

Eric Hardman Taylor, Baxter, Woodhouse & Taylor and Windak

His life's work in providing Flying Suits and breathing apparatus for Parachute Troops and Pilots during and after WWII

This account is given by his son, John Crawshaw Taylor

At the age of eighteen in 1922, Eric joined Baxter's as a semi-invalid after breaking his back playing cricket just as the Great Depression was starting. His accident occurred in May, just before his Matriculation Exams so he was without any certificates to continue in Secondary education or University. In later life he would say he had neither taken nor passed an exam in his life.

The Private Company, Baxter Woodhouse and Taylor¹ Ltd, had changed little over the years since Mr Baxter in 1836 had spotted the niche market for suit lining and trouser pocket material. The Cotton Industry tended to be horizontally integrated with specialist operators for each stage of the process; the whole structure was coordinated by the merchants like Mr Baxter who subcontracted out the work producing the finished bolts of cloth from the raw cotton.

Mr Baxter employed a Buyer whose sole function was to study the price of the Cotton Market in the Manchester Royal Cotton Exchange and then buy the raw cotton when he considered the price was right - fortunes were made and lost by buying at the right or wrong time. The bales of raw cotton were then transported to the firm's huge warehouse in the centre of Manchester in Sackville Street where the contents were inspected for quality. Quotations were then obtained to have this raw material spun into thread to a particular thickness and twist specification as the first step in the process. Each operation continued with quotations for weaving into grey cloth at so many threads per inch, bleaching and dyeing, filling, finishing and ironing with the cloth returned to the warehouse for inspection throughout its length between each process to ensure the quality of the finished bolts of cloth.

In the late 1880s Mr Baxter wanted to retire and Mr Woodhouse started to buy his way into the new partnership. But Mr Woodhouse had no wish to run the business so Mr Baxter then turned to his chief clerk, Mr John Crawshaw Taylor, who with the help of the County Bank became the sole partner in Baxter Woodhouse and Taylor.

Over 50 years later the partnership of Baxter, Woodhouse and Taylor had become a Limited Liability Company - always still known as Baxter's. When Eric Hardman Taylor joined the company, the cotton boom times had changed as it was now the Depression, with few gentlemen buying new suits or trousers. Small town tailors or large factory suit makers such as Burtons required little or no cloth to line their few suits or make trouser pockets. Baxter's could hardly support Eric with a subsistence wage - let alone a living wage. When possible, with little or no intellectual work required in Baxter's, he continued his self-education at the nearby Manchester Central Reference Library - to find something extra to occupy his enquiring mind and hopefully bring as his own contribution to Baxter's. He was made a director in November 1926.

¹ 'Taylor' being John Crawshaw Taylor, Eric H Taylor's grandfather and my name's sake great grandfather.

Eric found a lack of intellectual stimulation working in Baxter's in the slump when few organisations were wanting to pay for supplies of cloth for suit pocketings and linings. His energies went into creating his new cotton cloth to produce recreational outer garments to replace the traditional woollen jackets. In the late 1920s, the chemical giant, Imperial Chemical Industries, was working on long chain molecules that could be used to protect surfaces to make a hydrophobic coating. Eric investigated how his new windproof cotton cloth, woven by Haythornthwaite Mills to his specification, could use this new chemical treatment. ICI were enthusiastic and started working with Eric to achieve his goal for a new niche market product for Baxter's - a rain-resistant and windproof cotton cloth.

Eric involved himself in the detail of cotton from the raw material to the theory of spinning and weaving. Cotton was widely used for every sort of undergarment but had no use as external clothing – here wool was supreme. How could he make a windproof rain-resistant cotton cloth for use in replacing wool in outer clothing? The British Navy had used windproof cloth for their sails for generations - so what was the secret?

The Navy used a long staple linen fibre with a very tight warp and weft to give a cloth with a thick feel and no gaps between the warp and weft to make the cloth wind proof. Eric started commissioning special sample cotton cloths based on Egyptian cotton with the longest staple of raw cotton available, woven as tightly as the looms could be set up. One mill in particular, Haythornthwaite's in Burnley, was more vertically integrated with both spinning and weaving machines; Eric started working with them for his new specialist cloth.

Even when he had achieved his goal to his own satisfaction - there was no market. Everyone from their own personal experience knew that if you went outside on a windy wet night in your pyjamas, you got wet and the wind blew through and chilled you - there was no market for his cotton cloth as everyone knew it could not be rain-resistant and windproof.

Sir Wilfred Grenfell, the Labrador Doctor, lived and worked for 10 months of the year in Labrador. He only returned to Britain in the summer to lecture and fundraise for his medical charity work in the Arctic. Eric saw a flyer for his public lecture in Manchester and went along with his wife, Gwen to learn what he could from Sir Wilfred about polar clothing. After the talk, Eric invited Sir Wilfred out for a meal. The two men were quickly engrossed in their discussions and became firm friends. Gwen welcomed Sir Wilfred to visit and stay in their home, Brookside whenever he was lecturing in the Potteries, the Lancashire mill towns or the Yorkshire wool or steel areas.

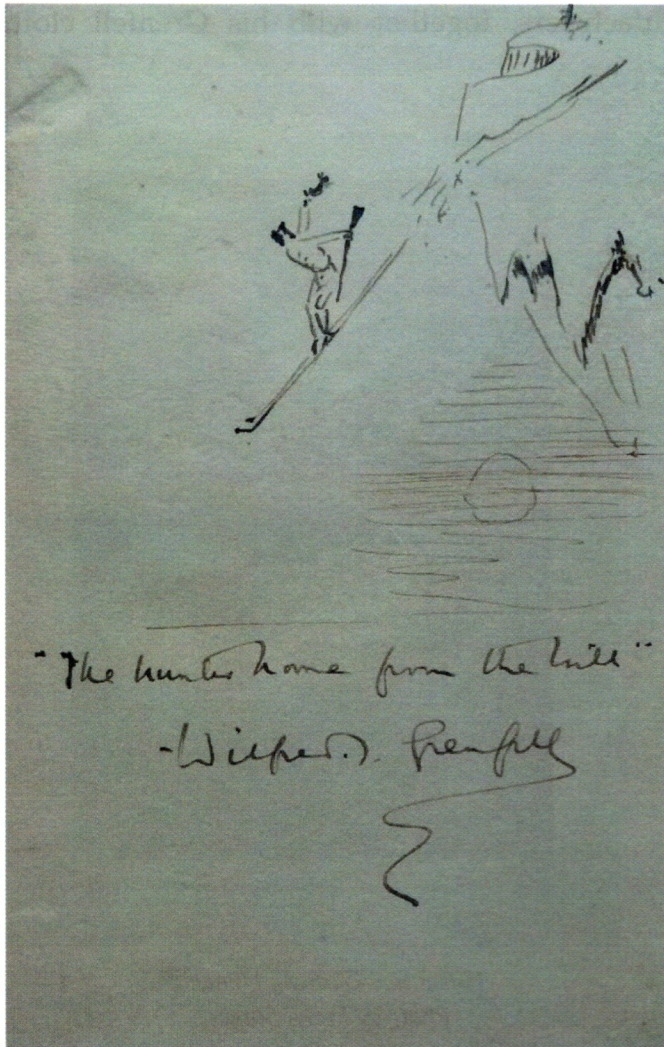
The late summer in the UK is noted as the silly season for newspapers from the lack of political news as Parliament is in recess. The Daily Express² and the Daily Mirror³ took up Sir Wilfred's cause and ran his stories of delivering Inuit babies in igloos and traveling round the settlements by dog sled tending the sick.

Sir Wilfred had adapted to the Inuit ways and wore sealskin trousers and a bearskin coat to keep warm in the Arctic winter. He was not at all convinced by the concept of outer garments made of cotton cloth but as a good will gesture to his friend he agreed to take and try a cotton suit made from Eric's new cloth. Eric adapted the Inuit tradition of an Anorak

² The Daily Express reported about Grenfell's work in the 1920s and 30s including a full page piece in 1939. Daily Express Archive, UKPressOnline.

³ Small caption story on page 13 of the 23 Oct 1922 edition of the Daily Mirror. UKPressOnline.

as the outer topcoat, modifying the Inuit concept to work with his new fabric. Thus, the adaptable English language has adopted another language's word as its own and *Anorak* has entered our vocabulary from my father's design. Sir Wilfred returned the following year to report to Eric on his findings using the cotton anorak and trousers. All his scepticism was confounded when trying out the new garments in actual winter conditions and to his surprise they were indeed windproof on a fast moving dog sled. What particularly impressed him was that the clothes were also draught proof. Bear skin was all very warm in theory but the odd piece of Cariboo horn with a rawhide loop to (unsuccessfully) try and keep the blown snow out could not compete with Eric's use of the new-fangled zip.



Sir Wilfred presented Eric with the latest reprint copy of his autobiography that he annotated with *The hunter home from the hill*⁴ together with his signature *Wilfred Grenfell* below a sketch of a hunter on skis zooming over a cliff carrying his rifle. With the complete endorsement from Sir Wilfred of Eric's cotton cloth in general and the clothing in particular, Eric asked a favour to call his new cloth Grenfell Cloth and to his delight Sir Wilfred agreed. It was to be a boost to getting more general acceptance by having Sir Wilfred's approbation.

Other groups were more open to the new clothing concepts for expeditions and mountaineering. Thus Eric equipped the Gino Watkins expeditions to Greenland in 1930-31⁵ and then in 1932; the Everest Expeditions in 1933 and 1936 with clothing and cloth for their lightweight tents. Another of Eric's innovations was to include a 4in wide extension piece from the centre of the back of the anorak that

could be brought between a climber's legs and clipped into the front at waist level. This *Beaver's Tail* not only retained the back of the anorak close to the mountaineer's buttocks but also provided thermal insulation on the inside of the *tail* to keep the vital male appendages from cold and risk of frostbite. Being clipped at the front at waist level, the *tail* did not restrict the climber lifting their legs.

⁴ *Requiem*, written by Robert Louis Stevenson is inscribed on his tomb in Samoa:-

Under the wide and starry sky, Dig the grave and let me lie. Glad did I live and gladly die, And I laid me down with a will.

This be the verse you grave for me. Here he lies where he longed to be; Home is the sailor, home from sea, And the hunter home from the hill.

⁵ Where the fabric used in Augustine Courtauld's tent saved his life when almost completely covered in deep blown snow for several weeks with him trapped inside.

The Leaders of these Himalayan climbing expeditions, Hugh Rutledge and Frank Smythe, proposed Eric as a member of the Royal Geographical Society and he was so elected on 18 November 1935. His cotton Grenfell Cloth had also been chosen by the specialist mountaineering tentmaker, Burns, for the Everest Expeditions lightweight high-altitude tents. Frank also gave Eric several of his photographs taken high up on Everest.

With the highly successful use of Eric's windproof and rain-resistant Grenfell Cloth on the Everest expeditions, Eric asked to use one of Frank Smythe's expedition photographs of a climber in profile against a Himalayan mountain background to promote his cloth. With Frank's approval, Eric commissioned new garment labels from one of the Macclesfield miniature tapestry woven silk label manufacturers, together with his Grenfell cloth trademark.



*The North Peak of Mt. Everest
Taken from above 28,000ft
Photo by Frank Smythe*



*Nilkanta – Garhwal Himalaya
Photo by Frank Smythe.
Both these photos were presented to EHT*

In the early 1930's, news of Eric's new cloth and the new sports clothing it spawned soon spread to Canada. Fred Deacon came from Belleville Ontario to Manchester to visit Eric and learn first-hand of the use of Grenfell Cloth and how to layout and cut jackets, trousers and anoraks. Fred was so impressed; he took a licence to use Grenfell Cloth and Eric's designs; he invited Eric and Gwen to visit him at Belleville. The young couple sailed across the Atlantic in June 1933 to New York and on via Niagara Falls by train to Belleville – it was their first holiday together out of the British Isles.

Deacon Bros had been set up by Fred's father and uncle who had started out as shirt retailers. They decided there was more money to be made from manufacturing shirts and

selling them throughout Canada. They built a custom designed factory in Belleville, in Art Nouveau style and expanded production into other sports garments as well. Fred had taken on the business after his father had retired and too was looking for new lines such as sportswear to expand their clothing range.

Eric brought his latest colour swatches and jacket and anorak patterns together with layout nests for all the parts ensuring the lay of the cloth was in the line of the jacket. Eric went home with a handsome order with his wife on the *SS Duchess of Bedford* from Montréal to Liverpool arriving on Friday 7 July 1933. Gwen's next sailing on the *Bedford* was to be in stark contrast to the glitz and glamour of a 1930's Atlantic crossing – the ship would be hunted by Nazi submarines.

Grenfell Cloth was now a major adjunct to the traditional pocketings and linings in Baxter's business. Large manufacturers like Burtons were now offering golf jackets as part of their range of garments to retailers. In comparison to *pocketings* and *linings*, the unique Grenfell Cloth was highly profitable. Of course, Haythornthwaite were only manufacturers, but by delivering the bolts of cloth they knew the customers and the volumes each needed.

One day Mr Haythornthwaite phoned⁶ Eric and asked him to come to see him at his office in the mill. He told Eric to sit down and then thanked him on behalf of the Haythornthwaite Company for all his efforts to design a wind and rain-resistant cotton cloth and establish Grenfell Cloth in the market. However, since Eric had not had the foresight to file for a patent on the new method of weaving that he had proposed to Haythornthwaite's nor to register the Grenfell Cloth⁷ trademark, he himself had registered the trademark on behalf of Haythornthwaite & Sons Limited in 1937. Similarly, since the water proofing was an ICI product now available to all, he had no further use for Eric's services as he was taking over the business, supplying direct to customers starting forthwith. All customers had agreed to his price reduction and looked forward to dealing with Haythornthwaite's from now on.

Whereas the RGS records show that for the Everest expeditions of 1933 and 1936 the Grenfell Cloth was supplied by Baxter, Woodhouse and Taylor, the suppliers of Grenfell Cloth for the 1951 and 1952 expeditions were Haythornthwaite & Sons in Burnley. However, on their company internet site, Haythornthwaite claim that they alone developed Grenfell Cloth and they alone supplied all the pre-war cloth for the clothing and tents for the British Expeditions.

All Eric's hard work had been usurped. Eric found that Frank B Dehn & Co were the foremost intellectual property lawyers and patent agents in London at the time and went to brief Dr Dehn himself. The advice was not what he wanted to hear; although he had a sound moral case, he had no legal case as he had no registered intellectual property to rely on. Dr Dehn advised Eric against any legal action as such cases were prohibitively expensive and he would probably lose as well.

From now on Eric should seek patents, trademarks and any other intellectual property available on any new venture. Eric immediately set about finding alternate mills

⁶ Was this to avoid a paper trail of Haythornthwaite's actions?

⁷ On Wednesday, August 25, 1937, HAYTHORNTHWAITE & SONS LIMITED filed a Canadian trademark application for GRENFELL CLOTH trademark. HAYTHORNTHWAITE & SONS LIMITED is located at Rylands Street, Burnley, Lancashire, GB. TrademarkElite. 2023. TrademarkElite. [Online]. [Accessed 23 February 2023]. Available from: <https://www.trademarkelite.com>

to manufacture to an even higher standard his improved design of wind and rain-resistant cotton cloth in 1938, with the Registered Trademark ®Windak⁸.

My father's achievements in the development of expedition and mountaineering clothing did not pass unnoticed. The civil servants of the day tried hard to ensure Britain at least laid out the design work to fight a war. The new RAF Parachute Regiment were still supplied with WWI heavy woollen greatcoats. These then turned inside out, blown up to obstruct the parachuters view and safety on landing. Major General F A M Browning, *the father of the British airborne forces* approached the Royal Geographical Society (RGS) in London to find an expert in polar or mountain expedition clothing. With the RGS having elected my father a Fellow, his name was the obvious choice to pass back. Eric quickly adapted his Everest designs that already included what he called his *Beaver's tail* which proved essential for paratrooper's smocks. If the anorak was used in less arduous duties than Everest, the beaver's tail could be clipped safely away up the inside back of the anorak with two press studs.



British Field Marshal Sir Bernard Montgomery beside a Plane at 1st Army HQ, wearing a Windak smock. The line of the back of the 3 press studs shows the adjustment fixing of the Beaver's tail allowing for unrestricted lifting of the knees.

*Credit: Canada. Department of National Defence / Library and Archives Canada / ecopy,
Copy of version available at
<https://recherche-collection-search.bac-lac.gc.ca/eng/home/record?app=fonandcol&IdNumber=4233436&q=4233436>*

⁸ On Monday, April 4, 1938, BAXTER, WOODHOUSE & TAYLOR LIMITED filed a Canadian trademark application for "WINDAK" trademark. BAXTER, WOODHOUSE & TAYLOR LIMITED is located at Cheshire, England, GB. TrademarkElite. 2023. TrademarkElite. [Online]. [Accessed 23 February 2023]. Available from: <https://www.trademarkelite.com>



Monty in Germany wearing one of our Airborne Smocks.

Credit: Correspondence sent by Michael Bingham (BW&T Chairman in 1985)

In 1942, Eric's prototype paratrooper smocks were tested and quickly approved but his designs were then sent out to tender for large production quantities without even asking Eric and Windak to quote! However, these photographs show British Field Marshal Bernard Montgomery wearing a *Windak smock*. I surmise that small batches of Windak smocks were eventually ordered from Eric's company. These are easily identified by the line of six press-stud backs for adjustment of the Beavers Tail and the wool lined collars.

FROM: MAJOR GENERAL F.A.M. BROWNING, C.B., D.S.O.

Headquarters,
Airborne Division,
Home Forces.

15th January 1943.

Dear Sirs,

I was much taken back the other day to discover that when our smocks were put into production your firm was not given the order. In view of this, and consequent on the most unstinted help you gave us last year in designing the smock, I feel it is essential that the specimen smocks, a number of which you made for us, should be paid for, and I should be glad if you would kindly let me know what is due.

The placing of contracts is nothing to do with me, but I should like to say that I very much regret that the order was not placed with you.

Yours faithfully,

F.A.M. BROWNING.

Messrs. Baxter Woodhouse & Taylor Ltd.,
The Mill,
POYNTON,
Ches..

Credit: Correspondence sent by Michael Bingham (BW&T Chairman in 1985)

Copy of our reply to Major General F.A.M. Browning, C.B.E., I.S.O.,
R.Q. Airborne Division, Home Forces.

EHT/PF

POYNTON

January 19th/43.

Dear Major General Browning,

Thank you for your letter of 15th January,
which we appreciate.

We have often designed equipment that we have not been in
a position to make except for the first, generally urgently wanted,
initial production for some special job.

Most of our development work to date has been for the
R.A.F. whose production contracts are placed by the Ministry of Air-
craft Production.

In this instance the production contracts have been placed
by the Ministry of Supply, a department with which we are not in very
close touch, so that it was not until last week, when I was talking to
a Ministry of Supply official who had come down to see us about some
special garments for "Combined Operations" that I actually knew the
smocks we had designed for you had been put into production.

We would have liked to have made some of these garments for
you but could only have handled a small proportion of your requirements
in view of our present commitments to R.A.F.

As an organisation we are proud of the fact that we have
been able to design garments for men doing such specialised work as
those under your Command and so, if you would agree to make "payment"
for any service we may have given, in the form of a specimen garment
from your stores we could see which garment proved most satisfactory,
at the same time it's addition to our collection of garments would
please our workpeople much more than a garment they made merely as
"another sample".

If we can be of any further use to you we are always at
your service.

Yours sincerely,

Credit: Correspondence sent by Michael Bingham (BW&T Chairman in 1985)

The government also issued a simple specification of the bombers - to fly to Berlin, drop their bombs and fly home again. The specification for the flying suits that Eric was given was to keep the crew from the cold at up to 30,000 feet altitude at down to -35°C in an unpressurised, draughty cockpit or for the gunners, virtually in the full 250mph slipstream in their gun turrets for hour after hour.

Travelling by train to and from Manchester to the Baxter's warehouse, as well as the mile walk to and back from Chapel en le Frith South station and his home Brookside Combs, gave Eric plenty of time to consider the problems. High altitude flying created an environment hostile to man - even without the enemy counter measures to neutralise the bomber. Eric realised that in such a harsh location, with temperatures down to -35°C , mere clothing would not keep a man warm; some additional heat would be essential.

On the aircraft with over 1000hp available from each engine and a dynamo to match, Eric decided to use the Lancaster's 28 volt aircraft bus system to provide the energy for his suits. Early tests with electrical resistance wire were disappointing. The wire gave a line of intense heat but the human body needed more gentle warmth over a wide area. Also, if anti-aircraft flack were to hit a crewman and cut a wire the whole circuit would have been lost. The solution he came up with was to use strips of woven wire gauze. By using different thicknesses and different resistances of wire in the woven gauze, it was possible to get the same watts density in different widths and lengths of gauze as was necessary for say the man's trunk, waistcoat and his gloves. The low voltage also removed the possibility of electrocution if the airman was injured by shrapnel and uninsulated parts of the circuit touched his skin. Much experimentation was necessary to make the concept practical.

Eric was also determined that his suits would have no thermostats to control the temperature. He was rightly worried that the slow make and break of the contacts inside the thermostats would result in contact arcing. He well knew that Marconi had used an arc to create radio signals to pass morse messages across the Atlantic. He also knew that Luftwaffe aircraft were fitted with radio direction finders so German night fighters could home in on any radio noise to find an incoming bomber. The low watts per square foot produced by the gauze elements also obviated any requirement for thermostats.

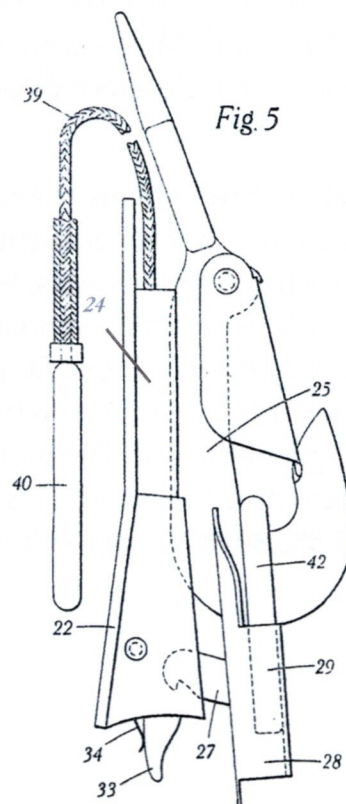
Inside a damaged, out of control aeroplane, it was impossible to foresee the orientation of the escape hatch, so crews had to wait several seconds after bailing out before they were clear of the wrecked aircraft and could safely pull their parachute rip cord, thereby ensuring the opening canopy did not snag on the tail.

Before starting any design work, Eric wanted to understand all the necessary requirements for the bomber crews. This brought him into contact with Leslie Irvin of The Irvin Parachute Company. Whereas their silk parachutes had been originally designed for airborne paratroopers, they were less suitable for aircrew as they were bulky and restricted mobility. Irvin's were suggesting that the aircrew solely wore their parachute harness but had detachable parachutes that were stored ready for use by the escape hatch of the bomber. As the crew already had their parachute harness worn round their thighs and body, with attachment clips for the separate parachute, the attachment of the main parachute cords by clips made the Irvin system possible. On the outside of the parachute pack grouping the

cords into left and right-hand groups required two clips. However, a third fiddler but equally important attachment had to be made for the parachute release rip cord.

Understanding this, Eric was worried that in the heat of the moment of abandoning an aircraft enveloped in flames, this third attachment might be overlooked or a slow crew member struggling to engage this third clip might be *helped on his way* by other crew members eager to escape the doomed aircraft. Eric therefore set about designing a primary attachment method that automatically engaged the parachute release mechanism. Thus, only the two large hooks had to be engaged. Eric applied for a patent on the 5 May 1937 with the full support of Leslie and he gave a free licence of his patent to Irvin's company. This resulted in Patent GB 493,958⁹ and Eric's mechanism became standard equipment for the RAF and Commonwealth forces, thereby saving many lives.

As a quid pro quo helping the re-armament effort, Leslie allowed Eric to have unfettered use of his patent GB 407,445 relating to full length zips on trousers.



'...The slipper 24 is further provided with a longitudinal groove along its base which groove is adapted to receive a cable 39 adapted to serve as a rip-cord and terminating at one end in a handle or rip-ring 40...'
from the patent description GB 493,958.

As Europe descended into war, Eric started to make preparations for his family to go to Canada. Three days after Dunkirk, Eric made a transatlantic call to his Canadian Agent, Fred Deacon. Fred agreed to rent and furnish two small houses for the two families and

⁹ Go to the European Patent Office site, find their *Advances Search* page Then enter GB493958 (no spaces or commas) in the 'Publication' Number Box to find a copy of the Patent Specification.

provide an allowance; this was to be repaid out of the royalties Deacon Bros owed Baxter's on the cloth, garments and patents. The final reckoning either way was to be settled after the war. The next passage available out of the UK was from Liverpool on Thursday 30 May 1940 on the *SS Duchess of Bedford* which sailed, together with the *SS Duchess of Richmond* and His Majesty's frigate *HMS Revenge*¹⁰, in convoy across the Atlantic to Halifax and then on to Montréal. I remember not how we arrived at Liverpool – only my father's admonishment, 'Now don't forget to look after Mummy for me.' Then for him to disappear ashore, lost in the crowd to three and a half year old me. Thus, I grew up from a child in Canada trying to fulfil his instruction '*...to look after my Mother*' as the sole male in a household of three female generations.

Eric would spend long hours developing his new electrically heated suits. He was also volunteering to man one of the listening posts set up on the moors above Combs each night for the Royal Observer Corps. This was a huge reporting system to try to estimate the number of bombers and their course and speed to help get the fighter squadrons to find and destroy the enemy aircraft. Eric could only work such long hours for his country by not having a normal family life. The Derbyshire Moors were crossed by Nazi bombers on the way to try to destroy the Port of Liverpool, the preferred harbour for the trans-Atlantic trade with Canada and the USA.

A simple boiler suit is comparatively lightweight and hangs in one piece from the wearer's shoulders. As the thermal insulation, electric elements and interconnections added considerable weight to the Taylor electric flotation suits, Eric found that this resulted in the wearers having to lift the weight of suit with their arms each time they reached up an arm above shoulder level. This introduced an undesirable fatigue in the arms. Eric solved this inherent problem by incorporating internal braces within his suits so the outer suit shoulders no longer carried the weight of the suit. The braces then carried the weight of the suit on the inner tops of the shoulders near to the neck, leaving the outer shoulders and the arms free. The resulting patent GB 550,801 *One piece suit internal braces* was applied for on 24 April 1941.

¹⁰ Details also paralleled by <https://pier21.ca/stories/wartime-visitor-to-halifax-ann-e-miller>

The Windak suit in use No. 1

"Brace it up"

Always remember this when donning your WINDAK flying suit (officially known as SUIT BUOYANT). Brace as high as possible and remove all weight from the shoulder points, the jacket is comfortably "bloused" and everything sits easily. This is one of the many points which make WINDAK the ace of operational flying suits. Every requirement has been provided for; electric heating, freedom of movement, ventilation, floatability, quick release if in trouble, ample pocket room . . .



WINDAK Suits incorporate features covered by Irvin Patent No. 407445 and others.

BAXTER, WOODHOUSE & TAYLOR, LTD.
Queen's Buildings, Stockport, Cheshire.

Windak flying suit (officially known as Suit Buoyant)

Credit: Grace's Guide to British Industrial History

<https://www.gracesguide.co.uk/>

I immediately recognise the face in the photograph as my father.

Today my father's invention of internal braces is still universally adopted throughout the World by virtually every special suit design such as for firemen, lifeboatmen and other heavy protective suit users.

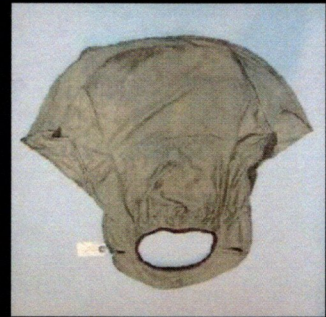
The so-called Mae West lifejackets also received Eric's attention. These also had to be worn by the bomber crews in addition to the parachute harness and the aircraft safety harness. Eric was using Kapok wadding as the thermal insulation in his electrical heated suits. Kapok, unlike cotton wool wadding, was hydrophilic. Could this also be used to obviate the need for a life jacket by the suit itself providing the necessary floatation? He did some experiments and found that just doubling the size of the suit collar provided the necessary floatation support for his head, even if he had been unconscious. The doctors in Farnborough were sceptical but Wing Commander Roxborough of the Aviation Medical Division decided that he would try out Eric's new suit in the local swimming bath.

The Basingstoke swimming baths were crowded by RAF flight crews relaxing and Roxy in his full Taylor heated flotation flying suit was an instant centre of curiosity. Roxy was amazed how successful the new suit was - however much he tried he could not lie face down in the water. He therefore asked some of the airman to make waves around him, and then to try to push him underwater - but he omitted to arrange a stop signal. Initially all went well and the suit was completely successful but more and more airmen joined in the fun of trying to push him underwater and each time he surfaced twenty or so airmen helpfully tried to push him under again - as originally instructed. The watching group of doctors shouted 'Stop!' enough was enough - but to no avail. However much the doctors shouted, they made no impression against the several hundred men enjoying themselves.

Finally, a quick-thinking Doctor picked up Roxy's RAF jacket with his Wing Commander gold epaulets and broad rings and waved it at the sporting throng. 30 seconds later the swimming bath was completely empty - except for Roxy - still with his new suit collar keeping his head above water. It was the ultimate demonstration of the success of the new design. All suits were to be made with integral lifejackets in the future.

The Taylor RAF electrically heated Flotation Suit c1943

Kapok internal flying suit heat insulation extended up into a flotation collar creating an integral lifejacket

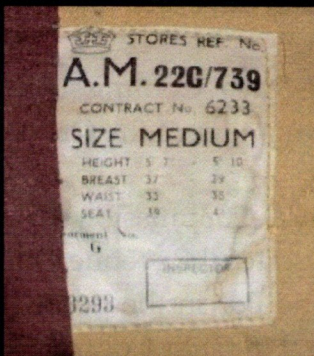


Electrical connections for electric heated Air Gunner's Windhood

Main suit opening at the top quick release zip pull in case of fire

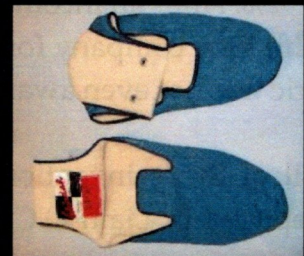
Twin full length leg opening at the top quick release zip pull in case of fire

Electrical connections for electric heated gloves



Internal Air Ministry reference numbers and size dimensions

Internal electrical connections for electric heated slipper socks



One of the very few documents that survived in my father's mementos was a survivor's letter from a tail gunner, written to my father. His letter simply states how my father's suit saved his life; he could write no more details as these would have been removed by the censor.

919258. SGT. A. KAHN
c/o R.N. SICK QUARTERS
SWANBOROUGH MANOR
LEWES
SUSSEX
14.8.43

Dear Sir,

I would very much like you to know that after ditching returning from an Op, my life was saved by one of your Taylor Suits, as when I woke up after being knocked out by the impact, and thrown from the rear turret I recovered consciousness floating good side up in the water at 17.10 hrs on 12.8.43, and am now thankfully recovering from the after effects.

Thanking you very sincerely
A. Kahn

JCT's Transcription

919258 Sgt A.Kahn
c/o R.N. Sick Quarters
Swanborough Manor
Lewes
Sussex
14.08.1943

Dear Sir,

I would very much like you to know that after ditching returning from an Op, my life was saved by one of your Taylor Suits, as when I woke up after being knocked out by the impact, and thrown from the rear turret, I recovered consciousness floating good side up in the water at 1710 hours on 12.08.43 and am now thankfully recovering from the after effects.

Thanking you very sincerely

A Kahn

The Royal Commission on Awards to Inventors was reconvened in 1946 to hear claims of inventors who "allege that their inventions, drawings or processes have been used by Government Departments and Allied Governments during the War."

Air Commodore Frank Whittle was awarded £100,000 by the Royal Commission for his development of the Jet Engine. He was also made a Knight Commander of the Order of the British Empire.

Eric Hardman Taylor was also awarded £100,000 by the Royal Commission for his work on clothing, saving lives of aircrew and airborne troops. The grateful Revenue Office then charged him income and super tax up to 19/6 (19 shillings and 6d) in the pound or 97½%. After all income tax allowances some £10,000 was left to invest in Otter Controls Ltd – his new company formed to exploit his new bimetal thermostat invention.

Eric was not even awarded an MBE. I wonder what happened to Whittle's £100,000 taxwise?

All of Eric's inventions¹¹ for the RAF are shown detailed in use by the bronze airmen depicted in Liam O'Connor's London Bomber Command Memorial in Green Park to the

¹¹ They are also commemorated in the *Manual* published by Hayes - RAF 100 Technical Innovations that have benefitted the RAF in their first 100 years 1918 – 2018.

55,573 airmen who died in 1939-45. Eric's *Taylor Buoyancy Electrically Heated Suits* are also depicted in the RAF commemorative 81p postage stamp issued on 18 September 2008.



A bomber crewman, wearing his electrically heated Taylor Buoyancy suit carrying his parachute with his electrically heated gloves tucked into his straps.



Taylor Buoyancy Electrically Heated Suits are also depicted in the RAF Centenary commemorative 81p postage stamp. Electric heater hoods were also made.

© Royal Mail

Aircraft development entered a new phase when Frank Whittle's first jet engines were incorporated in the Meteor and Vampire jet fighters. Jet bombers were proposed climbing to 60,000ft at temperatures down to -60°C. The specification for the bomber suits required thermostats – an anathema to my father. The slow make and break contacts would give radio interference enabling the enemy fighters to home in on the radio waves and the bomber squadron.



Messerschmitt Bf 110G-4/R1 of 6./NJG 6 that landed at Dubendorf in Switzerland by mistake on 15 March 1944. Note the aerial array for the FuG 202 Lichtenstein BC airborne interception (AI).

© IWM HU 108217

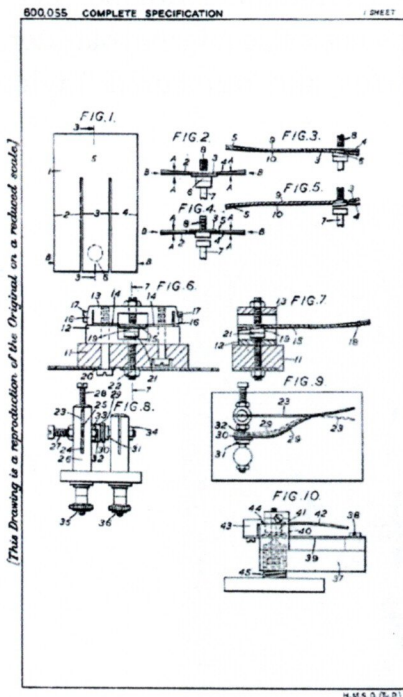
www.iwm.org.uk/collections/item/object/205234650

Eric decided that, yes, thermostats would be a necessity with the new, huge temperature range. He must design a simple new type of thermostat that operated with a snap action to stop the radio interference. The slow make and break contacts slowly reduced their contact pressure until there was no contact pressure left and the slightest vibration gave contact bounce and contact arcing. Now there's a problem for Eric to solve.

Eric set himself the task of making the contact pressure increase as the temperature rose. The contact pressure would then be at a maximum until the mechanism suddenly snapped the contacts open. Before he completed and proved his invention, WWII finished on 2 September 1945. All development contracts were cancelled by the Air Ministry.

However, Eric felt he was onto something with his new concept for a bimetal thermostat that operated with high contact pressure until the point of snap action. He continued his research in the evenings at home. After my supper, inquisitive nine year old me would come into my father's little workshop to watch him making prototype bimetal thermostats. He had obtained various samples and thicknesses of *Wilco* bimetal from The H A Wilson Company which later took a licence to manufacture snap action blades under his US patent.

Dad's invention used an E shaped bimetal blade. The snap action was induced by squeezing the two outer legs on the top and bottom of the E slightly together on their mounting. This caused the centre leg of the E with the electrical contact to rise up above the outer two legs and create the increase in contact pressure against the fixed contact riveted on the stationary brass contact plate. A fixed stop on the brass high expansion side of the E bimetal blade limited the travel of the contact to a few thousandths of an inch, thereby reducing the temperature change necessary to create the snap movement.



I noticed that the huge 15amp round pin electrical plug, in use for all British electrical appliances at the time, had slots in the pins that were almost as narrow as the bimetal was thick. I suggested to my father that if he drilled a small hole in the centre of the pin and used one of his thread cutting taps to cut a screw thread then a screw could be used to accurately tension the outer legs of his E bimetal together to increase the temperature difference between the snap open and the snap shut again.

This idea was not an invention in its own right nor was it used in practice but it easily explained his invention of stressing the E bimetal. To my great pride the screw is shown, numbered '28', in the drawings of his patent 600,055 applied for on 5 November 1945.

The first claim in the patent reads:—

1. A thermally controlled electric switch comprising a differentially stressed system as herein defined, adapted to control the movement of a movable contact with respect to a fixed contact, said system incorporating a bimetallic member which carries or directly controls said movable contact, said fixed contact constituting an abutment against which said bimetallic member causes or assists said stressed system to move in a switch operating direction upon a change in temperature altering the shape and/or stress of said bimetallic member, so that said movable contact will be urged initially against said fixed contact in a direction opposite to that in which it is ultimately moved by the movement of said stressed system through its unstable position.

With the Cold War between Russia and NATO emerging, defence and aircraft came to the fore again and Eric was asked by the RAF Medical Team in Farnborough to take a new contract to develop Partial Pressure Helmets for the new RAF jet fighters. At high altitude the atmosphere is so thin with the air pressure so low that even 100% oxygen is insufficient to keep a human alive. Above 30,000ft the human respiratory system needs to be pressurised to keep the oxygen in the haemoglobin. This presents all sorts of physiological problems with expelling carbon dioxide and the valve systems necessary to economically control the pressure reduction from the 2000lb/sq in (130 Bar) oxygen bottle. The major problem is making inhaling and exhaling still an easy natural process for the pilot. Flight into the upper atmosphere was all new for the aviation medical doctors and constant visits to RAE Farnborough were necessary to create safe systems for the new frontier of space.

Everyday Dad drove down to Poynton and Baxters to continue development work on high altitude pressure suits and helmets that became new RAF Taylor Partial Pressure helmet and standard equipment for the jet fighter squadrons of Hawker Hunters and then English Electric Lightnings.

To obtain adequate sealing of the internal oxygen mask to provide the pressurised supply of oxygen, the Partial Pressure helmet needed to give a much more accurate fit to the pilot's visage. As a case in point, one of the first uses for the Taylor Helmet was for the

BAC test pilot for the Lightning aircraft in August 1954, Wing Commander Roland "Bee" Beamont, CBE, DSO & Bar, DFC & Bar who needed an extra-large neck size internal bladder.

RAF squadron pilots all had their own individually sized and numbered Taylor Partial Pressure helmets.



*Taylor RAF Partial Pressure Helmet
Notice the red access door for refreshment or if air sick.*



*Rear of Taylor Partial Pressure Helmet with quick release zip
(Aged 16, I designed and made all the early samples of the fancy sennet and
Turk's heads to create a strong rigid yet flexible white nylon release cord).*

For an emergency removal of the Taylor Partial Pressure Helmet, EHT used the same method of making a zip fall apart from the top as he used for emergency removal of the RAF Bomber Taylor Flotation Suit in WWII. But there was a major different consideration - The Taylor Partial Pressure Helmet opened at the back of the pilot's head and needed a release cord recognisable by touch with a gloved hand whereas the Taylor Flotation suit zips were all visible on the front so simple cloth extensions were all that was necessary.

I had become fascinated with sailors Knots and Splices as a young teenager. One of my hobbies was rope fancy work and I had a lovely book by *Spencer – Knots, Splices and Fancy Work* as a 14th year birthday present from my mother. I took one look at the prototype Taylor Partial Pressure Helmet with the bits of string sewn into a folded cloth and offered to design a proper professional looking replacement made in white nylon cord with a Turks Head on each end of a flexible braided sennet.

This was my contribution to the Squadron RAF Taylor Partial Pressure Helmets¹².

Whereas the British aviation industry was able to develop three different but successful V bombers by three different companies, there was little continuity planning of later post WWII governments for the defence and offence aviation requirements of the UK.

Run from the defence budget, the Royal Aircraft Establishment (RAE) was the main government space technology centre, involved in most of the UK's space projects which, in the mid-1960s, included sounding rocket, launch vehicle and satellite design, testing, construction and operation, both in-house and in association with industry.

Even with the Labour Government's cancellation of most aviation and space projects, the RAE continued the development of full pressure space suits through its medical division. This culminated with BWT demonstrating a bicycle being ridden by the cyclist wearing a fully functioning space suit pressurised through uncoiling a 50 metre pipe. Some of these developments were disclosed in EHT's space suit development patents:-

GB955,099 Pressure suit breastplate, application date	27 May 1960
GB1,027,681 Oxygen demand valve, application date	8 Feb 1962
GB1,027,682 Tilt valve, application date	8 Feb 1962
GB1,038,963 Pressure suit restraint harness, application date	8 Feb 1962
GB1,038,964 Shoulder sealed bearings, application date	8 Feb 1962

Whilst with the Space involvement cancelled by the government, many of these inventions were not used by the RAF, but they were used in TV and film. The full pressure suit can be seen in the film *First Men in the Moon* in 1964 and in the 1966 TV series *Doctor Who, Season 4, The Tenth Planet*. The suits later appeared in the *Star Wars* films, worn by Bo Shek in *A New Hope* in 1977 and by the bounty hunter Bossk in *The Empire Strikes Back* in 1980.¹³ A resemblance can also be seen between the full pressure suit and the X-Wing pilot jumpsuit worn by Luke Skywalker and other rebel pilots like Garven Dreis and Biggs Darklighter.

¹² There are interesting photos and text at <https://www.scottbouch.com/aircrew-uk-flying-helmet-partial-pressure-e-type.htm> of my father's development facilities at BW&T and of the RAF Taylor Partial Pressure Helmet.

¹³ See <https://senioraerospacebwt.co.uk/2021/04/07/bwt-contribution-to-star-wars/#> and blogs <https://everexcollett.wordpress.com/windak/> and <https://www.scottbouch.com/aircrew-uk-flying-suit-full-pressure-windak.htm>

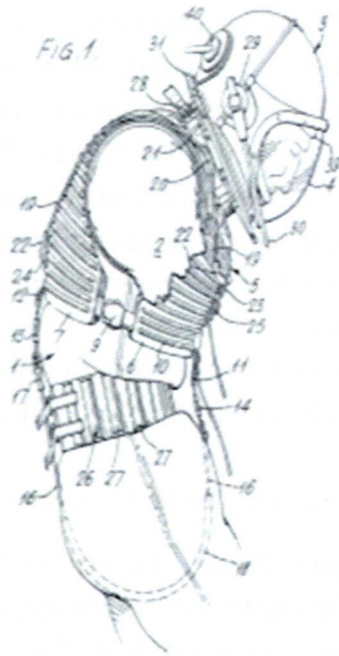


Fig. 1 from Patent GB 1,038,963.

An aviator's pressure suit including substantially rigid means situated at the front and/or the back of the upper trunk portion of the suit, said rigid means being so shaped and disposed as, in use, to distort the upper trunk portion of the suit when pressurised to a noncircular shape such that it does not exert restrictive pressure on the sides of a wearer's chest sufficient to hamper breathing.

This drawing is a reproduction of the Original on a smaller scale.



Garven Dreis' X-Wing pilot jumpsuit from *Star Wars: Episode IV- A New Hope* on display at the *Star Wars and the Power of Costume* travelling exhibit at the Detroit Institute of Arts in Detroit, Michigan (United States).

Credit: Michael Barera, CC BY-SA 4.0

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Eric Hardman Taylor died aged 68 in Halfways, St David's Pembrokeshire on Thursday 4 May 1972. He was cremated and I later interred his ashes according to his wishes in Ramsay Sound at Abermyharan.

Eric is named as the Inventor on some 40 British Patents with many corresponding Patents in Europe, Canada and the USA.

Dr John C Taylor, aged 86

2 June 2023