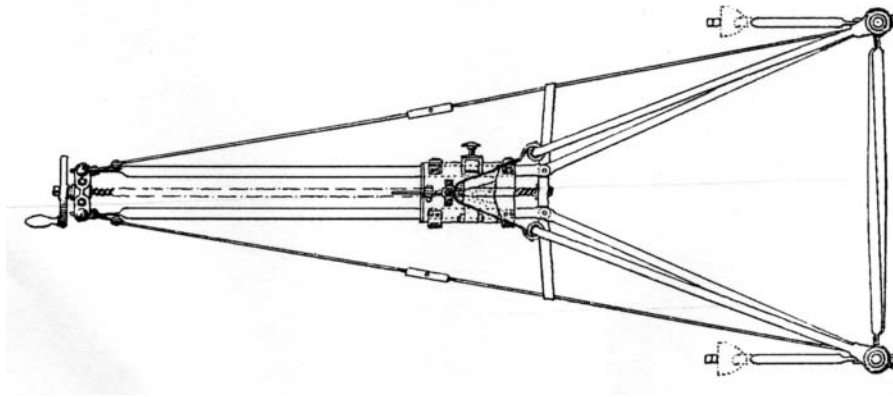


FIGURE 16 Glascodine trench catapult; plan view.

of devising a silent weapon based on mathematical calculations and theoretical physics. This led to the production of peculiar hybrids, partaking of the characteristics of the catapult as much as the bow or crossbow, when an evaluation and development of traditional forms with steel bow laths might have led to a more useful result. Across the world, whether in locations with engineering/garage facilities or in remote and 'backward' regions it would surely have been easier to undertake repairs or retemper steel bows than expect a resupply of 'rubber bands'.

A simple built-in spanning lever was a feature of the stone bow or bullet crossbow from the 17th century and a hinged front found in some weapons enabled the bow lath to be removed and easily replaced, without the need for removing the string.⁴⁹ The *ballestrina*, small enough to be secreted in a pocket or under ones clothing has been the subject of close study in recent years by the late W. E. Flewett and Douglas Elmy.⁵⁰ Payne-Gallwey tested a variety of crossbows he had reconstructed or restrung and tells us

The longest flight I obtained from one of the best and strongest of these weapons, one that was originally carried by a cross-bowman in battle, was 399 yards with a bolt of $2\frac{1}{2}$ oz in weight, and the shortest flight from the same bow, 380 yards'. The weight of this crossbow, without its windlass, was $15\frac{1}{2}$ lb. Its steel bow was 2 ft $7\frac{1}{2}$ in long and at its centre $1\frac{3}{4}$ in wide and $\frac{3}{4}$ in thick. The former distance, in my opinion, is considerably further than any longbow archer of mediaeval times could drive the arrow of warfare. — The crossbows for killing deer were somewhat lighter and less powerful than those intended for war, their bolts being, of course, also smaller. I find these sporting crossbows send their bolts at farthest 350 yards, their average length of flight being from 330 to 340 yards. The point-blank, so-called, range of a good sporting crossbow with a steel bow was from 50 to 60 yards, which was no doubt a sufficient one in the days before animals became wary owing to the report of hand-guns, and when deer could be laid in wait for by the hunter with his noiseless cross-bow as they wandered across the glades of a forest or visited their feeding and drinking haunts. The extreme range of the smaller sporting cross-bow, that shot a light poisoned [in Europe only 17th century Spanish sources refer to the use of poison] bolt, was from 270–280 yards.⁵¹

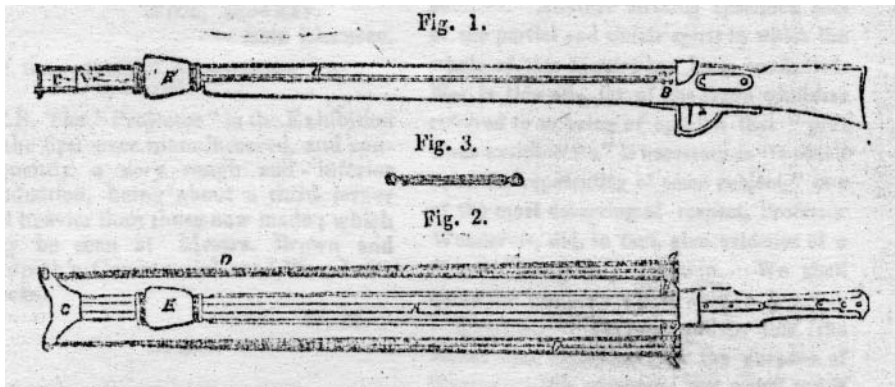


FIGURE 17 Hodges 'elastic gun'.

A 'crossbow gun' powered by elastic had been patented in 1929 by E. G. Sperry though whether Klopsteg and his team were aware of the fact is not known.⁵² This weapon had a wooden gunstock with a short crossbar fitted at the forward end of the slotted barrel. Lengths of rubber fastened to each end of the bar were connected with a short leather strap which was drawn, by hand, down to the trigger release. A simple lever pushed the 'string' out of a resting groove releasing the tensed elastic so as to eject the arrow.

Indeed 'elastic guns' have a pedigree going back to the middle of the last century, when there was a tremendous interest in the application of the unique properties of India-rubber to things other than the waterproofing of garments as perfected by Mr Mackintosh. In 1849, Richard Edward Hodges registered a patent for 'Obtaining Mechanical Purchases by means of Resilient Forces of Caoutchouc, and Application of such Force to Projectiles' (figure 17).⁵³ A number of these elastic guns still survive in public and private collections and are of two main types. Both have a gunstock but one has a divided barrel and the elastic providing the means of propulsion is attached to small lugs at the muzzle-end; the other lacks a barrel and is provided with a 'fore-spreader' giving it a crossbow-like appearance. In the same year, John Shaw, a musical instrument-maker from Derbyshire, designed an airgun in which the release of stretched elastic acts on a piston to cause a rapid compression of air.⁵⁴ A prototype was exhibited at the Crystal Palace exhibition in 1851.⁵⁵ In 1853 M.P. Phillips patented a gun in which strips of vulcanised rubber acting within a tube were linked with a 'traveller' in an adjoining tube or barrel. Pressure on the trigger released the pent-up force of the elastic and the 'traveller' acted against the missile. It was envisaged that the two barrels could be mounted 'over and under', 'side-by-side', or even one within the other.⁵⁶

It is interesting to note that a group of German prisoners-of-war held at a camp in Western Canada made a remarkably impressive crossbow improvised from the materials at hand, namely bedsprings, woven bed wire, steam-pipe strapping and wood from barrack furniture. Whether it was intended for shooting the guards or throwing an escape line is not certain because the weapon was discovered in April



FIGURE 18 Home Guard demonstrating a large elastic catapult.

1945 before it could be used. Tests have demonstrated that the arrow, a plain metal rod without fletchings, penetrates an inch into pine planking when shot from a distance of twenty-five yards. The two limbs of the bow are attached to helical springs, providing the propulsive power, fixed at their opposite ends to a short crossbar set in advance of the bow.⁵⁷

All sorts of improvised weapons were created by inventive members of the Home Guard (figure 18). A Sussex unit made a wooden crossbow, designed to shoot a grenade fifty yards, which was proudly demonstrated to the Under Secretary of State for War during a tour of inspection.⁵⁸ Men of the London, Midland and Scottish Railway constructed 'An enormous catapult, capable of hurling a four gallon petrol tin for a short distance'.⁵⁹ Another intrepid group at the 'Bank of England produced from the works where its notes were printed, a modern version of the Roman ballista'. At the height of its powers this apparatus was able to throw a Molotov cocktail a hundred yards; it was called 'Larwood' after the Nottinghamshire fast bowler.⁶⁰

Whether it really was a torsion weapon like the Roman ballista and the fictional weapon described by Geoffrey Household cannot be ascertained.

Uziel Gal (1923–2002), inventor of the Uzi sub machine gun, at the age of 15 and living on a kibbutz is said to have made 'a makeshift automatic gun which fired arrows'.⁶¹

A crossbow in New Guinea

The long and difficult jungle campaign against the occupying Japanese by ANGAU⁶² Australian forces working with the native peoples of New Guinea, also led to the design of a crossbow. This weapon was not dreamed up in a research establishment but devised by two serving soldiers, Sergeant J. Wright and Corporal L. J. Campbell both of Ryde, New South Wales. Described as the Arrowspeed crossbow-gun it was given trials in New Guinea in February 1943.⁶³ Intended for use by raiding parties in the jungle it was provided with both 'killing arrows' and shafts with explosive

heads. No precise details of measurements are available to me but an excellent series of photographs preserved at the Australian War Memorial, Canberra, give a clear picture of its form and method of operation. The steel bow is bolted to the fore-end of the metal stock and the string is drawn by means of a ratchet mechanism. Two linked arms project one on either side of the stock each with a hinged pawl. The arms, each provided with a wooden hand grip, are slid forward carrying with them pick-up hook to take hold of the string. The hook moves along a slot which also serves as an arrow groove once the bow has been drawn. Each arm is worked alternately, the pawls engaging a series of teeth on either side of the stock, until the string is brought back to the resting position. Figure 19a shows Corporal Campbell, in a



FIGURE 19 Arrowspeed crossbow gun a. spanning b. shooting an incendiary arrow c. and d. Arrowspeed being tested.

Australian War Memorial, Canberra; picture nos 134477, 134482, 134480, and 134481

very medieval stance, one foot firmly on each limb of the bow with the string drawn about halfway. The draw length is considerable and figure 19b shows the crossbow being aimed with a phosphorus or High Explosive (HE) arrow resting in the arrow groove, the rounded warhead several inches clear of the bow lath. Note that the ratchet handles remain in the extended position and do not fold down before shooting. The gun butt appears to be made of wood and release is by means of a trigger set within a large trigger guard which accommodates the whole hand not just a couple of fingers. The 'string' is in fact a multi-stranded wire, the ends fastened to small eyebolts each of which is coupled to a fixture riveted to the tips of the bow. A hand grip, with a wooden handle, is permanently fastened beneath the forward end of the stock angled back at roughly 45°.

Note also the struts on either side of the grip which are braced against the belly of the bow lath. A brief description of the bow published soon after the war tells us that the draw weight was 380 lb and the bow had a breaking strength of 25 tons.⁶⁴ Using a 25 mm high explosive arrow a range of 175–200 yards could be achieved and in a test the missile broke into 96 fragments on impact, with a fragmentation range of 35 yards. The simple anti-personnel arrow could be shot over one thousand yards.

Incendiary arrows, depending on size, carried between 400 and 800 yards. The anonymous author illustrates six different arrows, two of incendiary type (narrower than the phosphorus and HE types), also a white phosphorus warhead, 22 mm and 25 mm HE arrows, and an anti-personnel arrow. The photograph is not very clear but the latter appears to have a small leaf-shaped head. The author tells us that one of these 'fired (*sic*) at fairly close range, will pierce 19-gauge bullet-proof steel where a .38 or .45 calibre bullet will mushroom and not penetrate!' All the arrows are furnished with three vanes, broad with a rounded profile, apparently of natural feathers (figures 19c and 19d). As well as being used as offensive weapons directly against the Japanese these crossbows were also employed for pot-hunting, to procure food silently without the risk of disclosing the position of troops as a rifle shot might have done. No operational reports are available and it is not known how many were constructed and issued for trial or active service, but it is claimed that soldiers who used the crossbow 'over a period of time became especially adept in the rapid cocking and firing of the weapon'.⁶⁵ No example is known to survive but this powerful weapon with a steel bow is recognisably in the European tradition of crossbow making but with a unique spanning mechanism which could be regarded as analogous to a deconstructed cranequin fixed to the stock. Though no doubt spanning the bow was a relatively slow process it gave the user the benefit of the power of a heavy steel bow and an arming mechanism that was integral and could not be lost or separated from the weapon.

In the post-war period the Swedish army experimented with the use of the crossbow but abandoned the idea.⁶⁶ In the 1980s the French Foreign Legion included the use of a crossbow equipped with a telescopic sight as part of its training at the Mont Louis Commando School.⁶⁷

Vietnam

Neither the Korean war nor a variety of insurrections, such as the Mau Mau rebellion in Kenya,⁶⁸ and the actions of the Communist guerillas in Malaya add anything to the story of the crossbow. Kenya does, however, provide a striking example of the efficacy of the simple handbow when Kiprotich arap Ndotich, a 'forest guard', fought off a Mau Mau gang killing one instantly and severely wounding another. For this he received a British Empire Medal (Civil Division) which must be unique among British medals in having been awarded for an act of bravery while employing a bow.⁶⁹ In the recent ethnic conflicts in Kenya following the disputed elections of December 2007 the bow has been very much in evidence, along with clubs and machetes. Some of the fiercest encounters have taken place in the Rift Valley and members of the Kisil tribe were photographed armed with bows after a raid by their Kalenjin neighbours.⁷⁰

The special circumstances of the war in Vietnam presented the unlikely spectacle of two opposing forces both using the crossbow, GIs using the latest designs from the USA and the Viet Cong the primitive weapon of the Montagnards.⁷¹ The effectiveness of the guerilla tactics of the Vietnamese resulting from the dense jungle conditions, which favoured the activity of small but deadly groups working covertly, caused the Americans to counter-attack in a similar fashion. All clandestine forces require weapons which perform well at short range and can deal a stunning or fatal blow with the minimum of noise. Guns can be fitted with a variety of silencers which though effective in reducing the sound of the bullet being fired, do not eliminate muzzle flash. The obvious alternatives to firearms are the bow and crossbow. The Viet Cong knew of the latter from its use by the Montagnard tribesmen of the Central Highlands and this silent weapon was a useful addition to their armoury. Easy to maintain or replace, with all the raw materials readily available growing wild and in abundance it was preferable to more sophisticated devices for which spares would be obtainable only from a depot remote from the scene of action.

The US forces had a vast range of weaponry at their disposal but initially most of this was designed for normal tactical use in skirmishes or open battle. As they gained experience in counter-insurgency techniques and the use of commando troops capable of operating deep into hostile territory, their attention was turned to the need for weapons appropriate to these special conditions. For the British in their fight against the Communist insurgents in Malaya . . . 'SLRs [self-loading rifles] and shotguns were the most favoured weapons, the ideal being something which would have adequate killing power over a short distance and would not be caught up in the tangled vegetation. Visibility was rarely more than 25 yards, and concealment was no problem at all'.⁷² It is interesting to note that shotguns were supplied to the Nakanai tribesmen in New Britain for guerrilla warfare against the Japanese.⁷³

In Vietnam adoption of new arms and techniques seems to have depended to a very large extent on the initiative of individual team leaders, and seems to have lacked the support of government-sponsored research and development teams which were available to covert forces during the Second World War. The crossbow did, however, receive official scrutiny in the USA in 1962–3 by the army's limited warfare

laboratory but was rejected as not having sufficient potential for development as a military arm.⁷⁴

The 19th Special Forces Group (Utah National Guard) under the command of Col. Jack M Mennoch trained in the use of *handbows*, and this is referred to in an undated cutting from the *Popular Mechanics* magazine

Utah's National Guard is issuing bows and arrows to its armed forces. Maj. Gen. Maxwell E Rich, Utah Adjutant General, says-space age to the contrary- that 'unconventional warfare demands unconventional weapons'. He explains that archery-trained units could be dropped behind enemy lines to organize guerrilla fighters. Best weapon for the job, he says, would be the medieval, but silent, arrow which has an effective range of 300 yards.

These were of the type legally in use in Utah for hunting and with a draw weight of 50 to 60 lb. Practice was against both conventional marks and instinctive shooting at pop-up targets at unknown distances. One of the men improvised an explosive head by filling a paint tube with 2 oz of plastic explosive and inserting a demolition primer. Two large caps, as used in a toy cap pistol, were placed on top of the latter and the end of the arrow shaft inserted. Impact caused the cap to set off the primer and thus explode the charge.⁷⁵

Sometime in 1966 a colonel in the US Army, also thinking that the handbow was a weapon he could use for undercover work, wrote to the makers of Bear bows for their advice. They were convinced that the crossbow would be more fitted to military needs and put him in touch with David Benedict, an ex-marine and crossbow-maker in California. He forwarded one of his standard models the Black Knight with a 70 lb fibreglass bow, at the same time promising to design something more suitable for combat purposes.⁷⁶ Benedict reckoned that with minimum instruction a soldier ought to be able to put six arrows into a 6 in. diameter target at 40 yards and with a little practice precision at 100 yards should be obtainable. A military crossbow should be lighter and smaller than a normal target or hunting weapon so as to allow easy portage and manipulation in bush and jungle conditions. In addition he considered that the components ought to be entirely of fibreglass, aluminium and stainless steel so as to resist the deleterious effects of a tropical climate. After trials with the Black Knight the prototype, still having a 70 lb bow, with a phosphorescent foresight for shooting in the dark, was despatched and tested in safety outside the combat area. The Colonel concluded that a bow with a stronger pull than 70 lb was necessary and that it would be desirable to use a heavier arrow which could more easily penetrate the foliage without either its momentum being seriously reduced or its path deflected.⁷⁷ The natural feathers should also be replaced by sturdier ones of plastic or metal, coloured black or green.⁷⁸ Furthermore a folding butt like that used on a paratrooper's carbine or submachine gun would make the crossbow more compact and easier to carry. These points were borne out during Operation Birmingham which lasted through ten days of torrential rain in the deepest jungle, though the opportunity to try it against the enemy did not present itself. In these conditions the forward sight broke off after snagging foliage and the rear sight seized up after seven days but

was released with the application of easing oil. The nock reinforcements on the limbs of the bow were lost and the bow-string broken and lost too, caught by sharp edged jungle leaves. The matt black finish of the stock proved inadequate, such that a process of 'browning' as used on firearms was considered desirable. This vigorous field trial enabled Benedict to improve his design and the 150 lb crossbow he subsequently built shot a heavy arrow furnished with a long three-bladed head for maximum laceration and penetrating power. A fibre-glass bow-lath was still preferred for the new weapon rather than one made of steel or duralumin (figure 20).

It is interesting to note that the Montagnard crossbow could be almost as powerful, as reported by Lt. Col. Floyd Lien of the 1st Logistical Command:

'There are three distinct styles of Montagnard crossbows. The Rhade tribe use a long, slender bow with a long slender stock. The Mèo use a wider and thinner bow with a curved stock. The Jaré use a Mèo-type bow with a stock patterned after a gunstock. All use a similar release mechanism. No metal is used in any of them. The triggers are made of horn, hoof or hard wood. Bowstrings are made of hemp, root, bamboo or other fiber material. The strings made of bamboo are quite interesting; they split the bamboo at either end into many fibers, plait the fibers into a rope, and then back-splice to make an eye. Arrows are of split bamboo with barbed points. The butt of the arrow is split; a folded palm-leaf vane is inserted and the end bound with thread. Many of the war bows pull 150 pounds; short pull with only about a six-inch brace. The string is slack until the bow is cocked'⁷⁹ (figure 21).

'The Viet Cong also use these bows.⁸⁰ On one occasion, our forces captured forty Viet Cong crossbows in a raid near Ankhe. The Viet Cong have even devised a huge crossbow with eight-foot bolts, on the principle of an ancient catapult, for shooting down helicopters'.⁸¹

The stouter weapons require the shooter to sit down and place both feet on the bow to cock it. Arrows are held in the groove with a little blob of a resinous substance near the butt. Arrows might be poisoned with excrement and Sergeant Dane, commander of a Long Range Reconnaissance Patrol (LRRP, these were familiarly referred to as Lurps) in Vietnam refers to 'bamboo crossbows that can fire (*sic*) an arrow four inches into a tree trunk'.⁸²

An anonymous report tells of two helicopters brought down in 1963 during a routine Special Forces resupply mission that morning, they had been hit by arrows fired by some angry Montagnards!

As I gazed at the aboriginal crossbow arrows protruding from the bubble of one helicopter, effectively preventing it from rendering help to the most advanced space vehicle known to man, I became somewhat reflective.

The observer had been sent to enlist the possible help of these aircraft if the flight of American astronaut Gordon Cooper, whose orbit passed over South Vietnam, for any reason had to be aborted bringing him down in hostile territory.⁸³

The Montagnard crossbows are variants of a type found in Southern China, the North East frontier of India, Burma and Indo-China where it has virtually replaced

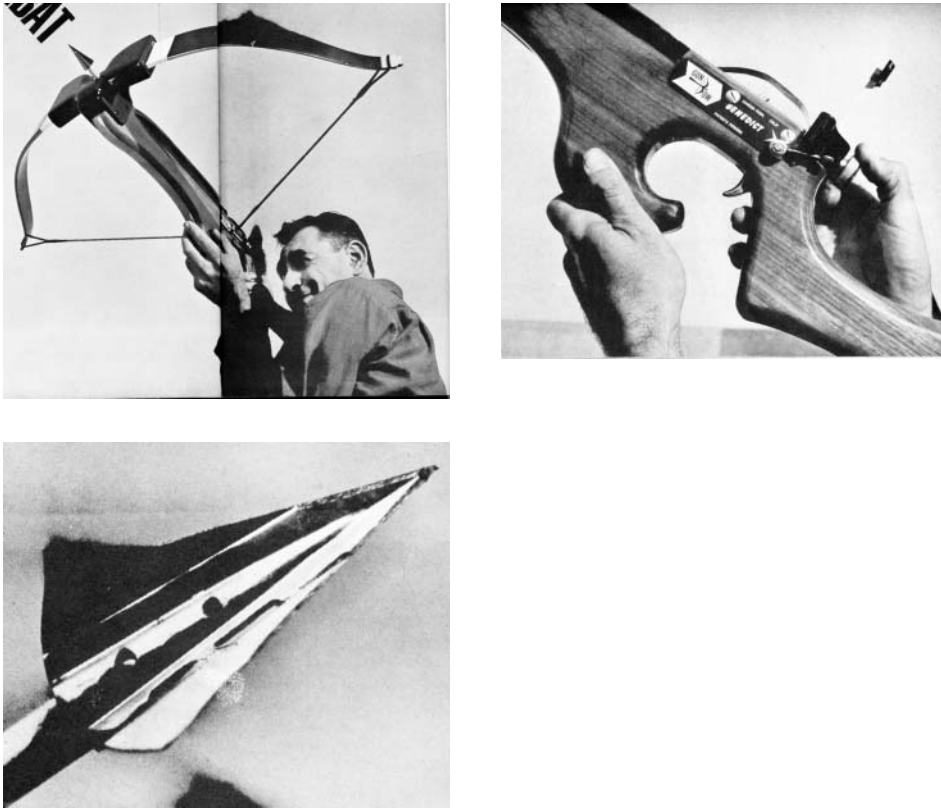


FIGURE 20 a. and b. David Benedict's crossbow c. arrowhead for Benedict crossbow

the handbow. Simple in construction with a slender wooden stock and a bowstave which is generally, though not invariably, of considerable span in proportion to the length of the tiller. The arrows usually of bamboo have a fletching formed from a piece of palm leaf folded into a pentagon shape and inserted in a slot in the butt of the shaft. Spanned by hand and foot without any mechanical aid the arrow is released by means of a simple trigger lever which pushes the string out of its resting groove. In the 1960s the Hre favoured a design, influenced by acquaintance with firearms over several generations, with a hand grip like that of a pistol. It was cocked by standing on one foot and spanning the bow with the knee of the free leg unlike the traditional straight stocked crossbow which was generally cocked by placing the butt against the stomach and drawing the string back.⁸⁴

Burchett, an Australian journalist who spent eighteen months with the NLF (i.e. National Liberation Front or Viet Cong) forces in South Vietnam, gives a lively description of their struggle against the Saigon government troops of President Diem. Pho Nia, a district leader of the Hre Moutagnards who occupied the valleys and mountainous areas of the western portion of Quang Ngai province, seems to have been a particularly inventive guerilla leader and equipped his men with crossbows and a



FIGURE 21 Sketch of a Vietnamese Montagnard tribesman with crossbow.
Courtesy of Fred Lake

variety of home-made traps and guns. Starting in the July of 1959 he set up a series of ambushes and night attacks using fire arrows shot from crossbows aimed at the thatched roofs of the Diemist barrack houses:-

‘The *ten lua* or fire-arrows are shot by special crossbows with a range of up to 200 yards. They look like ordinary arrows but have a hollowed-out section in which sulphur and a bit of gasoline-soaked cotton and a wick are placed in lightly separated sections. A special haft set behind the arrowhead prevents it penetrating too deeply into the target, usually a thatch or palm-leaf roof. The wick leading to the sulphur is lit before firing, and at about the moment of impact the sulphur explodes, the gasoline-soaked cotton ignites, and the thatch is a blazing mass within seconds. It is the guerillas answer to napalm; but infinitely more selective and accurate. The *ten lua* are mainly used against garrison buildings’.⁸⁵

A deadly bow trap resembled the tiger traps of India but shot a whole series of spears or arrows at the enemy. These ‘... multiple spear launchers which might be called jungle Katyushas, after the Soviet multiple rocket launchers. A young sapling cut and trimmed is firmly pegged down at one end by two or three of the strongest of the tribesmen, and bent back until the bowstring — also of jungle

creeper, which the tribesmen prefer to any cord — reaches the required standard of tautness. A delicate triggering mechanism is set and anything up to a dozen spears are put in place, their hafts fitted into the bowstring, their heads resting on the sapling. The latter is almost, but not perfectly parallel to the ground, so the spears are in a slightly tilted position to ensure that each flies at a different height — from around eight inches to seven feet. These are set at spaced intervals along the track'.⁸⁶

The elastic power of rubber cut from old tyres or any such commonly available source was applied to a makeshift gun 'taught his tribesmen how to make a wide variety of traps and also the *sung van nang*, "ten thousand-purpose gun", a primitive firearm with a firing pin triggered by rubber thongs and which fire any small arms bullets likely to be picked up on the battlefield . . . The barrel was made of metal from plane or automobile remnants, heated in local smithies and beaten around a perfectly straight, slim stick of appropriate caliber, the stick being burned out later'.⁸⁷

There were adjustable 'grips' for those bullets which did not fit the barrel exactly and these simple weapons were easily concealed, fixed to a hoe or plough handle. Empty cartridge cases were refilled with home-made powder produced by roasting bat's dung and mixing it with the ash of a certain type of bark. Bicycle ballbearings were a common source of shot.

The Jarai Montaguards of the Western Highlands organised groups of young men as 'self-defence corps' against the Diemists. These were armed with the crossbow and 'spent most of their time preparing defences; digging ditches for spikes and preparing all sorts of other traps along the approaches to the village'.⁸⁸

From the American side the following report is given by a member of a Long Range Reconnaissance Patrol, units of five or six men engaged in reconnaissance, harassment, sabotage and assassination; they infiltrated NLF bases and sometimes wore the peasants' black pyjamas: 'We follow a Viet Cong patrol going single file at night, and keep picking off the last man. If he's hit in the heart, he drops without a cry. With poisoned bolts, even a flesh wound is fatal. The trick is to get your man silhouetted against the sky. Often it takes them some time to realise what's happening. When they do, we open up on them with shotguns loaded with buckshot'.⁸⁹ This is just what the Iban tribesmen did to Japanese patrols in Borneo with their blowpipes '— silently picking off the last man of jungle patrols with poisoned blowpipe darts, kept the Japanese to known, well-cleared paths and prevented them outflanking [our positions]'.⁹⁰ Potentially the blowpipe is the ultimate silent weapon and is perfect for 'shoot and scoot' operations when the user can melt into the jungle immediately afterwards. For attacks on sentries and other enemy personnel requiring follow-up the necessity for a really quick-acting poison to neutralise the victim without him being able to raise the alarm makes it more problematic.⁹¹

A major step forward in the production of an effective combat weapon was the development of the Commando crossbow by George M. Stevens (figure 22 a, b, and c). It has a 140 lb steel bow which 'before stringing is bent in nearly a forty-five degree recurve' and instead of the standard single or double nocks has a pair of nocking lugs

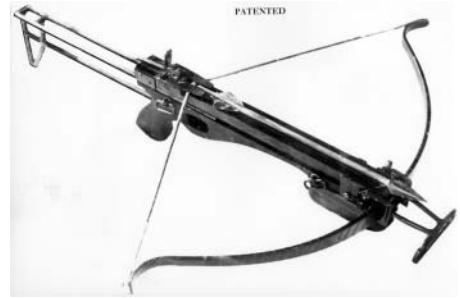
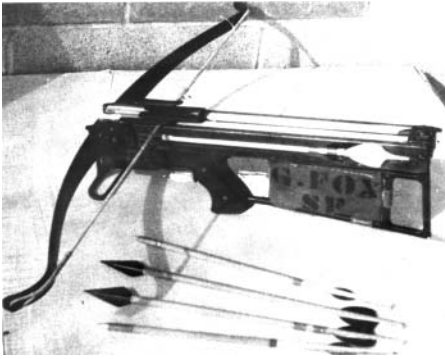


FIGURE 22 George M. Stevens
 'Commando' crossbow a. prototype
 Commando crossbow b. production version
 of Commando crossbow c. George Stevens
 with crossbow slung over his back; butt
 retracted d. 'Commando' crossbow with
 butt retracted.

'the lugs protrude three-eighths inch and are welded on the side of the recurve' — Stringing the Commando is accomplished by placing the bow tips on two boxes or blocks about a foot of the ground. Place one foot on the extended stirrup and press down with the foot, holding the bow steady by the stock and pistol grip. Being sure the sliding stock is to the rear far enough not to interfere with the operation, secure one loop of the string on one limb and bend the bow until the other loop can be secured'. The string are Teflon and taped — 'the string should rest by releasing one

end and adding twists, until the string rests at the right measurement'.⁹² A telescoping skeleton butt not only provides a simple way of reducing the size of the weapon when not in use but also an effective way of spanning the bow. The lock mechanism is welded to the butt and cocking is accomplished by first pushing the lock all the way forward, or until the detent is well under the string. Then with both feet in the T-shaped stirrup the sliding butt is pulled back to the full extent causing the string to be drawn rearwards to engage the catch. Before cocking is attempted the trigger should be well forward and the safety catch set. The latter is on the left of the stock behind the trigger and is spring-loaded so that pressure must be applied to it in order that the bow can be shot.

When not in use the stirrup folds down under the fore-end of the stock and is held in place by a friction catch. Plastic tape (e.g. 1/2 in cellophane) is spirally wound round the Dacron string to protect it from the cutting effect of 'sword grass'. A bifurcated magnet holds the point of the arrow in the shooting position. Aiming is achieved by a ring and post fore-sight aligned with a perforated rear-sight both mounted on the right of the stock. To improve field visibility three orifices of the rear sight, one above the other, are joined by a thin vertical sawcut; an arrangement which allows easy range estimation even between the holes along the length of the slit. Both sights fold into small recesses on the stock when not in use. There are no mechanical sight adjustments; to zero the sights the rear sight is removed and bent slightly and then replaced and tested until the shooter is satisfied he has found the proper alignment. It was easily cleaned by releasing stops at the rear and pulling out the lock unit. A bastard string was also supplied to enable string to be replaced.

For quick instinctive shooting the man simply aimed by pointing the arrow at his target, 'we get excellent body shots at 25 metres without the sights'. A typical broad-head arrow is 14 11/32 in. long and weighs 390 grains, a target bolt 12 11/32 in and 378 grains and a practice bolt 14 5/32 in and 443 grains. Stevens recommended the use of two fletchings made from natural feathers for they continue to function well even when crushed or mutilated; 'Sweetland compressed wood gives us a nice weight, even in so short an arrow'.⁹³

Overall weight of the crossbow is 5 1/2 lb; length of stock is 18 1/4 in. which increases to 28 1/4 in. with the butt extended. Draw weight is 140 lb and the draw length is 13 1/4 in. The steel bow has a span of 28 in. when strung. A swivel link on the right side of the stock allows the bow to be slung over the back leaving both hands free.⁹⁴ In test, starting at 50 ft, using the lower hole of the rear sight there was no difficulty in putting five bolts in a two foot square of cardboard 'of ten thicknesses'; at a hundred feet it shot with same accuracy and at 150 ft, using the top hole, there was a slight drifting to the right but this was adjusted for by a change in aiming point.⁹⁵

The following is a testimonial from a serving marine:

1st Marine Division (REIN)FMF, Vietnam

13 August, 1969

Dear Mr Stevens,

Thanks so much for your concern and help. I received the anxiously awaited box yesterday and followed your instructions to the letter. I smeared hot grease over the entire

weapon and let it sit a while and wiped it off well. I centered and marked the string and shot it a few times with unbelievable accuracy! I have my next mission in about 10 days and you be certain the crossbow will be employed. The majority of my work is prisoner snatches and I'm at work on some ideas for drug injectors to be shot into rear or thigh. Any ideas?

Several team leaders have crossbows but all were too cumbersome (*sic*) and weak to be carried and the idea was discarded. I remembered you and knew that if anyone in the world could make a crossbow for my purpose, it would be you, and you did it! Everybody here is *quite* impressed by your work! Thanks very much!

We employ silenced weapons but the crossbow is still quieter and the sycological (*sic*) effect of an arrow is outstanding!

Further information on combat use comes from a reminiscence some years after the end of the Vietnam War:

14 April 1982

I realised what a wonderful tool the crossbow would be both psychologically and practically and of course my thoughts returned to you. I thank you so much for your timely help there and the superb quality of the bow you made me. I practiced hours on end with the bow and could assemble and disassemble [it] quietly in the dark. My missions there were of course highly classified penetrations of their territory with 5 other men, 2 of whom were former NVA officers,⁹⁶ impersonating them [Viet-Cong] and capturing, raiding or wire-tapping. I carried my bow in a M-60 machine gun barrel bag and then set it up when arriving at the ambush-capture site. Though we had silenced weapons, I used the crossbow because it had no mussel (*sic*) flash and produced such fine results. My only regret was that I was wounded and medivaced back to the States before I was able to use the hypodermic bolts! The next regret was that they were so pleased with the crossbow, I was forced to leave it with my unit for further missions. Certainly I am glad they wanted to keep it, however, for good use.

He further explains the pains he took to ensure silent and efficient deployment of the crossbow in action:

I taped the parts that touched while assembling as I would often put the bow together in the midst of enemy soldiers, and silence was paramount! I tried many things to make the bow as silent as possible whilst firing (*sic*) as this was essential in not revealing our location. You must bear in mind that we often stationed ourselves (6 man team) by high volume trails close enough to be spit on! Due to the nature of the terrain and the density of the vegetation this was often the only means of gathering the information that was needful to us. For this reason for a bow to be used in commando/ reconnaissance missions the 3 things of most value from any perspective are (1) accuracy; (2) silence and (3) as light as possible whilst keeping ruggedness.

The need for a fire-arrow arose during various missions to set light to thatch on the native huts for example. For this purpose a child's sparkler, a thermite composition, was inserted within a hollow shafted bolt.

A slight drawback of the Steven's crossbow, as with many others, was that the user was somewhat vulnerable at the moment when he stood up to draw back the butt in

the process of spanning the bow. A built-in cocking system which can be operated without the necessity of standing up is a decided advantage.⁹⁷ Apart from this one reservation the major problem in the deployment of the crossbow for combat seems to be the inherent scepticism of the military hierarchy. In the words of the officer of marines we have already quoted at length: —

‘One of the hesitations the military people have, no doubt, is that training is required on an intensive basis and they are not geared to this. My commander was impressed by the bow and its use but only because of my youthful enthusiasm at the time’.

A further, anonymous, report suggests that the native weapon was a prime inspiration for the use of the crossbow in Vietnam ‘I talked to a young G.I. who was so impressed by the effectiveness of the Montagnard crossbows that he’s got several bows from George Stevens of Arkansas for himself and his friends serving in Viet Nam’. Because he was uncertain of the legal status, he asked not to have his name used.⁹⁸

The native crossbow had evidently been an item sold in the local markets as souvenirs for visitors and tourists and a journalist visiting Saigon after the war had ended tells us that the terrace of the Continental Hotel had been screened off ‘putting out of business, the vendors of pictures, *cross-bows*, ship’s bells (made out of ammunition cases) and horoscopes’⁹⁹

The crossbow persists in use amongst the peoples of South East Asia, from the borders of China to Nagaland in North East India. The Karens of Burma found it a



FIGURE 23 Karen tribesman of Burma with crossbows.

Courtesy of Fred Lake

useful weapon against the occupying Japanese forces during the Second World War and continue to use it alongside modern firearms against the oppressive military regime in contemporary Myan Mar (figure 23).

A variety of arrow-shooting devices were tested by the Special Forces reserve unit at San Diego, California, in 1966 including the hand-bow, crossbow and modified sling-shots. The aim was to find the best silent hunting weapon for survival behind enemy lines. Snares can be used for many animals but arboreal creatures such as monkeys do not leave a game trail!¹⁰⁰

During the conflict in Biafra an artillery colonel devised a weapon consisting of 'a leaf spring from a 10 ton truck attached to a mahogany log, two hydraulic jacks, it has a four or five thousand pound pull, a range of a thousand yards, for a 20lb load' (*Boston Globe* 1 August 1969). There was a report from Kisandji in the Congo of a UN helicopter being brought down by an arrow which pierced an oil pipe, this was probably shot from a native handbow.¹⁰¹

In 1971 in Belfast, security forces recovered two 10 in. feathered bolts which had been shot during an outbreak of rioting but otherwise the various paramilitary units seem not to have found the crossbow a useful weapon.¹⁰²

A non-lethal use of the crossbow by British armed forces, the Queens Gurkha signals operating in Hong Kong in the 1970s, was for the purpose of shooting a line across difficult terrain when setting up a telecommunications link.¹⁰³ Crossbows are also reported as part of the extensive armoury available to the SAS (Special Air Service) both for survival and offensive use. In 1974, R. G. Shepherd patented his *Elastic Type Arrow Projecting Gun*, marketed as the 'Balista' and distributed by M and M enterprises, Illinois (figure 24a and 24b).¹⁰⁴ A cocking lever hinged at the distal end of the stock drops down and carries the trigger assembly forward to pick up the 'string', formed of a closed loop of elastic passed around two pairs of pulleys. This power train can generate a pull of up to 200 lb and projects a full-sized arrow of wood or aluminium either through the air or under water. The whole weapon is 36 inches long with a crossbar of 12 inch span. The assessment of Ragnar Benson in 1985 was 'hopelessly inaccurate on land and works best under water'.¹⁰⁵ A series of illustrations appear in Roger Combs compendium of 1987 by which time it was no longer in production.¹⁰⁶

Yet another elastic weapon appeared in the 1980s, said to have resulted from some research for the military it was marketed as the Break Free 'Linear Bow' produced by



FIGURE 24 R. G. Shepherd's arrow projecting gun a. 'Balista' at rest b. start of cocking process.

Break Free (a division of San/Bar Corporation), Santa Ana, California (figure 25). It was powered by a strong specially cured 'latex band within a set of parallel guides and travels around a set of wheels to assure smooth delivery. Retainers hold the band at the ends of the forks, and a wire nock engager is in the center of the band. When the band is drawn and placed over the cocking device, the nock engager lies dead center to prevent any uneven stress on either side of the band'.¹⁰⁷ The latex was expected to last up to 100 shots and overall the weapon was 37 in. long, 7½ in. at the widest point, and weighed 6¾ lb.

In 1987, Lord Monckswell asked a parliamentary question, wanting to know the average cost of crossbows and longbows that might be used by the special forces; Lord Trefgarne replied 'There are no crossbows currently in service with HM forces. The longbow ceased to be standard equipment for HM forces during the reign of Elizabeth I and our information on costs is therefore a little out of date. Information available to us suggests a price of 6s 8d (33p) for a first class English-made bow of best foreign yew at 1566 economic conditions. A good quality modern equivalent costs about £300 or more'. Monckswell was concerned about the reliance on high-tech weaponry and thought there might be a requirement for silent weapons like crossbows and longbows by the Special Boat Service and the SAS.¹⁰⁸

Though a wide variety of bows and crossbows may have been evaluated by Special Forces around the world there is a lack of evidence that they have found effective use in service. Widely published images of the Yugoslav armed forces parading through Belgrade to celebrate 'Unit Day', 28 January, 1999, show special forces carrying a variety of weapons, including a crossbow fitted with a telescopic sight (figure 26). More recently the crossbow was to be seen, along with clubs, guns and riot shields, amongst the Chinese troops brought into Xinjiang to quell the unrest among the Uighur population in Urumqi, July 2009 (figure 27). The weapon has a fold down stirrup at the fore end and is equipped with a telescopic sight. The double string with a pulley wheel at the ends of the bow lath indicate a compound bow.

A huge variety of crossbows are currently available around the world and the 1980s seems to have been a period when the number of designs proliferated enormously. One of the outstandingly original crossbows made at this time is the 'Oakland'

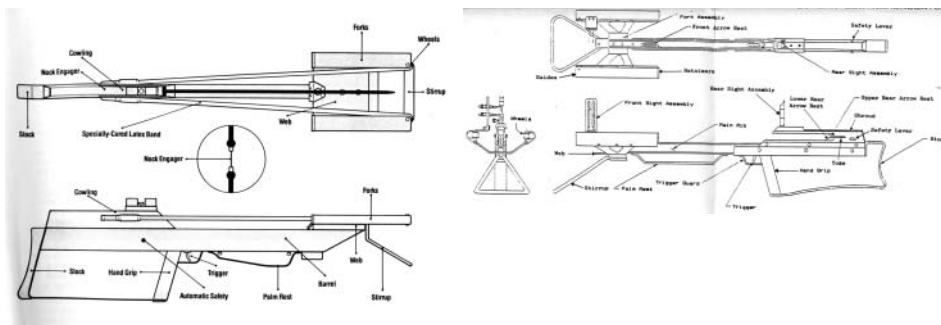


FIGURE 25 The Linear bow a. top and side views b. the parts identified.

Publicity brochure



FIGURE 26 Member of Yugoslav Special Forces with crossbow, 1999.



FIGURE 27 Chinese soldier armed with crossbow; Urumqui, 2009.

designed by Ivan Williams (figure 28).¹⁰⁹ Finely engineered, uniquely the bow can be mounted in either the vertical or horizontal planes. The stock is heat-treated aluminium alloy, resin coated, and has a built in side-acting cocking lever, the centre shot arrow released by a double-set hair trigger with revolving nut. Weight is 8lb

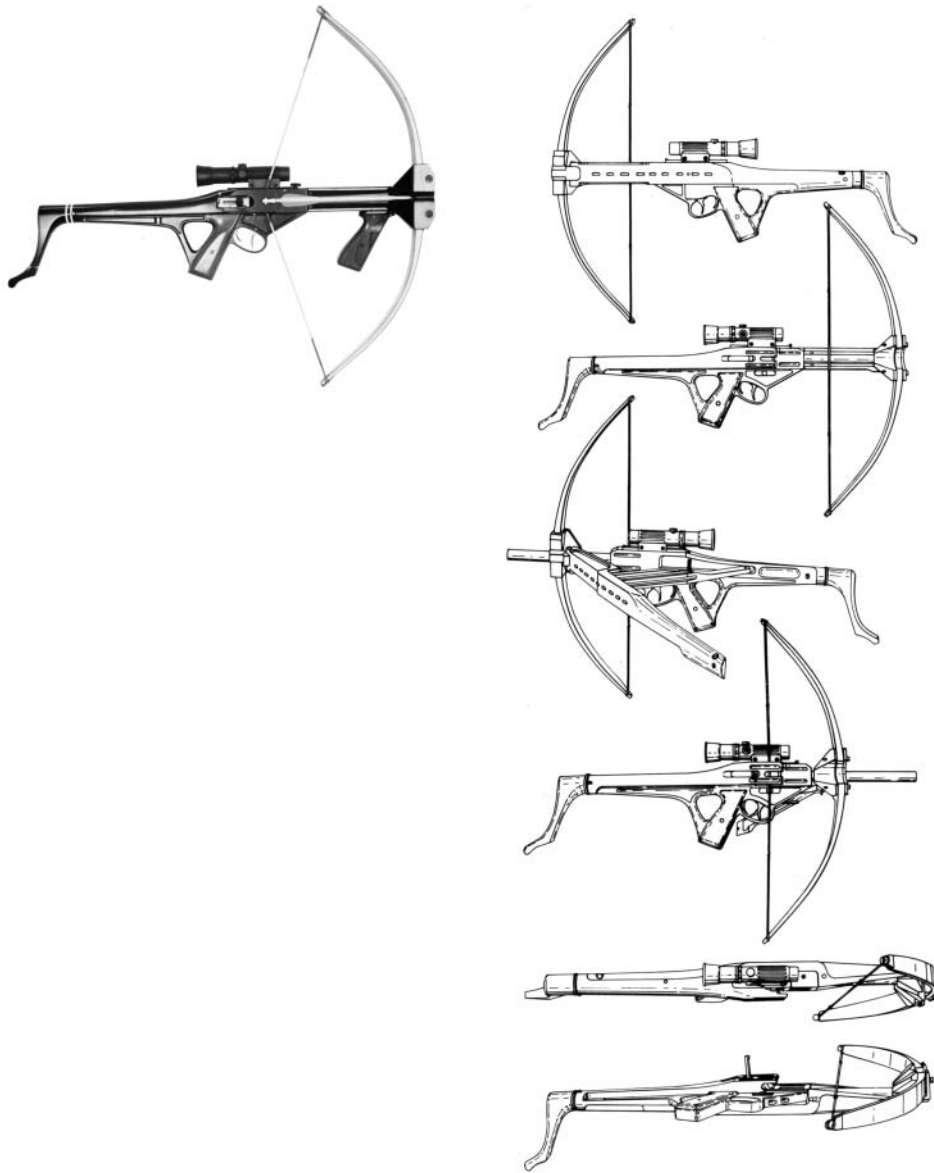


FIGURE 28 Ivan Williams' 'Oakland' crossbow a. in vertical mode b. outline drawings, vertical and horizontal modes; cocking.

Publicity brochure

12 oz, length 33 in., height 27in., width 3.25 in. and the bow has a span of 27 in. Draw weight is up to 200lb at 10in. draw. If the crossbow is to be used in the horizontal position the heel plate is rotated through 90° and the iron sight on the right hand side of the stock is raised, the front sight is permanently in position. The arrow has three flights and must be fitted onto the string so that two of the flights are against the action and one flight is pointing away from the stock. If not then the nock

must be released from the string and rotated through 180° otherwise the flights will interfere with the arrow rest as they pass through.

As well as possible military use police forces have also been interested in its capabilities. During the 1980s the Ontario Provincial Police SWAT team was equipped not only with firearms but the Barnett 'Commando' crossbow produced in England. The basic 'Commando' is a pistol crossbow with a 50 lb pull; 'Commando II' is full sized and produced with either a recurve or a compound bow, the rear of the stock pivots to act as a spanning lever, and the stock is either black or camouflage (figure 29).

The publicity of various manufacturers, large and small, and the names they give to their products often imply that the types of crossbows supplied by them have been used for warfare or undefined special purposes, and this becomes a selling point. As yet details of service use of crossbows post Viet Nam is shrouded in secrecy and one suspects that over the last 20 or 30 years crossbows and various unorthodox weapons may well have found greater employment amongst mercenaries and freelance soldiers. Certainly crossbows are frequently advertised in the *Soldier of Fortune* magazine.

In the 1980s, R. A. Ekins, Mitcham, Surrey, offered their 'Special Forces Survival Crossbow (Regd. Design 1009022) CM 10 M2, priced £57 (figure 30). Overall with butt extended it measured 762 mm (30 in.), 356 mm (14 in.) and a span of 600 mm (24 in.)'. The all steel stock, with wooden forestock, had a black non-rust finish and the alloy bow a draw weight of 125lb. with a Dacron string. Overall weight 3½ lb, range up to 260 yards and an effective lethal range of 55 yards, when collapsed it fitted into a special pouch or pocket on the Bergen rucksack. A knife, with 'hardened steel blade and alloy grips may be locked into a fore socket to act as a bayonette. Clips onto the side of the forestock when not in use. Balanced for throwing'.

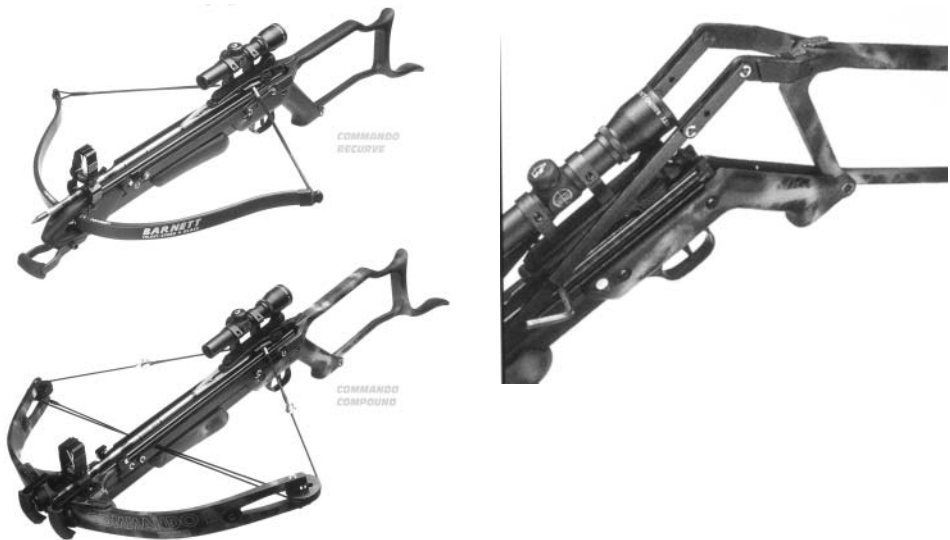


FIGURE 29 Barnett 'Commando' a. standard recurve bow, above, and compound bow, below b. cocking the Barnett crossbow.

Publicity brochure

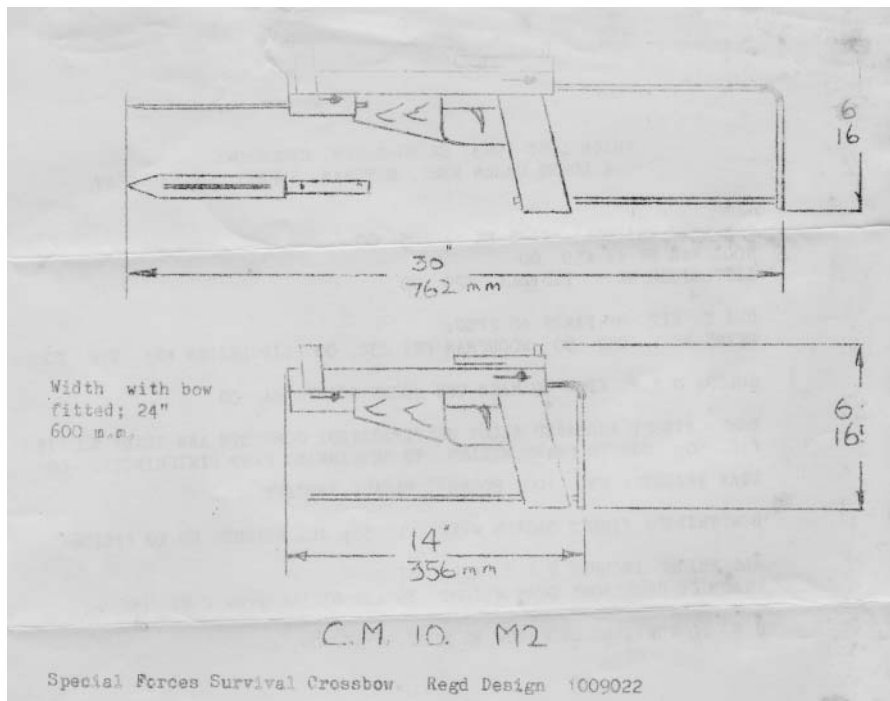


FIGURE 30 Ekins 'Special Forces Survival Crossbow' a. plan b. overall view, with knife set alongside stock c. knife displayed alongside.

According to the company leaflet 'This crossbow has been tested and is in use in countries demanding a weapon to withstand the most arduous conditions. An entrenching tool may be fitted in the knife socket'. Ekins also supplied the 'Blue Steel' repeating crossbow with a magazine on top of the stock accommodating a stack of eight arrows, total weight 5½ lb; patents 1983666 and 4201868. The alloy bows were supplied with draw weights of 60, 80, 100, and 130 lb.

In the world of entertainment and adventure stories the crossbow is frequently regarded as the 'assassin's' weapon. For example in the James Bond film *For your eyes only* (1981) the female protagonist uses a crossbow to hunt down the man who killed her father, and Michael Caine in *Deathtrap* (1982) shoots his young rival with a crossbow.

In the light of attacks on world leaders the crossbow and various exotic weapons have come under scrutiny. A series of tests were carried out by Raymond L. Walters of the Michigan Law Enforcement Officers Council in 1975 with shuriken ('death stars'), nunchaku (two staves joined by chain or cord) and crossbows. A bullet-proof vest effectively stopped shuriken, though the wearer would have suffered some bruising and possibly broken bones, depending on the range, sharpness and force with which it was thrown. The considerable force from the impact of the nunchaku would have caused severe injury. The third test with a 'Wham-O' Power Master crossbow, 80lb pull, at 50 ft, showed that the conventional bullet proof jackets then available were extremely vulnerable. A 13½ in. arrow, 1/4 in. diameter shaft, with a bullet shaped head caused a noticeable dent in the pine board backing indicating that the wearer would likely have suffered broken ribs. A 15 in. arrow with 2½ in. head, 1 1/4 in. wide made of razor sharp, lightweight steel alloy completely penetrated the vest and over ½ in. of the pine backing. Powerful reflex and compound bows with similar draw weights were likely to be just as effective in penetrating body armour.

The history of the crossbow extends over two millennia and the hand bow back to the Mesolithic and in the developed countries both have evolved and survived for largely recreational use down to the present. In addition it seems that they will always have the potential to fulfil a role as a serious weapon of war whenever the requirements of stealth and silent action are paramount. This will not necessarily be for lethal anti-personnel use but often for pot hunting by forces operating under clandestine conditions and maybe improvised by individuals cut off from regular means of supply. A recurrent use for bow and crossbow is to project fire arrows and also to carry a line, useful as an aid to climbing, crossing waterways and difficult terrain. An example of the use of the hand bow as a survival weapon comes from the recent Falklands war. Lt. Dick Hutchins, marine commando, made a forced landing in Chile aboard a Sea King helicopter. During the eight days he remained undetected, he ate an eagle shot with a bow and arrows constructed on the spot.¹¹⁰

Acknowledgements

I am indebted to the late George A. Stevens, master crossbow maker, who died in September 1982. He gave me many insights into the design and use of the modern

crossbow and was an enthusiastic and engaging correspondent. John Minnery was a most helpful correspondent and the late Herbert Woodend, Curator of the MoD Pattern Room, Enfield, gave generously of his time and showed a keen interest in my researches as did Peter Gillett, D. J. Penn of the Imperial War Museum and A. J. Guy of the National Army Museum. The OSS devices, formerly at Enfield, are now part of the National Firearms Centre, Leeds, and my thanks to Richard Jones for his help. Thanks to Fred Lake for providing me with a number of important references and Roy Hungerford for the illustration of Lord Heathfield's catapult and the late Dr W. E. Flewett for sharing his special insights as a designer and maker of crossbows.

My thanks also to J W Brunner who has made a special study of the OSS 'crossbows', to Andre Gillet of the 'Ancien Grand Serment Royal et Noble des Arbaletriers de N-D du Sablon' for information regarding the Arrowspeed, and to the Australian War Memorial, Canberra, for permission to reproduce photographs of this weapon.

Appendix I

Lieutenant Colonel Jack 'Mad Jack' Churchill — archer extraordinaire.

If anyone archer deserved the soubriquet 'mad', then it was Jack Churchill. A larger than life character whose wartime exploits earned him a reputation for eccentricity; his name has passed into archery folklore because of one particular exploit. Although the event does not feature within his obituary there is no reason to doubt its authenticity, and it is certainly one which exemplifies both the man and his ethos.

The account which appears in Donald Featherstone's *Bowmen of England*, London 1967, and is repeated by E.G. Heath in his 'Archery, a Military History' London 1980, is explicit and although absent from the official records bears repeating.

'On the 27th May 1940, whilst in command of a mixed force holding the village of L'Epinette, near Bethune, during the retreat to Dunkirk, Captain Churchill who had been slightly wounded two days earlier, became the only Englishman for centuries who during war, had killed an enemy with the longbow'.

'Climbing into the loft of a small granary, through a vertical opening in one wall normally used for hauling up sack of grain, Captain Churchill saw, some thirty yards away, five German soldiers sheltering behind a wall but in clear view of the granary. Quickly and quietly Churchill fetched up two infantrymen and instructed them to open rapid fire on the enemy but not to pull the trigger until he had loosed an arrow at the centre man. He lifted his bow, took careful aim and loosed the shaft. At the same time as the bow-string twanged, the air was shattered by the rapid fire of the two infantrymen. Captain Churchill was delighted to see his arrow strike the centre German in the left of his chest and penetrate his body; the remaining Germans of the party slumped to the ground. With the idea of retrieving his arrow by pushing it through the wound, Captain Churchill swiftly ran to the body but was unable to extract the shaft. In his haste he broke the arrow, leaving its barbed head in the German's body. At this moment enemy machine-gun fire was opened down the line of the road and everyone dived for cover' (Heath 1980).

Amongst the Churchill memorabilia, which the writer possesses, is a small number of broad headed hunting arrows. Four of these are 32 inches in overall length, have red parallel shafts with self-nocks and deep, triangular fletches. The three intact heads fitted are similar to F. H. Ayres 'Saxton Pope' type, whilst the fourth, which is now without its blade, may have originally had an oval head fitted.

It is uncertain whether these very basic arrows were made professionally for Churchill, or whether he made them himself. A fifth hunting arrow is by Ayres and bears a 'Saxton Pope' style head.

The writer is privileged to own a number of Jack Churchill's bows and although amongst them is not the 100 lb draw-weight weapon which the bowyer Purle is said to have made especially for him, the four described are reflective of his more conventional archery activity. Three are by ALDRED, and one is unmarked. He is known to have taken small parts in pre-war films and this latter may have featured in this activity.

- Bow 1. Maker ALDRED, London. Self-yew. Draw-weight 40 lb. Length overall 72 in. Handle covering in dark blue braid. A steeple shaped arrow-pass is fitted, in mother of pearl. This bow is badly cracked and has been extensively bound. One John Yates, presumably an archery colleague originally gifted this to Churchill in July 1933.
- Bow 2. Maker ALDRED, London. Yew backed yew. Draw-weight 48 lb. Length overall 72 in. Handle covering in green braid. A steeple shaped arrow-pass is fitted in mother of pearl.
- Bow 3. Maker ALDRED, London. Self-yew. Draw-weight 47 lb. Length overall, 69 in. Handle covering in green braid. A steeple shaped arrow-pass is fitted in mother-of-pearl. The shortness of this bow, unusual for this maker suggests that it may have been bespoke to Churchill.
- Bow 4. Maker unknown. Self-lemonwood. No draw-weight is marked. Length overall 71 in. Handle covering in black leather strip decorated with thread to the upper terminal of the handle cover. The belly above the handle is marked PB 75 × in Indian ink possibly referring to a 'point blank' distance.

A hemp bow-string is present with each of these bows and includes Churchill's 'trade-mark', a small unobtrusive piece of red cotton tied at eye level which could be used as a back-sight. Whether this sighting aid was legal is debatable; if the World Championships in which Churchill competed in 1939 were shot to F.I.T.A Rules, then Article 23 of the F.I.T.A Regulations does not permit 'dioptric' sights. Whether a piece of red thread in that position can be regarded as a 'dioptric' sight is a matter for conjecture. However, any form of back-sight offers a prospective advantage and we must hope that the string used by Jack Churchill when he represented his country in 1939 was bare of such an aid.

Two other bows complete the writer's 'Churchill Collection', — they are of low draw-weight and may have been used by other members of his family. They are respectively:

- Bow 5. F. H. AYRES. London. Self-yew: Draw-weight 27 lb. Length overall. 63 in. Handle covering in green braid. A steeple shaped arrow-pass is fitted in mother-of-pearl. It lacks a stringing horn, but is otherwise in excellent condition.

Bow 6. BUCHANAN. London. Self-yew. Draw-weight 24 lb. Length overall 60 in. Handle covering in green braid. A steeple shaped arrow-pass in mother of pearl is fitted.

Churchill's archery exploits continued after the war. In 1946 Twentieth Century Fox made a Film of 'Ivanhoe' and they hired Churchill as an archer to shoot from the walls of Warwick Castle, a role he portrayed to perfection.

Colonel 'Mad Jack' Churchill, born 16 September 1906 and died 8 March 1996 aged 89. Although a member of standing in the Royal Toxophilite Society, Churchill seems never to have joined the British Long Bow Society. Had he chosen to do so, then we may be certain that the Society with its motto 'Keep Faith', would never have had a truer servant.

Hugh D. H. Soar

Appendix II

Operating and maintenance instructions

Designed by Research Project 5

Northwestern Technological Institute, Evanston, Illinois, USA.

Constructed by New Products Corporation, Benton Harbour, Michigan, USA

BJ — 5 — BIG JOE 5 — FLARE THROWER or DART THROWER

Operating and Maintenance Instructions

I OPERATION

A. Setting Up

1. The front frame carrying the rubber is held in the folded position by the crank handle. Pull the rubber down and work the frame free of the crank handle.
2. As seen from the stock end, rotate the front frame carrying the rubber from the right side whilst at right angles to the stock.
3. Keeping the left struts on the inside of the front frame set pin on bottom rod of front frame into its seat at the front end of the wooden stock.
4. Slide the left struts into the left rubber pin and set the shoulders into the counterbores provided.
5. Tighten all wingnuts.
6. With the two wooden grips pointing down, pull the folding wire stock down and swing it back and up until its upper short crossbar falls into notch and underplate on the 'breech'. Tighten the locknut.
7. Wipe off all oil and grease as far as possible.
8. Carefully unwrap the rubber power unit.
9. Wipe off the remaining oil and grease, being careful not to get any on the rubber.

B. Loading

1. Push down the ratchet lever on the left side of the casting to release the ratchet and turn crank to run rack forward until the hook engages the metal link.
2. Check hook to make certain that toggle is in locked position.
3. Pull ratchet lever up, and wind rack all the way back. (The weapon will not fire unless the rack is pulled back to its full extent.)

C. Firing and sighting

FLARE-THROWER

1. Unwind safety wire from FLARE, pull out and discard wire.
2. Lay FLARE into trough, making sure that the back end lies against the link.
3. The sights provided are for the Dart-Thrower. The FLARE-THROWER must be fitted at an approximate angle determined by experience.
4. The weapon is fired in normal manner by squeezing the trigger.

DART-THROWER

1. Lay DART into trough, making sure that the end lies against the link.
2. The rear sight leaf is graduated in equal divisions. The weapon will have to be targeted in.
3. The weapon is fired in the normal manner by squeezing the trigger.

II MAINTENANCE AND INSPECTION

- A. **Oiling.** Like all weapons, this one must be kept clean, oiled and free of moisture. Unlike most weapons, the vital part is rubber, which deteriorates rapidly in the presence of ordinary oils, greases, heat and sunlight. Consequently the lubricating oil must be carefully (not lavishly) applied at the obvious parts of the mechanism.
- B. **Rubber.** A rubber lubricant, GLYDAG, is furnished in this kit. The GLYDAG should be used between the rubber and the supporting pins. It is not injurious to the rubber, and is essential to long life of the rubber. The GLYDAG may also be used on the waxed string serving under the hook.

III RUBBER UNIT AND REPLACEMENT

- A. Replacement (keep rubber in sealed can until needed).
 1. Undo the upper right wing nut about $\frac{3}{16}$ inch.
 2. Pull the upper front crossbar up against the wing nut.
 3. Spring the upper diagonal strut up out of the counterbore, and lay it along the forestock.
 4. Slip rubber in convenient bunches on the upper front crossbar.
 5. Remove both upper wing nuts.
 6. Remove upper front crossbar.
 7. Remove rubber from left spool.
 8. Smear some GLYDAG over both spools.
 9. Place one end of new rubber unit on left spool.
 10. Slip the upper front crossbar through the other end of the rubber unit, and replace the bar.
 11. Slip rubbers in convenient bunches from the crossbar onto the right spool. (NOTE: Take care to keep the rubber sets from one side to the other in the same order on both spools to avoid twisting.)
 12. Bring the upper right diagonal strut into position
 13. Turn down wing nuts until secure.
 14. Check all wingnuts for tightness.

- B. GLYDAG The rubber lubricant, GLYDAG, is a colloidal suspension of very finely divided graphite in glycerine. Since glycerine mixes with water, exposure to rain may wash off the GLYDAG. A reasonably good substitute for GLYDAG is a mixture of powdered graphite and glycerine. Another substitute is plain powdered graphite; this has rather limited staying power.

IV CAUTION

- A. GLYDAG is the only lubricant to come into contact with the rubber.
 B. Ordinary oils, greases, heat and sunlight accelerate rubber deterioration.

Packing List

- 1 Weapon, complete
 150 Darts 15 bundles of 10 each
 20 Flares
 1 Can, containing 1 Rubber Power Unit
 1 Can, containing 1 Rubber Power Unit
 1 Hank Coarse string
 1 Piece Beeswax
 1 Jar GLYDAG
 1 Tube Lubricating oil
 3 Sets Operating and Maintenance Instructions.

Appendix III

WEIGHTS AND PERFORMANCE OF SILENT, FLASHLESS WEAPONS (Rubber as Propellant)												
			JOE LOUIS		BIG JOE 5		BIG JOE 6		LITTLE JOE PEDAL		22 S & W 6" BARREL	
WEIGHT, lb.			35		9.4		5.8		3.1			
SIZE (in)	Open	18 x 48 x 26		8 x 25 x 16		5 x 28 x 15		5½ x 12 x 8				
	Folded	18 x 54 x 10		8 x 27 x 6		5 x 24 x 3½		5½ x 15 x 2½				
PRO- JEC- TILE	Kind	Rifle	Beano	60 mm	Dart	Flare	Dart	Dart	22 L.R.			
		grams		Mortar								
	9 8 7 6 5 4 3 2 1				44	140	44	24	2.7			
					678	2160	678	373	40			
VELOCITY, fps			170	200	100	180	140	200	170			
MAX. RANGE, ft.			800	900	450	780	600	950	700			
Rate of Fire per minute			2		3	3	3 - 4	4 - 5				
ACCURACY					3 inch group at 20 yd.		2 inch group at 20 yd.		3 inch group at 20 yd.			
KILLING RANGE, yd. (estimated)					150		150		80			
RUBBER PULL, lb.			1200		550		300		160			
PENE- TRA- TION AT SIX FEET	HORSE	Solid			8" in meat 9" through 7" cut by vanes		8" in meat 9" through 7" cut by vanes		12" in meat 4" cut by vanes		9.5"	
	HORSE MEAT				15" in meat 7" cut by vanes		16" in meat 12" through 7.2" cut by vanes		12" in meat 4" cut by vanes			
	3/4 in. Fir Plywood		Sacked									
					1.5"		1.5"		1.2"			

FIGURE 31 Comparison table for 'Penetrometer series'.

Notes

- ¹ Copied in Korea and Japan, countries within China's sphere of influence, but no crossbow with a repeating mechanism was known in medieval Europe. The relatively weak bow of 40 lb makes possible a one-handed pump-action. It may be noted that some of the Chinese repeaters had twin stacks of arrows side by side so that two arrows were shot at each stroke of the handle. Two repeating crossbows used in the Chinese 'Boxer' uprising of 1900 have been reported to the author; personal correspondence with J. Minnery.
In modern times the late George Stevens, Arkansas, devised a repeating crossbow with a gravity fed magazine holding five arrows.
- ² A Venetian by birth he became a naturalised Briton and accompanied James Robertson in 1855 to photograph scenes of the Crimean War. Two years later they recorded the savagery of the Indian mutiny and then Beato by himself accompanied the Anglo-French campaign in China. In 1862, he was one of the first European photographers in Japan and in 1884–5 he followed the Mahdist uprising in the Sudan. He eventually retired to Mandalay, Burma, where he set up a shop stocked with a wide range of native furniture and ornaments much of it sold by mail order catalogue illustrated with his own photographs! (Gernsheim 1969: 270–1; Lowry 1975: 659–60).
- ³ The flotilla of gunboats making the attack included vessels with batteries of rockets; Bonner-Smith and Lumby, vol. 95. One of the results of the war was the ceding to the British of the Kowloon promontory opposite to Hong Kong.
- ⁴ Sir Ralph Payne-Gallwey *Ancient and Mediaeval Projectile Weapons other than Firearms*; text of a lecture given at the Royal Institution, Friday, 29 May 1908 and printed in pamphlet form (19 pages).
- ⁵ Anon. 1915: 177.
- ⁶ Acc. No. 2000; received by the museum from GHQ France on the 9th December, 1918 and deposited by the Inspector of War Trophies.
- ⁷ Delhomme 1982: 32–6, esp. 33.
- ⁸ Seaman 2007: see introduction. For details of the design and production of a wide range of devices by MI (Rc), later M D 1, at their eventual base, the Firs, at Whitchurch, near Aylesbury, Bucks, under the direction of Maj. Gen. Sir Millis Jefferis, see Macrae 1972; and also the story of Maj. Gen. Sir Colin Gubbins and his involvement with MI (R) Independent Units, Auxiliary Units and SOE, Wilkinson and Astley 1983; and Lampe 1968: esp. chs. 6 and 7.
Gubbins was at the heart of Britain's development of irregular warfare and his *Partisan leader's handbook*, *The art of guerrilla warfare* and *How to use high explosives* became the essential training manuals for clandestine and irregular warriors.
- ⁹ Seaman 2007.
- ¹⁰ Turner 2006: 236.
- ¹¹ Presumably Prof. Dudley Maurice Newitt (1894–1980) scientific director of SOE from 1941, elected FRS in 1942. He was a chemical engineer, the behaviour of liquids and gases at high pressures his speciality. Initially a chemist with Nobel's, Ardeer, Scotland, he joined up in 1914, saw service on the N.W. frontier and then in Mesopotamia, and was with the victorious forces entering Damascus and Jerusalem. Post war joined staff of Imperial College, to which he also returned after the 1939–45 war.
- ¹² Turner 2006: 36.
- ¹³ Seaman 2007.
- ¹⁴ Turner 2006: 90.
- ¹⁵ McLean 1975.
- ¹⁶ McLean 1975: 15–17.
- ¹⁷ Author of *Turkish archery and the composite bow* 1934; see edition published by the Simon Archery Foundation, Manchester, 2001, which also appends Klopsteg's *Science looks at archery* 1935 and two other collected articles as well as biographical information.
- ¹⁸ He had worked with the rocket pioneer Robert Goddard and in the 1940s developed the rocket launched from a hand-held tube which became known as the bazooka. For a biography detailing the full range of his interests and expertise see Maryanne M Schumm *Clarence N Hickman the father of scientific archery* Maples Press, Pennsylvania, 1983.
- ¹⁹ After the war Hickman and others brought together their studies of bow performance in Hickman, Nagler, and Klopsteg, 1947. These studies were the foundation of modern bow design using non-traditional materials such as fibreglass and more recently carbon fibre.
- ²⁰ See obituary in Anon. 1981: 41; McLean 1975.
- ²¹ Featherstone 1967: 189–91; Heath 1980: 214–5; *Spectator* 4 April 1952. See also obituary of Lt. Col. John Malcolm Thorpe Fleming Churchill *Daily Telegraph* 13 March 1996.
- ²² Lampe 1968: 84–5; experiments were also made with fuses and detonators attached to the arrowheads
- ²³ Williamson 2004. The bibliography also lists published material for other regions.
- ²⁴ Hart-Davis 1974: 236. See Anon 1958: 33–4.
- ²⁵ Warner, 1980: 120.
- ²⁶ Langley 1990: 40.
- ²⁷ Dreyer 1936.
- ²⁸ Langley 1990: 100.

- ²⁹ Designed by Henry Kjellson in 1933.
- ³⁰ Ryan 2008: ch. 3, esp. 27–29.
- ³¹ Edward Hart ‘The Accles and Pollock Steel Bows and Arrows’ *Journal of the Society of Archer-Antiquaries* vol. 43, 2000: 37–8.
- ³² Household 1939 (Penguin Books 1984: 162–3). An improvised longbow features in another work, *The Sending*.
- ³³ Smythe (Alf Webb) 2002.
- ³⁴ McLean 1975: 112–22. The complete series of rubber-powered weapons was entitled ‘The Penetrometer Project’ and given the code SAC.
- ³⁵ Arthur G. Credland ‘Little Joe, Big Joe und William Tell; lautlose waffen im Zweiten Weltkrieg’ *Internationales Waffen-Magazin* September 1992: 584–7.
- ³⁶ McLean 1975.
- ³⁷ The clips extend from a copper or bronze collar around the butt of the arrow, held by spot punching on opposite sides.
- ³⁸ Brunner 1994: 59–65; Brunner 1990.
- ³⁹ Brunner 1990: 41.
- ⁴⁰ Brunner 1990: 38.
- ⁴¹ Brunner 1990: 43.
- ⁴² Illustrated between pages 148–9 of Boyce & Everett 2003/ 2004.
- ⁴³ Brunner 1990.
- ⁴⁴ McLean 1975: 121.
- ⁴⁵ Brunner 1990.
- ⁴⁶ Anthony Saunders *Weapons of the trench war 1914–8* Sutton Publishing, 1999, see ch. 3: 51–66 for descriptions and illustrations of British and French types.
- ⁴⁷ Ibid. Claude Pemberton Leach took his device to Gamages department store and they evidently provided resources to develop the design. A patent was applied for 22 May 1915 and granted as 7,710/15 in the following year. (Saunders 1999: 51–66).
- ⁴⁸ Ibid. UK patent 10,662/15 applied for on 22 July 1915. Yet another rubber powered machine was filed 26 August 1915 by John Robertson, head of Boss & Co, the London gunmakers, and granted 28 August 1916, UK patent 12,298/15. Leach catapults remained in use but by this time the availability of increasing numbers of trench mortars removed the necessity for developing any more substitutes.
- ⁴⁹ Arthur G. Credland ‘Daniel Higson and the bullet crossbow’ *Journal of the Society of Archer-Antiquaries* vol. 28, 1985: 24–31, esp. 30–1.
- ⁵⁰ W. E. Flewett ‘The Assassin’s crossbow? A reassessment.’ *Journal of the Society of Archer-Antiquaries* vol. 39, 1996: 78–93.
- ⁵¹ Sir Ralph Payne Gallwey ‘The mediaeval crossbow in *The Field*, vol. 99, 4 January and 1 February, 1902. See also his still useful monograph *The Crossbow* 1903.
- ⁵² US Patent no. 1,704,810, registered 12 March, 1929.
- ⁵³ UK Patent, no. 12,623, 29 November, 1849.
- ⁵⁴ John Shaw *Air Guns*; UK Patent, no. 12,728, 30 January 1849.
- ⁵⁵ Tallis 1851/2: 146.
- ⁵⁶ M H Phillips *Gun*; UK Patent, no. 1211, 8 November, 1853.
- ⁵⁷ *Canadian War Museum Handbook* 1966: 35. Also illustrated in Minnery 1979: 53.
- ⁵⁸ Longmate 1974: 69.
- ⁵⁹ Fleming 1957: 211.
- ⁶⁰ Fleming 1957.
- ⁶¹ Obituary *Daily Telegraph* 11 September 2002.
- ⁶² The Australian New Guinea Defence Unit; see Powell.
- ⁶³ Anon 1962: 9–11 and 62.
- ⁶⁴ Anon 1946.
- ⁶⁵ Published accounts of warfare irregular and conventional, see Powell 1996 and 2003, bear no reference to unconventional weapons used by Austrian troops, native recruits, or their allies, though in 1944 SOE supplied Motor Submersible Canoes (battery driven one-man craft) and Well-man one-man submarine (Powell 1996).
- ⁶⁶ Reid 1961: 270 and 286.
- ⁶⁷ Young 1984.
- ⁶⁸ The Kikuyu tribesmen of Kenya were, however, adept in assembling makeshift firearms, some little more than a piece of piping in which a bullet was inserted and then detonated by striking with an iron bar.
- ⁶⁹ The *London Gazette* 9 October 1956, ‘Kiprotich arap Ndotich and another Forest Guard were returning from work through South Tinderet Forest when they saw five armed Kikuyu coming towards them. As they passed, the two Forest Guards decided to retrace their steps, follow the gang in order to locate their hideout and report it to the police, but they were seen by the gang who immediately attacked them. Two of the gang attacked Kiprotich’s companion with swords, felling him to the ground and wounding him seriously about the head and body. When Kiprotich saw his plight he rushed to his help and attacked the gang single handed. Using his bow and arrow he shot the gang leader through the chest killing him on the spot. He then shot another member of the gang through the chest and was too much for the remaining members of the gang who ran off taking their wounded man with them. Forest Guard Kiprotich arap Ndotich acted with courage and determination’. I am indebted to Michael J Boyd for bringing this incident to my attention.
- ⁷⁰ There are 42 tribes in Kenya, the largest the Kikuyu comprising only 22% of the population. *Daily*

- Telegraph*, colour supplement, 8 March 2008: 28–9.
- ⁷¹ Montagnard is a general name covering the tribesmen occupying the central highlands of Vietnam. He normally uses his crossbow to hunt monkeys for food.
- ⁷² Warner 1980: 215. SLRs are of course self-loading rifles and the shotguns were presumably of the repeating type ('pump guns').
- ⁷³ Powell 1996: 242. A hundred shotguns and later a 100 rifles were supplied to the hundred strong Nakanai force in 1943–4. The Australian and allied forces had an assortment of Austen and Owen submachine guns, .303s and captured Japanese weapons.
- ⁷⁴ Roth 1967–1968: 318–20.
- ⁷⁵ Said 1963: 52–6. See also Roth 1968: 172–3.
- ⁷⁶ Lewis 1967: 44–5 and 58.
- ⁷⁷ In dense jungle growth even the .223 calibre bullet of the M16 often suffered deflection so the lower velocity crossbow bolts would be even more likely to suffer in this way.
- ⁷⁸ Though George Stevens preferred feathers to artificial vanes.
- ⁷⁹ Mannix 1967: 88–9. After the debacle of Dien Bien Phu in 1954 and the withdrawal of the French the Saigon government of President Diem moved large numbers of ethnic Vietnamese into the highland territory of the Montagnard tribes. This was accompanied by the imposition of taxes and an attempt to proscribe the crossbow. See Simpson 1983: 100.
- ⁸⁰ On occasion members of the American Special Forces units too.
- ⁸¹ Mannix 1967.
- ⁸² Anon. 1971: 21–2.
- ⁸³ Information from Dave De Laurant, USA.
- ⁸⁴ All these weapons are primarily used for hunting but they are still used offensively during occasional tribal disagreements or clashes with the authorities as in the case of the Nagas on the North East frontier. For a description of Montagnard life and culture, including weapons see Mole 1970: esp. 224–6.
- ⁸⁵ Burchett 1965: 137. Among other improvised weapons 'also made "praying mantis" guns, fearsome bell-mouthed affairs which discharge a cloud of grape shot accurate enough for the four yards range at which they operate. Set up to cover a jungle path, they are released when a guerrilla jerks a string from a respectable distance as the enemy approaches a pre-selected point!' (132).
- ⁸⁶ Burchett 1965: 139.
- ⁸⁷ Burchett 1965: 134–6.
- ⁸⁸ Burchett 1965: 164.
- ⁸⁹ Mannix 1967: 89.
- ⁹⁰ Powell 1996: 300.
- ⁹¹ The use of the blowpipe for hunting and recreation is not restricted to exotic cultures in South America or the jungles of Borneo but was widespread in Europe, and survived down to modern times, including a blowpipe to shoot tranquiliser darts for use by veterinarians etc., some of which were supplied to Humberside police in 1977 for use against potentially rabid dogs on board vessels docking in the port of Hull; see Arthur G. Credland 'The blowpipe in Europe and the East' *Journal of the Arms and Armour Society*, vol. X, No. 4, December 1981, 119–147. After the hijacking of four airliners by the PFLP, 6 September 1970, discussion in Whitehall 'was confused and sometimes bizarre... [with] 'surreal discussions', which included the use of blow-darts to overpower hijackers'. Andrew 2009: 608.
- ⁹² Correspondence with George Stevens; Tyler 1970: 20–3.
- ⁹³ Tyler *ibid*.
- ⁹⁴ Stevens 1978; Tyler: 1970: 20–23.
- ⁹⁵ Tyler 1970: 20–23.
- ⁹⁶ North Vietnamese Army.
- ⁹⁷ The Barnett 'Commando II' crossbow, manufactured in England fits the bill in this respect. When the skeleton butt is pushed down two brass levers engage the string and make easy the tensioning of the 175 lb draw weight bow. Despite its name this weapon is designed for target shooting and would probably need modification to ensure this sophisticated piece of craftsmanship would be rugged enough for service use. A major disadvantage is that the bow lath cannot be removed without first taking off the string.
- ⁹⁸ Mannix 1967: 89.
- ⁹⁹ West 1980: 41–53 esp. 46.
- ¹⁰⁰ Learn 1966: 3 2–5. A patent for a catapult to project a dart or arrow-like missile was taken out in North America in the late nineteenth century, i.e. O. H. Curtis *Catapult* no. 225,510 16 March 1880. Other US patents for catapult 'arrow projectors' were registered as follows: J. Fisher *Crotch type arrow projector* no. 2,645,217 14 July 1953; W. E. Sewett *Launcher with adjustable tension elastic bands* no. 3,415,239, 10 December 1968; W. R. Knerr *Arrow propelling weapon* no. 3,455,288 9 November 1966; J. M. Alban *Elastic type projectile device* no. 3,517,657 30 June 1970; and M. H. Feldman *Arrow projecting device with arrow retrieving mechanism* no. 3,614,947, 26 October 1971. A number of devices of this nature were available in the USA in the 1980s, including 'Big Archie', 'Arrow Slingshot' and the 'Bowslings' intended for both target shooting and hunting game.
- ¹⁰¹ Anon. 1964.
- ¹⁰² Anon. 1971.
- ¹⁰³ Anon. 1979: 31.

- ¹⁰⁴ US patent no. 3,783,852; registered 8 January 1974.
- ¹⁰⁵ Benson 1985.
- ¹⁰⁶ Combs 1987.
- ¹⁰⁷ Publicity brochure.
- ¹⁰⁸ Anon. 1987: 9.
- ¹⁰⁹ A British registered design no. 1011613; Design Centre approved. Manufactured by Oakland Design Products, Church Stretton, Shropshire. Distributed in the USA through Oakland Ltd, St James, New York.
- ¹¹⁰ Anon. 1982.

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