A short history of stretchers

by Peter Bell

Don't get carried away – but if you do, rest assured that the stretcher which supports you has a long history of development underpinning it.

This is a chronological view of some of the origins of, and the influences upon the evolution of stretchers used for mountain rescue; some information about those involved at the design stages; and a few technical notes.

The evolution of mountain stretcher design inevitably runs parallel with the evolution of mountain rescue. It is difficult to separate one story from the other; however, the focus here is upon stretchers themselves and their various designers, rather than upon those who have used them, or indeed the folk who've had need of them.

In common with nearly every advance, progress is usually influenced by a need to solve a problem identified in an existing facility. The rescue stretchers now available to teams have thus evolved from the earlier and more basic designs. It is, therefore, appropriate to have a quick look at what was in use prior to the emergence of mountain rescue as we know it today.

Warfare and work

Warfare from the 1850s onwards, leading to the inevitable human casualties, coupled with a most significant increase in work-related accidents in the late 1800s and early 1900s, fuelled the greatest advances in casualty care, and a consequential rapid evolution of stretcher design.

The Red Cross and the St John Ambulance Association

Two main participants drove the progress of this humanitarian phase – The Red Cross, who provided humanitarian aid, and the St John Ambulance Association, who deployed first aid skills and equipment. Both these organisations continue to function to the present day and hopefully will do so long into the future.

Henri Dunant founded the Red Cross movement, together with the parallel Red Crescent movement, in 1863. Born in Geneva, on 8 May 1828, he was appalled by the suffering of thousands of men, on both sides, left to die due to lack of care after the Battle of Solferino in 1859. He also went on to initiate the first Geneva Convention (twelve nations) in 1864.

In 1901, he was awarded the Nobel Peace Prize. However, despite all his massive contributions to the relief of suffering which endure to this day, on 30 October 1910, Henri Dunant died alone and in overwhelming poverty.

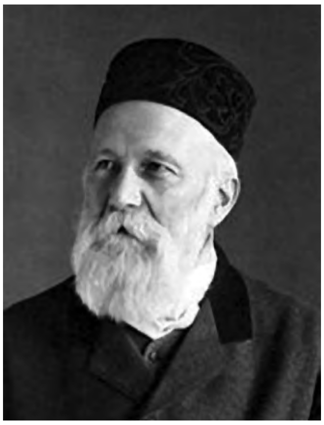
Others before him had tried, with some success, to raise medical standards on the battlefield. George Guthrie (1785–1856), surgeon to the Duke of Wellington, was certainly one of these, but nobody achieved the same measure of lasting success as Dunant.[1,2,3]

The St John Ambulance Association was created, in 1877, by members of the ancient British Order of St John of Jerusalem with the support of the Royal Humane Society (founded 1774). Their function was to help those involved in the increasing number of industrial accidents. They established first aid lectures and demonstrations in large railway centres and mining districts, in the first instance provided by two Aberdeenshire military officers, Surgeon-Major Peter Shepherd of the Royal Herbert Military Hospital, Woolwich, London, and Colonel Francis Duncan. Shepherd conducted these first classes in the hall of the Presbyterian school in Woolwich.

Soon after, in 1887, the St John Ambulance Brigade was formed as a uniformed organisation to provide a first aid and ambulance service. First aid teaching also continued to be provided by the Association. In many parts of Britain, St John Ambulance Brigade was the first and only provider of an ambulance service right up to the middle of the 20th century, when the National Health Service was founded.[4,5,6]

The Furley stretcher

The development and deployment of a standard casualty stretcher by the St John Ambulance Association was



Henri Dunant

[1]nobelprize.org/nobel_prizes/peace/laureates/1901/dunant-bio.html [2]www.ppu.org.uk/learn/texts/doc_geneva_con.html
[3]www.rhs.ac.uk/bibl/xSearch.asp?database=dcatalo&rf=200703734

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initiated and motivated by one person whose ongoing participation was of paramount importance. John Furley – later Sir John Furley, CH, CB (1836–1919)[7] – was born in Ashford in Kent. He became involved with the Association and gave his wholehearted support to its work, being credited with the design of the Furley stretcher and of the Ashford Litter, which was a basic Furley stretcher provided with wheels and a canvas cover. Wheel devices for Furley stretchers came to the fore during the First World War.[8]

To overcome some of the problems of using a Furley pole and canvas stretcher vertically, the Lowmoor Jacket, normally used as a hauling device underground, was adapted to fit the Furley stretcher. This 'jacket' originated from the small coal mines at Lowmoor, near Bradford.[9]

The Furley stretcher was now established as the foundation for the development of stretchers for use in open spaces. In essence, this stretcher consisted of two poles, four vertical supports to raise the stretcher bed off the ground, a canvas bed panel and spreader bars that could be folded or removed so the stretcher could be 'compacted' lengthways to assist storage and rapid deployment to an accident site.

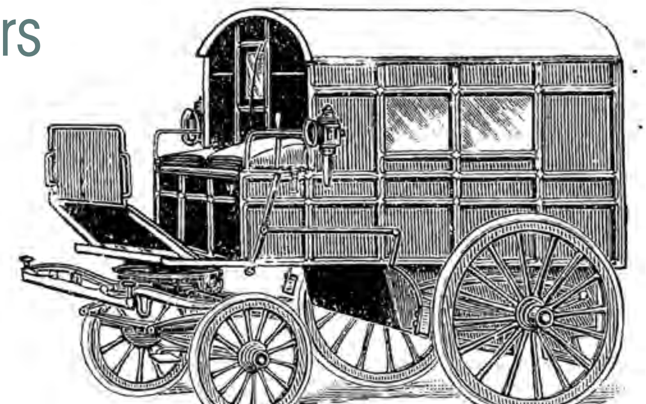
However, there continued to be difficulty in confined spaces. A need for a very narrow stretcher, to complement the standard Furley, became evident. Specifically this narrow stretcher, including attached casualty, had to be small enough to be hauled up a two foot six inch diameter hoist for fire-box ash from the boiler room of a ship. The Mansfield stretcher was already being used on some ships of the Royal Navy but there were occasions when this was unsuitable.

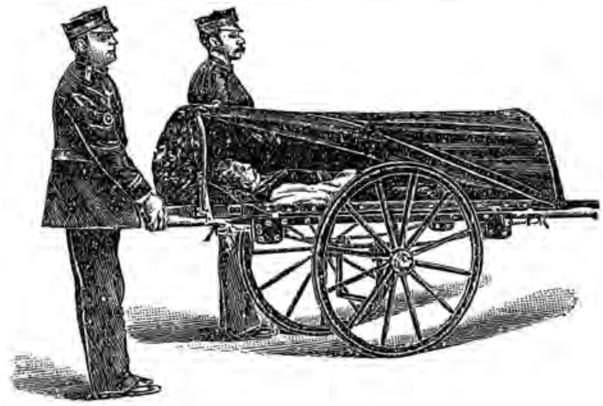
The Lowmoor Jacket in action

The Neil Robertson stretcher

By way of an alternative, twenty-four modified Japanese hammocks, were ordered by the Navy in 1907. This piece of equipment boasted the extremely wordy official title of 'Hammock for Hoisting Wounded Men from Stokeholds and for Use in Ships whose Ash Hoists are 2ft 6in diameter'!

It was from these Japanese origins, combined with experience of the Mansfield stretcher, that the 'Neil Robertson stretcher' evolved, to overcome problems specific to confined space rescue. Initial production took place shortly after 1906. How much John Neil



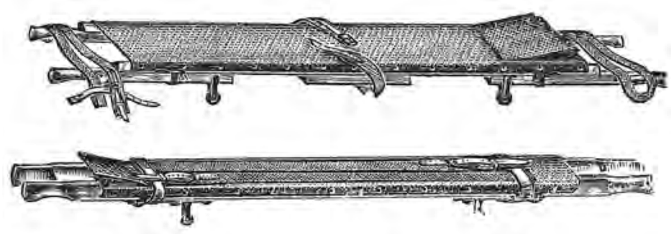


Above: Example of a horse ambulance carriage, which varied 'from a light vehicle to be drawn by two men or by a pony, costing with India-rubber tyres to wheels £32 10s, to a single or pair-horse wagon capable of accommodating three patients in a recumbent position and an attendant inside

Middle: 'The 'Ashford' Litter – a two wheeled under carriage fitted with elliptical springs and a Furley stretcher

Below: The Furley stretcher, with telescopic handles open and closed, 1899

Illustrations: First Aid to the Injured (St John Ambulance Association) 1904



[4]http://www.sja.org.uk/sja/about-us/our-history [5]http://en.wikipedia.org/wiki/St._John_Ambulance [6]BMJ 1994;309:1718–1720 [7]Obituary BMJ, 4 October 1919 page 453 [8]Illustrated History – World War 1 Lloyd Clark RMA Sandhurst [9]Ambulance Lectures, page 142 Surgeon-Major Evatt MD [10]Surgeon Commander J J Keevil DSO RN, page 162 RNMOJ 530 1944

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Robertson contributed to the design of the stretcher which bears his name, is not clear. From some evidence, it would seem he was the last of a number of contributors, which included Captain Fitzherbert, Captain C A W Hamilton and Fleet Surgeon I M McElwee.

That said, very rapidly, his adaptation of the original cane and canvas device became well known to mariners as 'the Neil Robertson stretcher'. It gave good service during both the first and second World Wars and continues to be of service. A hundred or so years on, it is still in production.

A parallel development was occurring in the US Navy, under the eye of Surgeon General Stokes. These simultaneous developments were to have an impact upon the scene in Britain but it was many years before this occurred. In fact, it was not until the new millennium that the Stokes stretcher entered the British mountain rescue environment. Accordingly, to maintain a logical sequence, the description of the origins and application of the Stokes stretcher is covered towards the end of this account.

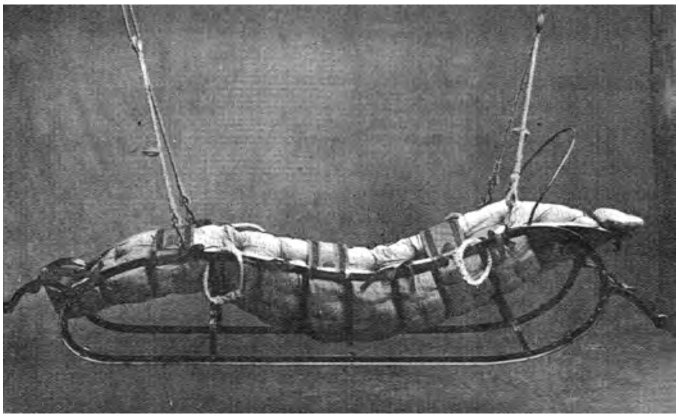
John Neil Robertson

The Neil Robertson stretcher, fitted with a skid means, a footrest and a device to hold a helmet or other head protection remains to this day in use underground, especially by the various cave rescue teams in England and Wales.

Fleet Surgeon John Neil Robertson, MB CM was born in Beith, Ayrshire on 28 July 1873. He qualified in 1895 at the University of Glasgow and travelled to India and America before working briefly in Scotland. His Naval service began in 1899 and, at the start of the First World War, he was serving on HMS Blake. He died of an aortic aneurysm at the tender age of 41, on 22 December 1914 and was buried, with full naval honours, in Ford Park Cemetery (Pennycomequick), Plymouth.[11]

During this time of rapid development in Britain, other stretchers and associated extras began to emerge but, except for the Furley and the Neil Robertson, none survived the test of time. For example, there was also, for a short time anyway, the Kirker Ambulance Sleigh, in which the casualty was carried with head and knees slightly elevated.[12] This was not unlike the much more recent Mariner stretcher.

A combination of the Neil Robertson with a skid device for use in the British cave rescue environment, circa 1994



The Kirker Ambulance Sleigh complete with dummy casualty – specially adapted for use on board ships or for extricating injured persons from mines

[11] John Adams; the British Medical Association; the Commonwealth War Graves Commission; Bill Cook at BCI; Mrs J M Greer; Sally Roberts; the Society for Nautical Research; the University of Glasgow Archives; and Business Records

[12] Page 1743, Arnold & Sons Catalogue of Surgical Instruments and Appliances, 1904

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Mountain rescue and cave rescue stretchers evolved from the strong roots provided by both the Furley and the Neil Robertson stretchers.

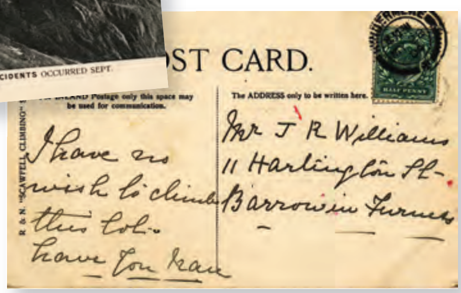
The very first recorded formal and coordinated introduction of stretchers into the mountain rescue environment was that of standard Furley stretchers. The Climbing Club of Great Britain initiated this move, establishing a subcommittee to expedite the matter. Amongst the members was Dr E C Daniel who, in addition, began to examine available skills to make the best use of this equipment.

One Furley stretcher each, complete with extra carry slings, was received by Wasdale Head Hotel and The Gorphwysfa Hotel (now Pen y Pass Youth Hostel) on 24 December 1903. The Pen y Gwryd Hotel and Ogwen Cottage were both kept informed of this development. The need for caches of emergency equipment was further emphasised by the Scafell accident in which four people died in 1903.[13]

Whilst these original Furley stretchers were excellent for short distance evacuation of a casualty from an accident site to roadside, there were inherent problems when long or steep carries were required. The handles were too short and no skid capacity existed. In fact, the design actually prohibited skidding. An extending handle version was later developed.

For the next thirty years or so, people who were injured in the mountains relied on self-help and local assistance with improvised equipment – often a farm gate doubled as a stretcher. The nearest St John Ambulance Brigade, equipped now with the Furley stretchers, might well be many miles away because these brigades were first established in the large industrial towns and cities.

As the number of people venturing into the mountains and onto rock faces increased, so too did the number of accidents and the associated requirement for a purpose-built stretcher. Ideally one of these stretchers and associated medical kit would be deployed to any known and accident area, ready for immediate support to a casualty in the mountains.



'I have no wish to climb this...' writes the sender in 1904

[13]CC Journal 1903 vol. VI – no. 22, page 98

Now here is a fine example of the necessity stimulating progress and invention. There is a saying that 'necessity is the mother of invention'. Some might add that 'a deadline is the father of invention'!

Another step on the path from farm gate to mountain stretcher

The next step in this rapid and timely metamorphosis from farm gate to dedicated mountain stretcher came when, in 1933, the Rucksack Club and the Fell and Rock Climbing Club formed a joint committee with A S Pigott as its chairman. It was from this that developed the 'Joint Stretcher Committee' chaired by C P Lapage – the forerunner of the Mountain Rescue Committee, now Mountain Rescue England and Wales (MREW).

The following account, which I include verbatim, originates from the archivist of the Rucksack Club. It admirably demonstrates the influence of necessity upon invention.

'The catalyst for the Stretcher Committee and its design was an accident to club member Edgar Pryor, a leader with the reputation of never falling off. When leading a climb he assisted another group who were in difficulties. Apparently the leader of this group, attempting to descend, decided to jump off, and swept Pryor off with him resulting in a complicated fracture of the leg. Pryor was carried to the valley on a makeshift stretcher based on a farm gate, suffering much discomfort on the way. Despite the best efforts of Club member Wilson Hey, Chief Surgeon at Manchester

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Royal Infirmary (MRI), the leg was amputated. The esteem in which Pryor was held in the club can be judged by the fact that a collection amongst the 230 members raised sufficient funds for the purchase of a car with suitably modified controls.'
Mike Dent
Archivist, Rucksack Club

An article in the Rucksack Club Journal, Volume Eight 1935, headed 'A new stretcher and first aid equipment' read as follows:

One of the problems which may at some time confront any climber is the treatment and relief of injuries, and the carriage of an injured man over rough ground. In emergency, of course, one must make the best of the material and appliances available, but extempore stretchers for instance, made with much waste of time from odd pieces of timber, clothing etc, are never easy to handle and are likely to cause an injured man much pain, or even to augment dangerously his injuries. Stretchers, even of orthodox types, have been found in practice to suffer from serious defects, such as excessive weight or inadequate strength, or they do not allow for the load to be borne fairly by the bearers. And no stretcher suitable for transporting a patient over really rough mountain country, say in bad weather, or for lowering him down a crag, could be found.

The increasing importance of this problem led in 1932 to the appointment of a stretcher subcommittee to investigate the matter. In 1933, this body joined forces with a similar body appointed by the Fell and Rock Club, thus forming the Joint Stretcher Committee. We were particularly fortunate in being able, between us, to command expert advice on the medical and surgical requirements, and also on the engineering difficulties which soon became apparent. It may at first sound strange to suggest that specialised engineering knowledge is applicable to the design of a stretcher, which to most people is simply a piece of canvas and two poles. If anyone cares, however, to attempt to solve the various conflicting requirements for a mountain stretcher, he will find, when he gets down to details, that they are not easily reconciled. Stated briefly, the more important of these requirements are:

(a) minimum weight.

(b) quite exceptional strength and rigidity under varied strains.

(c) provision for the loaded weight to be shared by more than the usual two bearers.

(d) provision to allow the bearers to walk in file on the level and to advance in line on a steep slope.

(e) portability (ie. it should be possible to take the empty stretcher apart in case of need).

(f) means to hold the patient in position with the least discomfort even when being lowered down a vertical face.

(g) means to keep his body from contact with the rock under such circumstances.

As regards first aid equipment, it will be realised that for the special circumstances of mountain accidents, bandages and dressings may not cover all, or possibly even the main needs.

The committee continued its deliberations so far beyond the normal period of gestation that ribald spirits suggested that it was barren. Some were taken for a ride in experimental stretchers and silenced. But much work was being done behind the scenes and, by Easter 1934, a new design was so far advanced, and the experimental model so comfortable, that even one of our most energetic past presidents became patient and lay down quietly – but this is recorded elsewhere.

The committee's report was issued at the beginning of this year, and the first stretchers are now available. One, with its special first aid set, is being installed in the Lake District by the Fell and Rock, and several of the first aid sets are being obtained by them for existing stretchers in that area. We have installed a complete equipment at Tal y Braich.

The general design and construction of the stretcher can be seen from the drawing [next page] and it will be apparent that there are a number of novel features. The report emphasises that the present design is not considered to be in any sense final, and that further improvements can probably be made. The design, however, is based on practical experiment and experience over a long period, and it is the writer's personal opinion that the most fruitful line of improvement is likely to be in the evolution and perfection of details rather than in any radical revision of the general design.

Before the committee decided that a new pattern of stretcher was required they had considered carefully existing designs of stretcher and of any similar devices which they were able to trace. These included:

- *Furley ordinary and telescopic handle pattern*
- *Lowmoor Jacket*
- *Neil Robertson stretcher*
- *Dr and Mrs Wakefield's stretcher*
- *Universal stretcher sheet*

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- *Swiss Army mountain stretcher (as used and recommended by the Swiss Alpine Club Central Committee)*
- *Parachute harness*
- *Fell and Rock design of 1931*

On the first aid and medical side, the report gives a detailed list of the items which, it is considered, should accompany the stretcher. It is not necessary to record the entire list here, as much of it refers to the usual first aid material and appliances. All the items are packed and kept in two rucksacks. The more specialised items include ropes, arm and leg splints, feeding cup, sugar and other material for hot drinks and for the relief of pain; also slit eiderdown bag with detachable waterproof cover, hot water bottles, kettles, and a paraffin vapour stove. (It will be realised that, in the case of a badly injured man, warmth may be one of the most essential requirements.)

The stage that we have now reached, therefore, is that the Joint Stretcher Committee has given us a working solution of the problem put before them, namely, a specification of what appear to be the most suitable appliances and equipment to have available against mountain accidents. It remains to arrange for the provision of such equipment where it is most likely to be needed. A first step is being taken, as previously mentioned, in the provision of several stretcher and equipment sets in the Lake District, and one in Wales. There are other centres, however, both in these areas and elsewhere, at which such rescue equipment should be available, and it is hoped to interest other mountaineering and kindred clubs or organisations in the question. Steps in this direction are now under consideration.

The work done by the Joint Stretcher Committee has been very painstaking indeed. Whether further experience calls for much modification of their findings or not, their labour has been fruitful. We are all in their debt for the great amount of time and trouble spent in investigating and working on the problem.

The joint committee comprised C P Lapage (chairman), B S Harlow, Wilson H Hey, A S Pigott, L H Pollitt and Eustace Thomas.

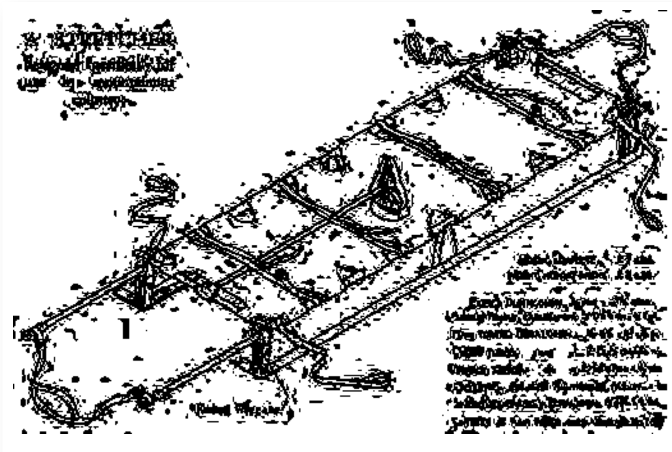
I am indebted to Eustace Thomas for the provision of the accompanying drawing. R.G.

Eustace Thomas

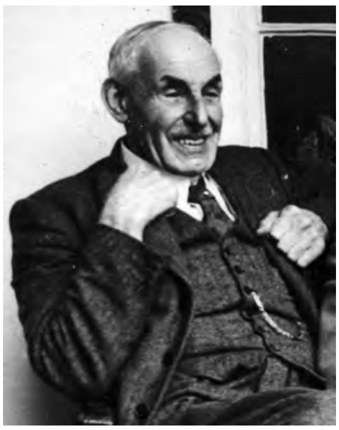
Eustace Thomas (1869–1960) was the principal technical expert on the Joint Stretcher Committee. He studied at Finsbury Technical College, and then moved to Manchester in 1900 to join Bertram Thomas (Engineers) Ltd, his brother's company. He joined the Rucksack Club in 1909 and the Alpine Club in 1923, and was the first Englishman to climb all known Alpine summits over 4000 metres, numbering 83 peaks in 1928.

Such was his enthusiasm on these Alpine holidays that sometimes, when his energy exceeded that of his guide, he would find it necessary to hire a second guide as replacement.[14]

So, as a direct result of the work by the Joint Stretcher Committee, the well-established Furley stretcher was, at least in the mountain rescue environment, superseded in 1934, by a purpose designed, Thomas mountain rescue stretcher. This was the first British stretcher design to focus totally on the difficult ground and conditions typically encountered during mountain rescue operations.



Eustace Thomas's original drawing



Eustace Thomas at the Old Dungeon Ghyll Hotel, Langdale in 1952 Photo: C D Milner

[14]Reference: Sid Cross and Joe Walmsley

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Note: it was Dr Hugh Owen Thomas (1834–1891) who invented the various types of Thomas splint, not Eustace Thomas of stretcher fame. Hugh Thomas, a British surgeon, is considered by many to be the father of orthopaedic surgery.

The Thomas stretcher

The Thomas was fundamentally of aluminium construction, having a canvas bed panel, extendible handles at each corner and wooden skis to permit sledging and to lift the casualty well clear of the ground. In much the same style as the Furley stretcher, which was designed to collapse sideways into a narrow load for easy carrying, so too was the Thomas stretcher originally designed to collapse sideways, again to make it easier to carry by two people along narrow paths and tracks. This facility was later eliminated to reduce cost. Consequently, the Thomas became a rigid one-piece stretcher and, as such, more cumbersome to carry out to the scene of an accident than was originally intended by the Joint Stretcher Committee.

This design had many aspects designed specifically for open country remote rescue. Two purpose-designed shoulder carry harnesses were provided for the stretcher bearers, one at each end. To aid visibility at the rear and to provide clearance between the casualty's feet and the front stretcher bearer, extending telescopic handles were fitted. These could be locked into place once deployed and were also captive within the main side tubes of the stretcher so as to prevent their inadvertent loss. Wide straps and simple buckles were provided to secure the casualty to the stretcher.

Originally, the Joint Stretcher Committee Thomas stretcher was fitted with narrow (1.5" x 1.25") angled aluminium alloy skids, which were detachable. Before long, these were replaced, one each side, by wide, full length wooden ski-like skids having curved up ends. These curved up ends were to assist dragging procedures over rough ground and the width underneath the stretcher sides helped to reduce sinking into soft mud. (Technical note: ski width does not influence drag resistance if the ground is hard enough to support the weight of the loaded stretcher).

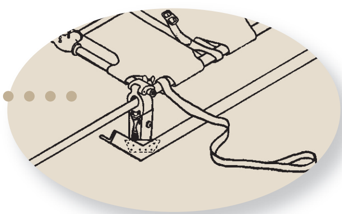
Herein lies the only fundamental design flaw which was not originally present. The main frame of the stretcher was lifted up above the ground by about eight inches, by means of shaped aluminium castings. The flaw originated from the moment these corner vertical support castings were modified, possibly to accept the new wide wooden skis.

Why this was never eliminated at the early trials, remains a mystery. It was to the bottom of these four castings that the flexible wooded skis were securely attached. So, as the skis flexed, quite appropriately, under the weight of the casualty as the stretcher was dragged over rough ground, they applied a bending force on the casting foot leading quickly to early stress, metal fatigue and premature breaking. Many examples of exactly this damage have been observed. This was not part of the original design as a close study of the original drawing will illustrate.

The canvas bed wrapped around the main side tubes and was tensioned by means of cord underneath. So, if contaminated, the bed could be removed for cleaning, although in practice this was seldom done.

Gradually, cost cutting was extended, various other components of the original Thomas stretcher were either eliminated or downgraded. The facility to enable the stretcher to collapse longitudinally had already been completely removed; the cost of each of the four corner castings was thereby reduced dramatically.

Next, the 'cost-cutters' struck at the telescopic handle mechanism. Much of this was internal and thus hidden from view. An ideal 'economy' target one might say. The original components provided to retain the handles, be they stowed away or extended, were also gradually downgraded. This degradation soon led to operational problems and the handles would be difficult to extend, or if already extended, could be difficult to push back into their respective main-frame side tubes. Again, not as the JSC had originally intended.



Original JSC design (right) and the later modification (below)

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It could be argued that, if the Joint Stretcher Committee had remained active for some time after completion of the original Thomas stretcher design work, they would have prohibited some of these cost reduction measures and fine-tuned the corner castings to accept the now more flexible, wooden skis. Had this been achieved and the cost-cutters thwarted, the Thomas stretcher might well have continued to give good service right up to the present day. Sadly, this was not the case.

One could argue that, if these so called cost-cutters were occasionally lowered down an exposed crag strapped to a stretcher that they have degraded by cost reduction, then this might focus their thoughts, to the advantage of the casualty rather than upon the bank balance.

Not every cost-cutting procedure necessarily degrades design or function. There is economy to be found by batch production and the associated build up of a stock of new stretchers for subsequent issue as required.

After a while, about 1965, a 'string vest' style bed panel replaced the original canvas bed. This was lighter and offered less wind resistance when the stretcher was being carried empty – there being no longer any scope to collapse the stretcher longitudinally.

Peter Bell

In 1967, Peter Bell began the manufacture of hood-style head cages. The framework was originally of welded aluminium tube and dimensioned to match the Thomas stretcher.

In 1968, George Fisher, the then team leader of Keswick MRT, sought Peter Bell's guidance on the possibility of dividing the Thomas stretcher across the centre so as to enable a two person independent or backpack load. But Bell had actually already devised a way of achieving this.

Part of this redesign involved the introduction of a wire mesh bed panel for the first time on mountain rescue stretchers. Bell carried out about twenty such conversions until the further supply of new Thomas stretchers for conversion was refused by the then manufacturer of the Thomas stretcher – W Kirkman of North Street, Manchester 11. Some four months after that, they offered their own 'transverse split' version of the Thomas, complete with a wire mesh bed.

The specification for the 'Thomas Mountain Rescue Stretcher' put forward by W Kirkman read as follows:

Due to the special and widely varying weather and terrain conditions under which a mountain rescue stretcher may be brought into service, the following requirements must be met:–

1. The stretcher must be of robust construction to withstand the severe stresses to which it will be subjected during use.

2. At the same time minimum weight is essential.

3. The patient will normally be carried prone, but it must also be possible to lower the stretcher by rope down a steep or even vertical face. Hence, the patient must be held securely but comfortably up to the vertical and his body must be kept off the rocks during descent.

4. Runner skids are desirable for descent of snow slopes or screes.

New style head guard in use during a display by Keswick MRT for the Duke of Edinburgh
Photo: D J Evans

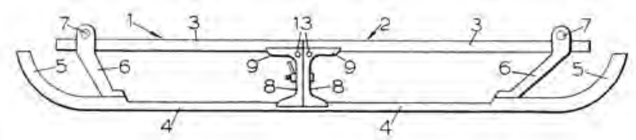

Diagram: From the 'stretcher apparatus' patent document, submitted by Peter Bell 15 February 1967
Below: The 'Split Thomas' stretcher

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5. Journeys on the stretcher will often be lengthy and the principal bearers, at head and foot, should be able to take most of the weight on their two shoulders. They should also be able to turn so as to move in any direction.

6. The stretcher must be capable of loading into the usual ambulance, and should not exceed 6' 6" in length. Extending handles are desirable so that the rear bearer can see where he is placing his feet.

7. Side shoulder straps should be provided to allow the side bearers to assist in lengthy journeys over rough country.

8. The stretcher bed must be of light strong mesh to present minimal wind resistance, maximum durability against damage by rock snags, and freedom from rotting and staining.

9. The materials used in construction must have minimum susceptibility to corrosion.

The Thomas stretcher meets those requirements as follows:–

The rectangular frame construction comprises main side members of 1½ dia. 1/16th thick Duralumin tube dowelled into aluminium alloy foot castings, to which are bolted renewable runner skids, the side assemblies so formed being braced apart by 1" dia. 1/8th" thick Duralumin cross tubes. 1" dia. Duralumin tube is also used for the extending handles, which are an easy fit inside the main side tubes to avoid jamming. The stainless steel plunger, phospher bronze spring and gunmetal trigger forming the handle release mechanism is supplemented by a phospher bronze safety anchor loop within the side tube to prevent accidental complete withdrawal of the handle.

Adjustable yoke straps enable the end bearers to turn or move in any direction, to facilitate level carrying when descending difficult slopes.

Four side straps enable helpers to assist in carrying. The strap is carried over the shoulder, one hand in the end loop, while the other hand grips the side tube of the stretcher. The strap slides easily over the shoulder, as adjustment is required on rough ground.

In practice, it is frequently necessary to lower the patient down very steep rocks. He may have damaged feet and legs, but is less likely to be injured in the crutch. The attachment, in addition to providing splint rods to which the limbs may be supported and immobilised in traction, allows the weight to be carried from the crutch on the padded crossbar, or saddle, whilst the tying on straps hold the patient securely on the stretcher. The skids fend off his body from the rock face during descent.

Length (handles closed): 6' 4½"
Width: 1' 8"
Height: 9"
Weight: 45lb
Ex works prices November 1969:–
Standard stretcher: £65.14s.6d
Demountable stretcher: £79.5s.6d.
A removable head shield may be fitted if required: £3.18s.9d.
Conversion from standard to demountable: £15.12s.6d.

An article in the Alpine Journal 1968, Number 317, by Ron James, titled ‘A comparison of mountain rescue stretchers used in Britain’ clearly places a strong preference for the official Mountain Rescue Committee Thomas stretcher built by Kirkman’s.

At this stage, Peter Bell, having outstanding orders, had no clear alternative but to design, develop and manufacture his own stretcher to satisfy these orders. This he achieved, obtaining a full patent for his design in 1972 – the start of the ‘Bell Stretcher phase’.

Donald Duff on Sheep Fank Wall, Glen Nevis with the Duff stretcher, circa 1956

The Duff stretcher

An exception to the dominance of the Thomas stretcher was that designed by Dr Donald Gordon Duff. The Duff stretcher was in use during the 1950s and 60s and a few were taken on the British Everest Expedition in 1953.

Dr Duff (1893–1968) spent some time in Denbigh, North Wales before becoming a consultant in Fort William. He was one of the pioneers of mountain rescue in Scotland.

The Duff stretcher

A short history of stretchers

His first stretcher (Patent 579493) was filed in 1944 and was, essentially, a wheeled stretcher. The wheel device was detachable. In March 1950, he adapted his stretcher design for use as a combined load carry device, handcart and stretcher. (Patent 678108).

This stretcher had a tubular steel frame and no handles. Channelled steel runners extended along two thirds of the stretcher and a wheel and undercarriage could be added. For transport to an incident, the runners could be detached and the remainder folded in two for backpacking.

There were various other stretchers designed for especially difficult conditions – many originating in Europe and America – and, occasionally, one would migrate to the UK. Many patents have been sought over the years both in Europe and the USA but it was only the Stokes, Mariner and Piguillem stretchers, which filtered across the seas into Britain in connection with the mountain rescue environment.

Clearly these external influences had an impact upon the design of stretchers in Britain. For example, it would seem that the Piguillem folding stretcher made a distinct contribution to the design of the Alphin folding stretcher. These stretchers, including the Piguillem and Alphin stretchers, are described in greater depth towards the end of this article.

Scotland and the MacInnes Mk1 through to Mk 7, together with additional developments to stretcher equipment

In parallel with the Thomas stretcher, Hamish MacInnes in Glencoe began to create an effective solution to casualty carry procedures, based upon an aluminium tube concept.

Hamish MacInnes OBE BEM, climber, explorer, innovator, author and rescuer of worldwide renown, was a founder member and former team leader of Glencoe Mountain Rescue Team.

When Hamish MacInnes came to live in Glencoe in the late 1950s technical rescues were becoming more frequent, yet there was no means of equipping the local volunteers. At the Clachaig Hotel, Glencoe on 19 December 1961, Hamish called a meeting with the purpose of forming an official mountain rescue team. It's interesting to note that the only other climber to attend that meeting was his friend, the late Dr Donald Duff FRCS, one of the early pioneers of Scottish Mountain Rescue and founder of the Lochaber Mountain Rescue Team.

After approximately two years trial, the first folding, all aluminium alloy stretcher, the MacInnes Mark 1, provided with 3" wide skis, was produced for the Glencoe MRT. This Mark 1 stretcher was introduced shortly after the Glencoe team was founded, and replaced their Thomas stretcher in 1961.

The early Mark 1 had folding handles and a net style bed. DeHaviland Aero constructed the frame, which was partly welded. Shortly after, a single 28" wheel, complete with hub brake, was added. The sub-frame to support this wheel was also formed from aluminium alloy tube.

Three years later (17 August 1964), based on operational experience, telescopic shafts were introduced instead of the original folding handles. Carrying yokes were provided front and rear and an integral 4-point sling set for winching was added – total weight 14kg. And thus, the original Mark 1 was upgraded to Mark 2.

There followed a rapid process of advancement spanning over the next twelve months or so.

Next (still in 1964) came the Mark 3, distinguished by the addition of Day-Glo fabric with overlaps for casualty protection. Casualty attachment was upgraded to 1" wide nylon straps, together with a stirrup, to provide additional support for the casualty during vertical lowers.

The Mark 4 saw the change from 1" to 2" wide casualty straps. A twin wheel assembly was introduced comprising two spherical wheels mounted in tandem. Soon after, now 1965, the Mark 5 evolved, also characterised by a twin wheel assembly, but this time with the wheels side by side.

Some interesting developments occurred between 1965 and 1968. Hamish devised a prototype shell style capsular stretcher. Mo Anthoine of Snowdon Mouldings constructed this for MacInnes using glass fibre. This novel design was found to be heavy and not exactly wind friendly and never went into commercial production.

About the same time, MacInnes made a batch of lightweight aluminium alloy stretchers for the Red Cross but these were not designed for, nor were they

Hamish MacInnes

A short history of stretchers

intended for, use in mountain rescue environments.

1974 saw two ultra lightweight stretchers, built for use at high altitude. Also that year, he introduced a motorised sub-frame based on a single wheel and a two-stroke engine.

1979 saw the introduction of the Superlite. A one piece folding aluminium stretcher provided with 70mm runners. No carry shafts but a set of transverse shafts could be added if required. A four-leg lift harness (usually fixed to the frame) was also included.

There followed a development gap, as the existing range of stretchers was providing good service. That is, until 1994, when the Mark 6 was introduced. This was a split stretcher, based upon the design of the earlier models, still constructed from aluminium alloy tube but all welding had now been eliminated. A foam bed layer was fixed to the alloy bed panel. A six leg, stainless steel, sling set having colour coded legs was included for the first time. This sling arrangement was similar to earlier versions but took into account a requirement for additional support at the middle of this new split stretcher.

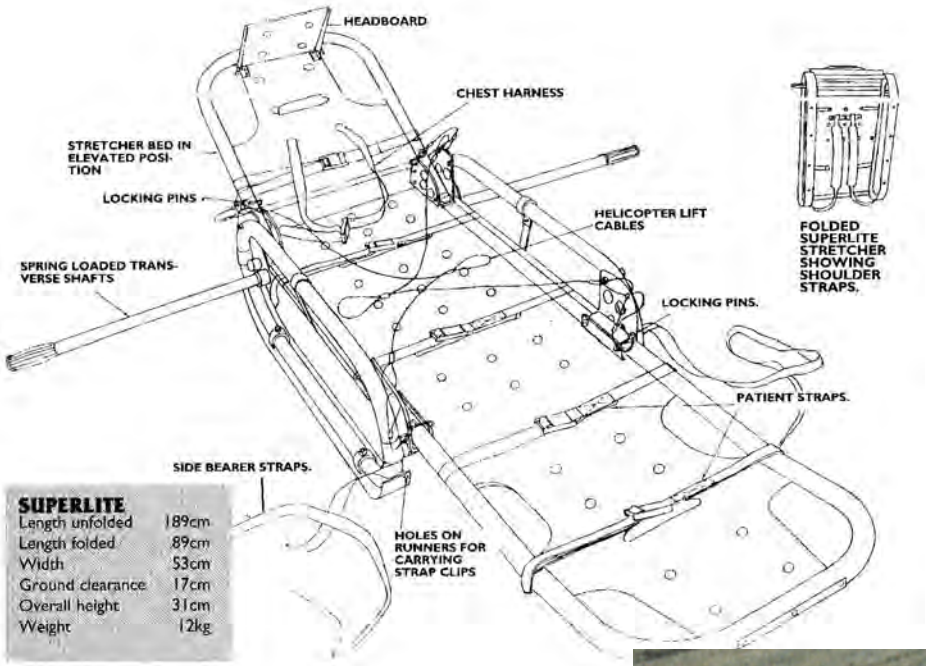
In 1996, backpack carry frames were added, which also facilitated the downhill carry of the loaded stretcher. A 'flip back' stainless steel head guard was added; the length of the bed area was increased and a new type of puncture-proof alloy wheel introduced, mounted on a folding sub-frame with rapid attach mechanism.

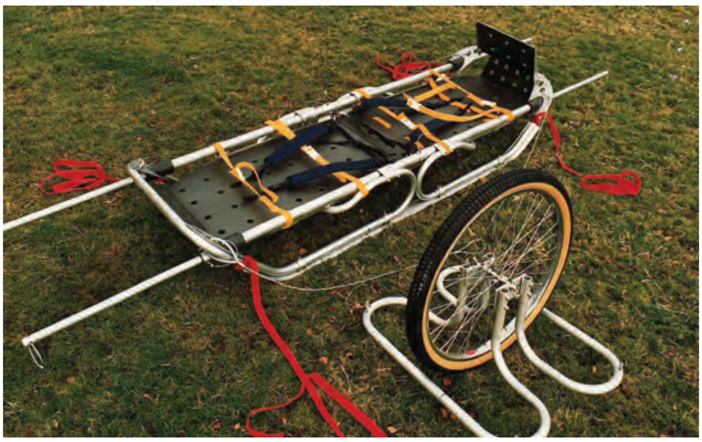
Original drawing for the MacInnes Superlite stretcher

The lightweight stretcher was developed due to the extensive use of helicopters in mountain rescue work throughout the world. It can be carried speedily to the scene of an accident by one person and is ready for use in seconds. There are no projecting parts to foul when being winched by helicopter and lift wires are standard.

Even though this is one of the lightest MR stretchers ever developed, it can still be used for the rough and tough carry-out situations, should helicopter assistance fail to materialise. It is equally suited to cableway and cliff use. The alloy patient bed gives maximum protection together with excellent rigidity for spinal/neck injuries. A fold-flat head protector is standard. Patient contact surface is coated in closed-cell foam.

The superlite has adjustable back and optional spring loaded transverse shafts. The transport wheel clips onto the runners with hook bolts. Stainless steel drop pins are used for locking the stretcher in position.





Above: The basic frame of the Superlite
Left: The Mark 6 with single wheel and alloy head guard

A short history of stretchers

Mark 6 Twin Wheel Unit
Photo: Hamish MacInnes

In parallel with the development and deployment of the Mark 6, Hamish also created a totally new stretcher based on a three-section concept.

The MacInnes Mark 7

Composite fibre materials were introduced in conjunction with Titanium alloy where feasible.

The stretcher shell is constructed from a high-strength composite material having high resistance to abrasion and low temperatures with an inner lining of carbon fibre. The bed shell is sandwiched with high impact foam.

Essentially the bed area is in three sections, with both ends folding over onto the central portion, reducing bulk considerably and making it compact for backpacking.

At both the foot and head ends are mounted carry shafts and grab handles made from titanium tube. Anchor points are provided for the 6-leg, colour coded, sling lift facility as on earlier MacInnes stretchers.

Various wheel devices were introduced and continue to be available – most can be fitted on scene in a few seconds. This design is aimed principally at rescue operations where lightness and speed is paramount and is equally suitable for high altitude mountain rescue and conventional mountain rescue operations.

Mark 7 stretcher
Photo: Hamish MacInnes

Sid Cross, founder team leader of Langdale Ambleside MRT, with the first Mark 1 Bell stretcher

Bell stretcher range 1972 onwards

All Bell stretchers are quite similar although, over the years, there have been innovations.

To summarise, the Mark 1 was constructed from steel and

A short history of stretchers

painted; the Mark 2 was essentially the same as the Mark 1, but constructed from stainless steel and fitted with folding handles; the Mark 3 was the Mark 2 fitted with integral lift rings; and, finally, the Split Tangent comprised a stainless steel frame with rounded corners and detachable extension handles.

The Mark 1

These early Bell stretchers had short, rigid handles, finger guards and nylon coated wire mesh beds fixed to the ends of the stretcher halves, half-inch casualty attachment straps and an aluminium head guard. Later, extension handles were supplied. The Mark 1 stretchers were made of steel and usually painted blue.

A move to stainless steel created the Mark 2 range in 1981.

The Mark 2

All Bell Mark 2 stretchers were made from stainless steel. Folding handles were introduced and the bed panels were attached at the corners only to provide clearance for handlers and improve the shock absorption characteristics of the bed.

In 1984, the handles were increased in length and the uprights replaced the side wires that were getting in the way when the stretcher was used horizontally as a working platform. These uprights also improved the rigidity of the stretcher frame.

The Mark 3

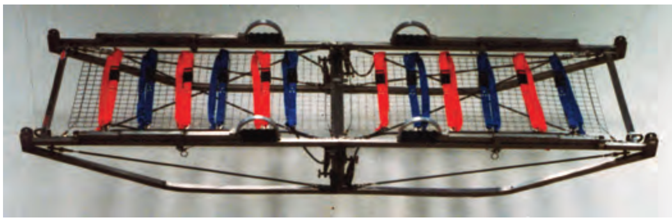
1988 saw the introduction of integral lift rings and the new Bell folding head guard.

In 1994, to reduce weight further, the square tube was changed to round tube on the head guard, uprights and handles, and the handle length was decreased to 700mm – these changes did not result in loss of strength.

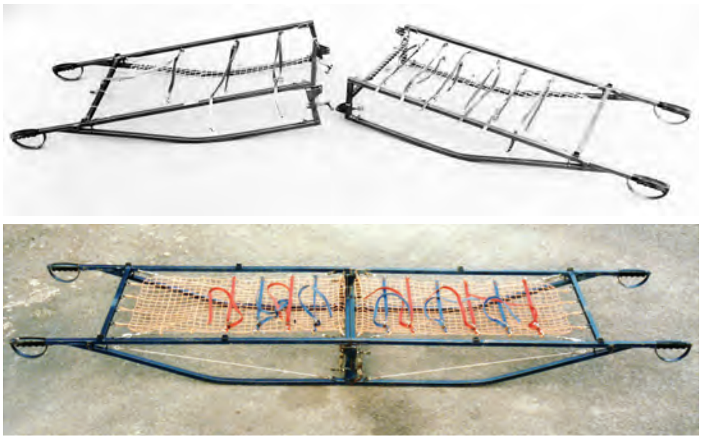
The last Mark 3 was made in March 2002. It weighed just less than 15kg without handles or head guard.

A modular upgrade to the Mark 3, was introduced in 2001.

This late Mark 1 has modified handles for use with RAF Wessex helicopters



The stainless steel Mark 2



Bell stretchers have always split into two halves with a symmetrical joint

The Mark 3 Bell stretchers all had integral lift rings

A short history of stretchers

The Bell Split Tangent stretcher

The halves of the Split Tangent can be nested for easy storage and transport and one person can easily backpack both halves, using a Bell carry harness.

The 'Ogwen' stretcher

The Ogwen is a multi-part stretcher, designed by members of the Ogwen MRT in 1989. It was intended for rapid deployment, within a rucksack, to an accident site. The frame and associated bed panels were then assembled on scene ready for casualty evacuation.

This was found to be a good arrangement for some situations but was not universally suitable.

Keswick MRT and the Thomas stretcher

To special order, in 1995, Peter Bell constructed four brand new Thomas-style stretchers for Keswick MRT. A few modifications were incorporated and these 'new' Thomas stretchers were almost indistinguishable from the original design concept.

Most of the cost-cutting modifications, introduced after the original JSC design, were eliminated except for the original lengthways collapse facility.

The Alphin stretcher

The Alphin stretcher (patent GB2175216A) was designed by David Allport and Dr Andrew Taylor of Oldham MRT and produced by Troll Safety Equipment in 1986. Designed as a folding one-piece stretcher, it has a polycarbonate bed and short spinal protection strip below the bed. It's narrow shape, useful for constricted spaces, means it is popular with industry and the Fire Service.

The Katie stretcher

Recent years have seen the MRC of Scotland able to develop a new stretcher, thanks to the generosity of benefactor George Smith[15] whose daughter, Catherine, tragically died of altitude sickness in 1991, during her honeymoon trip to the Himalayas.

On his death, he asked that part of his estate be used by a Scottish charity in pursuit of research into altitude sickness and mountain safety in Scotland. The subsequent £40k donation came with three requirements – that it be used for charitable purposes; was administered in good faith; and that the name of Catherine Smith be associated with its development.

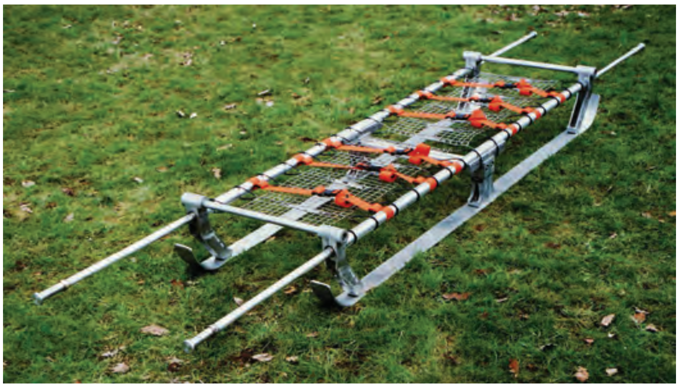
The new stretcher – officially called the Catherine Smith Casualty System, but more commonly referred to as the 'Katie' stretcher – has a three piece load bed, with a quickly detachable head guard and wheel unit.

The lower half of the load bed is a composite shell structure for drag ability, while the top is a lightweight metal frame structure providing lift and tie-on points. The load bed incorporates storage for gas bottles and casualty insulation. The wheel unit utilises a rubber torsion suspension system, with a cheap and durable wheelbarrow wheel.[16]

Initially, a subcommittee was

The Bell Tangent stretcher: shallower and having rounded corners

A range of optional wheeled subframes was introduced in 2005



The 'new' Thomas stretcher, purpose-built for Keswick MRT in 1955

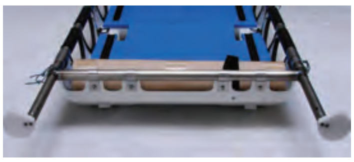
[15]Mountain Rescue by Bob Sharp & Judy Whiteside. Published by Hayloft ISBN 1 904524 39 7
[16]Casbag. September 2008

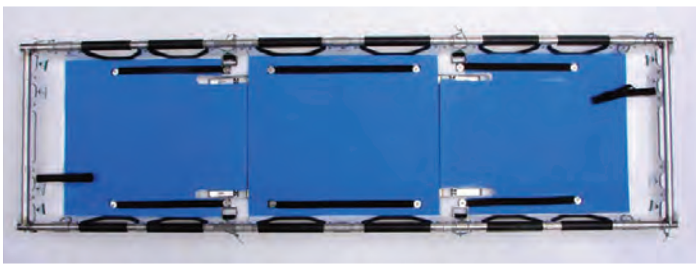
A short history of stretchers

formed, of interested members from across Scotland, with a remit to design a new system based on a very comprehensive specification of desirable features. The first prototype Katie was completed in February 2004, and development work has continued over the intervening years, with input and feedback from the majority of Scottish, and some English teams, led by Jamie Kean of Kintail MRT. Snowsled Polar Ltd completed the project at the production stage.

The stretcher is light, immensely strong and incorporates a number of unique features such as the ability to split into three sections which stack together – which means the entire stretcher is a one, rather than a two, person carry to the cas site. Storage space requirements are reduced and even the length of the stretcher can be adjusted. Features include an effective head guard and locations for the carriage of oxygen and Entonox bottles. The smooth exterior eliminates the problem of catching on obstacles such as rocks and trees and enables sledging when conditions allow. The stretcher has flotation properties, a unique capability for water-based incidents. There is also a wheel system which fits inside the three stacks when the stretcher is being transported to the cas site or in storage.

The Katie in action (above) Photo: Jamie Kean





Motorised undercarriages

Three different devices have been located during research, but possibly there are more out there somewhere.

Hamish MacInnes, Peter Bell and Mike Mitchell all constructed and trialled motorised units based on a lightweight chassis and two-stroke petrol engine. The so called 'Fellbounder' designed and built by Peter Bell for Ullswater OBMS went into a short production run but was not economically viable.

The original format of the Fellbounder

The influence of stretchers from abroad

Europe

Mountain rescue conferences were, by the '80s, enabling the exchange of ideas and experience to a much greater extent than ever before. At one of these, in 1983 at Glenmore Lodge, Aviemore, in Scotland, there was a display to illustrate some of the design concepts originating in Europe. These stretchers were rarely seen and hardly ever used in Britain. Nevertheless, this display had a marked influence over some of the stretcher designs that later developed in Britain.

A short history of stretchers

The Mariner mountain carrier

Wastl Mariner

Sebastian 'Wastl' Mariner (1909–1989) was an Austrian alpinist and a pioneer of mountain rescue in Austria, famous for the development of a wide variety of equipment intended for use in helping injured climbers. His 'mountain carrier' or 'one wheel litter' is still in use in mountain rescue today. His invention of the ice screw, special carabiners and various ski bindings all, incidentally, contributed to increased safety in the mountains. The first really usable lug sole for climbing boots was also invented by Mariner. His idea of wanting to help the victims of climbing accidents lead to the founding of the IKAR, the International Commission for Alpine Rescue. Indeed, for his untiring and courageous work in mountain rescue, he was repeatedly honoured, receiving the title of 'Professor' from the President of Austria – an honour that his modesty kept him from ever using.[16]

From 1939 to 1955 he was head of the mountain rescue service in Innsbruck. The School of Mountaineering Austrian Alpine Club was founded by him. His book 'Modern mountain rescue technique', translated by Otto T Trott and Kurt G Beam into English, paved the way for the development of alpine rescue in the US. Ironically, the so called European 'father of mountain rescue' died just one day after the death of the North American 'father of mountain rescue', Ome Daiber.

The Mariner mountain carrier was made of thin steel tubing, and consisted of two parts. Two pairs of longitudinal bars, the lower more curved, the upper less, met at acute angles and were fixed together by joints at their ends. In the middle they were firmly connected by bars which could be shifted to allow rapid disassembly and assembly of the device. A locating pin prevented independent loosening of the two bearing surfaces. Lever handles were adjustable to four positions and independent of each other.

A slightly dished tub of plastic served as a bed and shelter for the casualty, who would be secured into the stretcher by four pairs of straps.

The versatile Mariner was deemed suitable for moving the casualty over all grounds, for lowering on steep rocks, sliding down slopes, driving on narrow and steep mountain paths with the aid of a single wheel, driving with skis on glaciers and for carrying in the same way as an ordinary stretcher.

The Tyromont stretcher

The Tyromont mountain stretcher was also designed for transport of injured persons across all kinds of terrain, for roping up or down, dragging over rock or ice, carrying and riding on the single wheel – wherever a good protection of the injured and a rugged device are required.

Today's model, less than 14kg in weight, is divisible into three loads of approx 4.5kg. The frame is manufactured from lightweight, high precision steel tubing with a red powder-coated frame.

The circle-sector shaped frame design enables easy handling in all kind of terrain and the flat lying area for the injured is totally protected from side impacts by a rail that surrounds the whole stretcher – which also serves as a grip, allowing rescuers to hold the stretcher at any position. The two base runners are shaped in a circle-sector and retracted to the centre to provide more space for the legs of the rescuer when roping up or down steep rock.

The Tyromont Universal (UT2000) can be divided into two halves,

[16]Mountain Rescue Bergtrage, the newsletter of the Mountain Rescue Council, Seattle, No 134

A short history of stretchers

The Tyromont stretcher

each weighing 3.5kg, for transport on the back of two rescuers. Each half can also be used as load-carrying frame.

The tubular frame is made from high strength Alumi-num-alloy and the durable plastic lying area is shock and scratch resistant. The stretcher features a wide, padded shoulder belt, detachable carrying belts for helicopter transport, and four multi-functional load-bearing belts for securing the casualty in place. The weight of the complete stretcher is 6.6kg with a load-carrying capacity of 2000kg.

Piguillem stretcher

The 'Perche Piguillem', adapted as it is to winch rescue, is the most frequently used stretcher by the rescuers of the Peloton de Gendarmerie de Haute-Montagneby in the mountains of the Mont-Blanc Massif[17]. It is from this design that the Alphin stretcher (see earlier entry) has evolved.

Saveur Piguillem was an alpine guide and, for almost 20 years until 1971, instructor of the French Police Alpinism Centre. Until 1986, he was head of mountain rescue in Grenoble, Val d'Isere and Chamonix. Thanks to his extensive experience and knowledge of the mountains, Piguillem created and built a variety of rescue equipment, including the stretcher which took his name, a walls winch, a tow for the evacuation of skiers and a tow for use with avalanche dogs.

The Piguillem is carried like a backpack to the scene of the incident.

From the USA and Canada

The Stokes Litter

Invented by Charles F Stokes (US Patent application dated 21 July 1905, Full Patent granted 8 May 1906. No 820026), this remarkable device was not just a means of carrying a casualty – it had a dual, and equally important role, as a splint. The original designs were such that the mesh support areas were pliable, and specifically designed to mould around the casualty to provide local support and immobilisation. Uniquely, the leg end was divided into two longitudinal sections so that injured legs could be separately splinted by moulding the wire mesh as injuries dictated. Adjustable foot pieces were provided so support could be available or traction applied.

One or both of the footrests was capable of providing vertical support if the stretcher was to be lowered or raised vertically – an important characteristic when used aboard ship.

The frame itself was of lightweight steel and, according to the patent drawings, joints were riveted. However, before long, tubular steel was used to increase rigidity and the joints were then welded.

It seems likely that there was strong rivalry between the British Royal Navy, represented by Neil Robertson Surgeon Commander, and the US Navy, represented by Charles Stokes Surgeon General. In so far as it is possible to compare ranks between the British and US navies, Charles Stokes outranked (and outlived) Neil Robertson.

That said, the common objective was a stretcher capable of splinting and lifting vertically an injured seaman. Both men finalised their respective designs in 1906 and both stretcher formats continue in use over a century later – a technical and humanitarian achievement.

Over the past 30 years or so, the titles 'Stokes Litter' or 'Stokes stretcher', have become more generic, almost a household name, and they are now available

The Piguillem stretcher

[17]http://www.hopital-chamonix.com/rescue.htm

A short history of stretchers

Charles F Stokes
Photo: Clinedinst, Washington, DC

in a wide variety of formats, including moulded plastic. The original design, which incorporated splinting and leg channels, has all but disappeared with the Stokes Splint Stretcher now a simple basket stretcher.

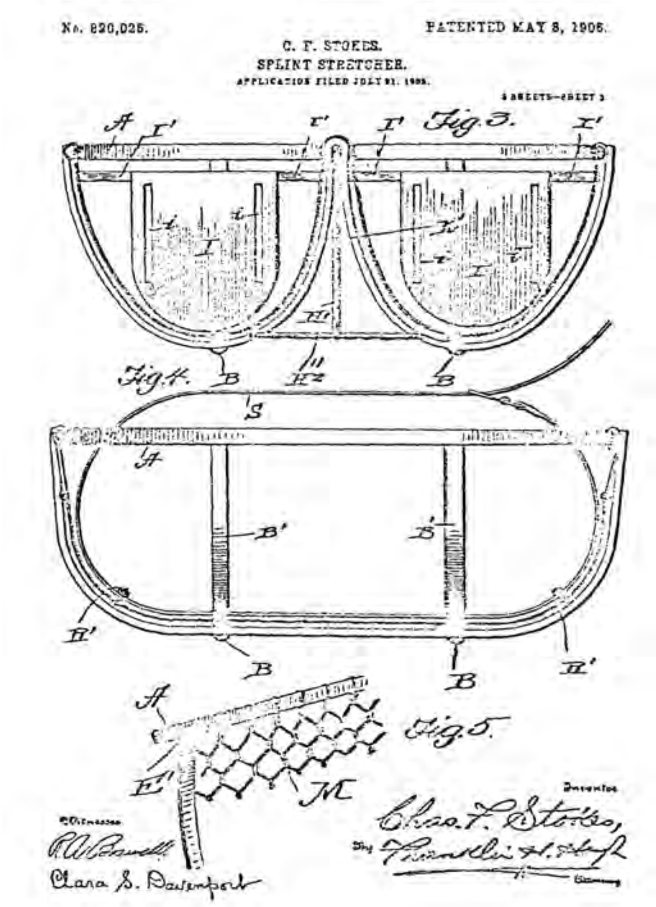
Charles F Stokes was the fourteenth Surgeon General of the United States Navy, and the eighteenth Chief of the Bureau of Medicine and Surgery. Born in Brooklyn, New York, on 20 February 1863, he was appointed from New York as an assistant surgeon of the Navy in February 1889, his first duty on the USS Minnesota. He was the first medical officer to command a hospital ship and was appointed as Surgeon General of the Navy in February 1910, holding office until 6 February 1914.

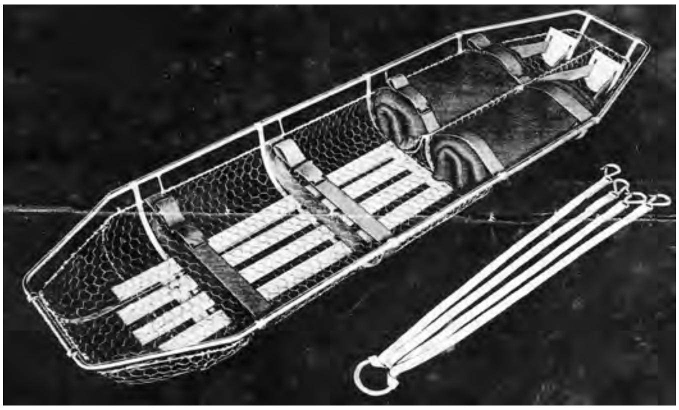
He was widely known as a skilful surgeon – a pioneer in abdominal surgery, he devised the first aid dressing which the Army and Navy used in modified form during the First World War, but is best remembered in the US Navy today for the stretcher he devised. The eponymous 'Stokes' has proved of remarkable value in the transportation of the sick and injured up and down the narrow ladders, and through the small manholes and hatches, on board ship. In it a patient could be lowered into a boat in comfort and, by simple fittings, the stretcher was made to combine splinting for fractures with the function of a litter for transportation.

The story goes that, in 1926, Doctor Stokes – who had retired eleven years earlier – was visiting the display of naval medicine in the exhibits of the American Medical Association held in Washington, DC. He showed much interest in the Stokes stretcher so the polite and efficient hospital attendant, on duty with the exhibit, explained the stretcher and its uses at great length. Only afterwards did the attendant learn that he had been explaining the stretcher to its inventor! Stokes praised him for his knowledge of the stretcher and its uses and expressed the hope that doctors on the hospital staff were as well informed.

After retirement, Admiral Stokes lived in New York City until his death on 29 October 1931, in his sixty-eighth year.

For some years, the Stokes Splint Stretcher was manufactured in military/naval supply factories for naval and other military use in the USA. Early in 1930, running parallel with the Joint Stretcher Committee in England, the Junkin Safety Appliance Company was formed in Louisville, Kentucky. It was in the early '40s that they began the commercial production





The Stokes Splint Stretcher Kit, consisting of the standard split stretcher, stretcher bridle and wool safety blankets

A short history of stretchers

of the Stokes-style litter, probably spurred on by an increased demand during the Second World War. By then the business was owned by John Junkin whose father had founded the business. John Junkin died a few years ago but, after the family was bought out in 1973, the business continues to flourish to this day.

(Note: Thanks to Chris Mercke and Rhonda, both of the Junkin Safety Appliance Company, for this background detail.)

The image (right) shows an early Junkin Stokes Splint Stretcher from their old Bulletin, number 108. The basket unit was then priced at $40, which provides an indication of the age of this illustration. This style of basket stretcher was rarely seen in mountain rescue environments here in Britain.

'The main stretcher frame is of 5/8" steel tubing and the cross braces and runners, of 3/16" x 5/8" flat wire. The basket is carefully constructed of 18 gauge, 1" hexagon mesh netting formed and securely fitted into the frame. Length 80½" – height 8" – widths: chest 22½", abdomen 22", thigh 21½", calf 20½". Rust-resisting aluminium finish. Individual carton. Shipping weight 34lbs.'

In 2007, a titanium tube option was introduced to reduce weight. A few of these titanium tube basket stretchers have been imported from America for evaluation. These have been manufactured for or by Traverse Rescue located at Mississauga, Ontario, Canada. Traverse Rescue is a Ferno Group Company.[18]

The Sked Rescue System

The Ferno Manufacturing Company (the foundation of the Ferno Group) was established in a rented building by Richard Ferneau in 1955 in Staunton, Ohio. The Ferno headquarters are now based in Wilmington, Ohio.[19]

Ferno Manufacturing started life as a manufacturer of cots and stretchers for mortuaries and ambulances.

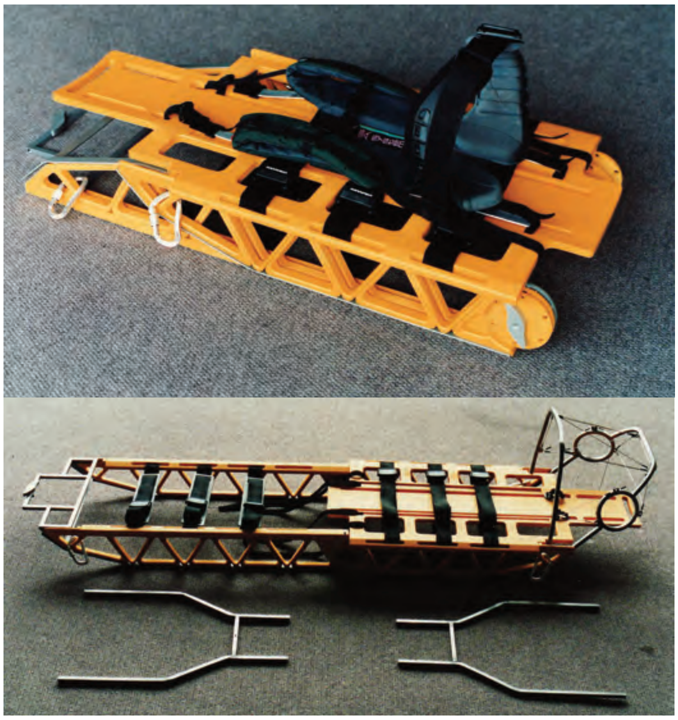
Note that the original 'Stokes' design concept of splinting as part of the integral design has lapsed. The mesh is not conformable and there is no facility for individual leg separation and splinting. Similarly, there are no foot plates to provide a casualty with that important sense of comfort, as injuries dictate.

Various plastic basket stretchers, designed for short carry, are manufactured in Britain or imported from the USA and Canada. Most mountain rescue teams do not regard these to be general purpose mountain rescue stretchers.

The Sked

The Sked is a fold-up stretcher device made in the US. It comes equipped for horizontal hoisting by helicopter, or vertical hoisting in caves or industrial confined spaces. When the casualty is packaged, the stretcher becomes rigid, the durable plastic providing protection for the injured during extrication through confined spaces. Popular with the military, the Sked is available in International Orange or olive green for military, SWAT and other tactical situations.

Again, this is not considered a general purpose rescue stretcher.[20]



Just one of many 'student' projects, by Thomas Bowthorpe, Newcastle upon Tyne

The student factor

Numerous other stretcher devices have been designed over recent years, many as Final Year degree projects. As such, they invariably incorporate novelty but rarely allow for the reality of mountain rescue and the harsh conditions and terrain encountered in the mountain environment.

[18]http://www.traverserescue.com [19]www.ferno.com [20]www.skedstretcher.com [21]www.snowsled.com

A short history of stretchers

Other stretchers

A few stretchers have been purpose built for limited applications – for example, a rucksack design which can be deployed as an emergency stretcher.

Snowsled Rescue (see earlier reference to the Katie stretcher) has, for some years, produced a most competent inflatable stretcher, a bit like a large airbed.[21]

Numerous designs have evolved for various applications other than remote area rescue or cave rescue but these have not been included in this article. Basically, if it is not a mountain or cave rescue stretcher, then it has not been included here!

The future... thinking about designing a new mountain rescue stretcher?

Proof load testing

Clearly different stretcher designs have different characteristics and intended prime functions. However, mountain rescue – indeed, any sort of rescue situation – is unpredictable in detailed terms. Any stretcher intended for use must clearly be fit for purpose, regardless of any unexpected complications. It must be both safe for the casualty and totally reliable, even outside the anticipated conditions.

The frame of the stretcher must be sufficiently rigid to avoid complications when a casualty having an injured spine is encountered. And the bed area of the stretcher should be sufficiently robust and rigid enough to enable external cardiac compression, should the need arise.

The weight of the casualty would not be known when a stretcher is despatched to the scene and it has to be said that people seem to be getting heavier. The additional weight of winter clothing and the possible addition of a gas cylinder need also to be included in the estimate of load. A load up to 25 stone weight (160kg) could possibly be encountered during a conventional rescue.

Regarding reliability, a reserve of rigidity and strength is required and this should be available whether the stretcher is loaded conventionally or when cantilevered over an edge or threshold. Probably doubling the test load to twice the anticipated maximum load would ensure reliability. At the same time, maintaining the maximum permitted central deflection.

From the above, a distributed load of 50 stone weight (320kg) minimum should not cause a vertical central deflection in excess of 30mm or 1½ inches and this test should be repeated on an inverted stretcher frame to prove reliability under cantilever conditions.

The frequency of this proof test regime would be a decision between user and manufacturer.

Manufacturers could be expected to declare a different maximum distributed load, in which case the proof test load, being twice the maximum working load would be altered accordingly.

Every stretcher must have a unique identifier so that any one frame can be directly related to a test report and traceable back to manufacturer. Any components designated as lifting points, such as lift rings, ought to be traceable and certified for lifting.

The design phase – will it be fit for purpose?

There is an ever present need to create an equilibrium between operational requirements, engineering options, inherent reliability, casualty compatibility, purchase cost and on-going maintenance costs. This equilibrium can also vary as new and lighter/stronger/cheaper materials become available.

The more problems one seeks to solve, the more complex the formula becomes. It is increasingly difficult to find one answer to solve an increasingly large number of conflicting priorities.

The list of priorities drawn up by the Joint Stretcher Committee and associated drawings, which subsequently led to the creation of the Thomas Stretcher, have already been covered.

So in general terms, what makes a good stretcher? Of course, as environment varies from area to area, so too do some of the design requirements. However, there remains a core set of characteristics which seem to be universally applicable.

It is of course fundamentally important that the casualty can be correctly supported and secured in a way which takes into account

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human anatomy. Flexing of the spine, in particular, must be kept to an absolute minimum. This must include limiting sideways flexing, as well as the more recognisable up and down flexing. The introduction of a vacuum splint between casualty and stretcher bed would probably eliminate most of these hazards.

Any mountain rescue stretcher should provide casualty security, be amazingly light, strong, inflexible, versatile, totally reliable, user friendly, available from stock and inexpensive. Essentially, only an engineer or draughtsman having extensive rescue experience should be the principal designer of any new stretcher.

A stretcher should ensure that the casualty could be transported without making any injury or condition worse. It should be possible to carry the stretcher without bumping into the casualty, so the ends of the handles should be well away from the casualty's feet. A slim or tapered stretcher might look good, but if the lifting points at the foot end are close together, lift slings, when under load, may pinch the casualty's legs and/or shoulders.

A stretcher should promote a sense of both comfort and safety. The stretcher should inspire confidence and be a contributory factor in the process of boosting casualty morale. A casualty should barely be aware of its presence, save for the feeling of security it provides.

Ideally, the stretcher should be equally unobtrusive from the carriers' viewpoint. The casualty is the prime focus of those attending to the injured. The stretcher should be an interface between casualty and rescuers. This implies that the stretcher should not only be designed primarily with the casualty's needs in mind but also that it should be able to cope efficiently with any problems that might be faced by those responsible for the evacuation. It should be easy to hold, devoid of places that trap fingers, and robust enough to remain undamaged even if handled roughly. It should be able to cope with whatever may be asked of it.

The design and manufacturing requirements become more demanding if a stretcher is of the split or hinged variety and is to be winched into a helicopter, suspended for rope rescue or exposed to cantilever and other reverse loads. A stretcher that does not incorporate joint symmetry, but functions on the basis that the weight of the casualty helps to hold the stretcher flat, is extremely vulnerable when subjected to a cantilever load.

On the crag, any portion of a stretcher may be subjected to a sudden reverse load, typically when the stretcher frame takes the full weight of the person guiding the stretcher.

An additional design constraint is that the framework of a stretcher, between two lifting points, should be straight. However, the two sides of the frame need not be parallel with each other.

It is useful, but not essential, if the stretcher is strong enough to be used as a working platform, thereby enabling rescue team members to stand on it to attend to the casualty.

The stretcher itself also needs to be capable of being dragged over rocks and scree, or lowered down (or raised up) a vertical face. It needs to be suitable for use either horizontally or vertically. Adequate ground clearance is essential and a facility to add lightweight skis is advantageous.

The stretcher becomes extremely vulnerable when subjected to a cantilever load

A strong head guard can be invaluable. Both fixed frame head guards and folding head guards are of considerable benefit to casualty security and safety on steep or loose ground.

The stretcher as a working platform

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Final comments

Best endeavours have been applied to ensure that readily available information concerning the history of, and the design of, mountain and cave rescue stretchers has been accurately recorded. Inevitably, some omissions will have occurred. However, the author has endeavoured to include all significant contributors to the gradual and ongoing evolution of rescue stretchers in the mountain and cave rescue environment.

Okay Phil... you can pass me the other half of the stretcher now...

Peter Bell started his career in mountain rescue as a teenager when, whilst walking in Ireland, he came across a walker who needed help and thus began a lifetime's pursuit. He was a founder member of the old Ambleside team and was their first team leader before the amalgamation with the Langdale team. He was subsequently deputy leader of the new Langdale Ambleside team, of which he was a very active member for many years. Awarded the Distinguished Service Award in 2000, he is also an Honorary Fellow of the University of Central Lancashire, and took on the role of MREW President in 2005. Recent years have seen his retirement from the production of his eponymous stretchers, but he remains far from idle, continuing to work to further the cause of mountain rescue both inside the organisation, and in the wider world outside.

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