Original Communications

THE KNPASACK AND PACK
AN HISTORICAL AND PHYSIOLOGICAL SURVEY WITH PARTICULAR REFERENCE TO THE BRITISH SOLDIER
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INTRODUCTION: ETYMOLOGY

It may be of interest at the outset to say a few words concerning the origin of some terms linked for so long with the various parts of the soldier's equipment. The word "knapsack" is found for the first time in the English language about the year 1600, and is derived from the Low German Knappen-Sack, meaning a food bag. During the first half of the seventeenth century it was commonly referred to by the Saxon derivative Snap-Sacke (snap or provender). The soldier's "haversack" is the equivalent of the Sarcina (Latin, a bundle), or the osier basket of the Roman soldier which, during the march, was often carried at the end of a forked stick or a spear. The term first appears towards the end of the seventeenth century as the French abresac, habresac, or havresac, and originates in the Low German Hafer or Haber-Sack, meaning an oat sack as commonly used for horses. The word did not appear in English until the end of the eighteenth century, and is still used in the Westmorland dialect as haver-cake or oat cake. We first hear of "canteen" in 1744; the word appears to be
derived from the Italian *Cantina*, meaning a wine cellar, or a receptacle for liquids. References to the word “webbing” do not appear in military dictionaries of the last century, but the following is noted in 1745: “Welch Webbing—a thick sort of woven flannel of which soldiers’ clothing is chiefly made.”

**Seventeenth Century**

The first British “Commission on Uniformity of Arms and Armor” met in 1631 and, after deliberation, introduced a sealed pattern of arms and accoutrements. As a result, the powder charges of the musketeer were carried in a bandolier and the bullets kept in a bag or loose in the pockets. A knapsack of canvas or fur was carried over one shoulder. Although by this time armour had almost completely disappeared, it was still being worn by one or two regiments; but we are told by General Monk, later the first Duke of Albermarle, that “the defensive Armor of a musqueteer is a good courage.” The cuirass (French, *cuirasse*—a leather jacket) worn by the cavalry of Sir Arthur Heselrig’s Parliamentary Regiment was of bright iron shell, and received from the Royalist soldiers the nickname of “Heselrig’s lobster.”

The pay of an infantry soldier in Cromwell’s army was a mere pittance of about eight or ten pence a day, of which sixpence was put aside for his “Subsistence”; and for this he was expected to march a full twelve miles or more. Although in the times of the New Model Army discipline must have been rigorous, there is evidence that (as found throughout the ages) “Pack Boys” and pack animals were employed for carrying the soldier’s load. Sir James Turner, when speaking of this period in his *Pallas Armata*, written in 1670, tells us as follows: “And although I joyn freely with him in his opinion, that the Souldiers should not carry such burthens as the Romans did of old, yet I would have neither Horse nor Boy allowed them; it is too much, that the Custom of later times, hath eas’d most of them of the burthen of defensive Arms, and therefore every one of them may, and should, carry his own knapsack, and four or five days provisione of meat, with a Hatchet at his girdle, which I see too much neglected, on this side of the Sea. . . . Though you allow every Souldier two pounds of Bread and Cheese every day, and God knows, he gets not so much, many times in four days. . . . Suppose he hath a couple of shirts and a couple of Stockins, and a pair of Shoos in his knapsack (and how many Souldiers have all of these), and a Hatchet, I say all of these will not weigh as much as a Head-piece and a Corslet, and he therefore may be well enough be obliged to carry them” (1).

**Eighteenth Century**

In 1752 Sir John Pringle, physician to the Duke of Cumberland, published his classic on Military Hygiene, and this became the standard work in England and on the Continent for almost a hundred years. We are told that “the life of the foot soldier, is divided between two extremes of labour and inactivity. . . . Sometimes when he is ready to sink under fatigue, having his arms, accoutrements and knapsack to carry, he is obliged to make long marches, especially
FIG. 1. INFANTRYMAN
Showing crossed belts and regimental breastplate, under which the chest strap can be seen, haversack and water canteen slung from the left shoulder (circa 1812).

FIG. 2. WINTER UNIFORM
Showing knapsack, canteen (mess kit) and ammunition pouch, haversack and water canteen slung from right shoulder (circa 1814).
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in hot or rainy weather” (2). Apart from this statement, Pringle expressed no interest in either the weight of the load, or its mode of carriage.

During the American War of 1775-1783 the British soldier met the enemy in a fashion aptly described by a contemporary Colonel Lloyd: “We borrowed from Germany cross belts which compressed the chest but had the disadvantage of throwing the sword to the rear, and to knock against the calves and cartridges, and to quarrel with the havresack; long gaiters which squeezed the legs and stopped the circulation in that useful member of the foot soldier, stocks which forced his head up even with the sun in his eyes, curl papers and tight shoes.” When the unpopular “queue” was done away with in 1808, the stocks became even higher. After the war, the Board of General Officers produced an improved pattern of infantry accoutrements. The single or crossed shoulder belts became narrower and lighter but remained of buff leather. The magnificent large ornamental buckles disappeared and were replaced by a small but handsome regimental breastplate, positioned where the belts crossed in front (Figs. 1 and 2).

PERSONALIA OF THE CAMP

From time immemorial, the movement of armies has been impeded not only by the weapons and equipment of the soldier, but also by women and other Personalia of the Camp. Sir James Turner, in his inimitable style, wrote again as follows: “... The Second Classe of Women is of those who ride on horseback, and these must ride in no other place than where the Baggage of the Regiment, to whom they belong marcheth; but they are very oft extravagant, gadding here and there, and therefore in some places they are put into companies, and have one or more to command and over-see them, and these are called in Germany Hureweibles, Rulers or Marshalls. I have seen them ride, keep Troop, rank and file, very well, with that Captain of theirs ... and a Banner with them, which one of the Women carried. ... They provide and dress their husband’s meat ... they bring in Fewel for fire, and wash their Linnens. ... That famous Duke of Alva ... they say ... he was given permission for Courtizans to follow his Army, but they were to ride in Troops with Banners. They were divided into several Squadrons according to their quality, and that was distinguished no otherwise by the difference of their beauty, faces and features” (1).

An account of an English family, written by the French General Lejeune, during the Peninsular War of 1808-1814 reads as follows: “The Captain rode first on a very fine horse, warding off the sun with a parasol. Then came his wife, very prettily dressed with a small straw hat and riding a mule. Besides madam walked her Irish nurse carrying in a green silk wrapper, the hope of the family. Last in the procession came a donkey laden with much miscellaneous baggage which included a tea kettle and a cage of canaries; it was guarded by an English servant in livery, mounted on a sturdy cob” (3). Sir George Bell wrote the following during the same period: “The multitude of soldiers’ wives stuck to the army like limpets; averse to all discipline, they impeded our progress particularly in retreats. They became the subject of a General Order...
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for their own special guidance. Under no control, they were always first mounted and away, blocking up narrow passes and checking our advance with their donkeys” (4).

**EARLY HISTORY OF THE KNAPSACK**

Since the time of Cromwell the equipment of the British soldier has included a knapsack for “Essentials” and a haversack for “Necessaries”; but it is to be noted that the canteen for water—“bluejack” of this period—was not issued to the soldiers during the Civil War itself (5). To near the end of the eighteenth century, the knapsack was a bag of canvas, fur or cowhide, slung over the musket or the right shoulder. The cost was about ninepence in the time of the Civil War (5), rising to a few shillings during the next two centuries. The bag was often painted the colours of the regimental facings, with insignia on the back. After an order of 1798, the knapsack was carried on the soldier’s back by two shoulder straps.

In 1805 a certain Mr. Trotter, who supplied the Army with most of its equipment (from his factory in Soho Square), introduced a new type of knapsack. This was a rectangular box of wooden framework, covered with black canvas. After this date, regimental facings and insignia were seen much less frequently. Several modifications of this equipment were issued during the next fifty years. In 1824 regimental records mention a new pattern; that of 1827 was said to be smaller and lighter. The knapsack of 1829 had a stronger wooden framework, with a pocket in the flap. Yet another smaller pattern appeared in 1857 (6, 8). These various modifications were, however, of little practical value to the soldier. Until 1871 the knapsack was itself regarded as a “Camp Necesssary” to be provided by “Off Reckonings” or “Stoppages” from the soldier’s pay; but after this it became an article of “Equipment” (6, 8).

In the first half of the nineteenth century the British soldier carried his knapsack high on the back, and independently of the crossed belts, by shoulder straps passing high in the armpit to the lower angles of the knapsack. The great coat or blanket was kept in various positions on top of the knapsack. It would seem that the stovepipe shako hat worn at this time must have sometimes been knocked off, and movements of the neck interfered with, during rifle fire or crawling (Figs. 1 and 4). A heavy ammunition pouch was situated over the rump or hip, the heavy wooden water canteen (later called a water bottle) was slung from the left shoulder; and from the right shoulder was slung the haversack, with its rations, extra ammunition and odds and ends. However, it is seen from Figs. 1 and 2 that the position of these pieces of equipment varied somewhat. No attempt was made to co-ordinate the different accoutrements, or to balance the knapsack behind with some load in front. In order to prevent the straps slipping over the shoulders, the former were joined by another strap, buckled tightly across the chest (Fig. 1), and at a level sometimes laid down by an Order, as for instance, that of 1829 (8). This chest strap produced so much distress that it was invariably unbuckled on the march; and we are told that at “the double” the soldier had to “put his hand on his cap, his other on his
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pouch—and what became of his musket!” The coatee was tight fitting, and the neck fettered by a tight collar with its leather stock—“an evil device which constricted the neck and tended to apoplexy” (Fig. 1).

The Overloaded Knapsack

An indictment against a badly balanced load of about 60 lb., carried by soldiers during a long retreat, is given by Rifleman Harris, who was attached in person to Major-General Robert Craufurd during the Retreat to Corunna, early in the Peninsular War (December, 1808). He recounts that “the knapsack was our worst enemy in this prolonged march. Many a man died, I am convinced, who would have borne up to the end of our retreat but for the infernal load we carried on our backs. My own knapsack was my bitterest enemy... more than once I felt that I should die under its deathly embrace. The knapsack in my opinion, should have been abandoned at the very commencement of our retrograde movement... if by such loss we could have saved the poor fellows who died strapped to them on the road” (7).

Even during the Napoleonic era, discipline was not sufficiently rigid to prevent soldiers carrying in the knapsack and haversack loot and other spoils of war, which could hardly be covered by the term “Essentials” or even “Necessaries.” In the Memoirs of the French veteran Sergeant Bourgogne, written after leaving Moscow in 1812, we are told the following: “I spent some time in making an examination of my knapsack which seemed too heavy. I found several pounds of sugar, some rice, some biscuits, half a bottle of liquor, a woman’s chinese dress embroidered in gold and silver, several gold and silver ornaments—amongst them a bit of the Cross of Ivan the Great—at least a piece of the outer covering of silver gilt, given me by a man in the Company who had helped in taking it down. Besides these, I had my uniform, a woman’s large riding cloak (as I could not guess how it was worn, I imagined its late owner to be more than six foot high), then two silver pictures in relief, a foot long and eight inches high. I had besides, several lockets, and a Russian Prince’s spittoon set with brilliants. These things were intended for presents, and had been found in cellars when the houses were burned down” (9). This truly amazing kit was apparently carried about by the intrepid sergeant for about a month, both on the march and into battle.

Whitehorne, in his History of the Welch Regiment, quotes as follows Sir William Butler, who wrote of the period preceding the Crimean War: “It was impossible not to love these old soldiers. They had so many splendid qualities. I call them old, in reality they were all under 40 years, but they were old in every other sense of the word. If you asked any of these men, when in hospital, what was wrong with them, they would usually answer—‘Only them pains, Sir,’ and if you asked what had produced the pains, they would invariably say it was the heavy belts and cumbersome pouches they had to wear for twenty four hours on guard. It was true, our stupid regulations broke down these fine soldiers long before their time.” Whitehorne quotes one of these old soldiers, a certain William Elcock of the 69th Regiment, who told him that “the knap-
Some of the equipments examined by the Committee of 1865-8 (metal parts shown dark). From War Office Confidential Papers.
sack with Field kit was always carried on Commanding Officer's parades and on Field days. I bear the marks of the knapsack straps on my shoulders to this very day” (10).

THE CRIMEAN WAR

During the time of the Crimean War (1854-1856), an attempt was made to improve the infantry equipment, but the British Army still wore the old pattern in Russia. In 1857 Colonel Hardinge (later Commander-in-Chief at the Horse Guards), president of the Field Artillery and Equipment Committee, wrote “The waterproof havresack has been recommended for trial, and has borne the test of use in Crimea with advantage . . . a tin water canteen, leather covered, to supersede the Italian wooden water canteen, has been ordered to be made and recommended for trial. . . . No article has been made generally so complained of as the wooden water canteen . . . leaky, weighty and pervious to heat in the extreme.”

A contemporary description of the issue equipment of 1857 (Fig. 3) reads: “The cross belts and strap, with 40 to 60 rounds, are not only tight across the chest, but the pouch moves and bumps against the man’s posterior. The shoulder straps of the knapsack cut the shoulders; and swelling, weakness, and numbness of the arms or hands, lasting up to twenty four hours is common after a march. So great are the discomforts, loss of strength, and pressure on the nerves, muscles and blood vessels, that, all nations of Europe but ourselves, have of late altered the system of packs and accoutrements. Various propositions have been put forward for a number of years, but none have been adopted, . . . the present knapsack is worst of all, and if we cannot recommend an absolutely perfect one, there is no reason to be content with the present one” (11). It is obvious that “Pack Palsy” of the infantry soldier is no new disorder (56).

The Royal Commission of 1858 (12) brought to light the constant resistance by the military to innovation and improvement. As early as 1839, James Berington, a retired army veterinary surgeon, produced a knapsack clearly an improvement on its predecessors. After a number of troop trials, apparently successful, and in spite of the matter reaching the ears of the Director General, Army Medical Department (Sir James McGrigor), and Wellington himself, the equipment was turned down. In despair, Berington put forward his case in some detail in the Lancet of 1849 (13). Some time before 1858, the equipment again proved its value on trials, and it was praised by the Commission of 1858. Three years later, army surgeons Martin (14) and Moore (15) spoke highly of its value to the soldier. Nevertheless, the knapsack was never accepted, and soon forgotten.

COMMITTEE OF 1865-1868: VALISE EQUIPMENT, 1871—PHYSIOLOGICAL TRIALS

The turning point in the history of personal load carrying equipment was reached during the period of 1865-1868, during which time there were four meetings of the Committee appointed by Lord de Grey. This Committee Appointed to Inquire Into the Effect on Health of the Present System of Carrying
the Accoutrements, Ammunition and Kit of the Infantry Soldier had as its president Major-General Henry Eyre, and the medical representative was a Dr. Edmund Alexander Parkes, the first, and recently appointed, Professor of Hygiene at the Army Medical School at Fort Pitt, Chatham. In the appendix to the first report we find a paper by Dr. McLean, Deputy Inspector-General, and Professor of Military Medicine at the Army Medical School at Netley.

Discussing the prevalence of disease of the heart and lungs in soldiers, he dismissed rheumatism and alcoholism as important factors, and came to the conclusion that the essential cause of these afflictions was the heavy load carried by the soldier, and the irrational method of carrying it. During the presentation of the paper, the heart of an old soldier was demonstrated, showing a white spot or "corn," which, the Professor believed, was not exceptional in old soldiers, and which he clearly ascribed to the pressure and friction of the crossbelts and chest strap of the soldier's equipment. A similar conclusion as to the cause of the "Soldier's Heart" had already been reached in 1862 by Sir William Aitken (16). However, it is nowadays well known that the "corn" or "milk spot" of McLean is in fact a manifestation of rheumatic heart disease, a disorder of young life, and in no way caused by the severe exertions or activities of the soldier. The Professor pointed out that he had discussed the matter of the soldier's load with numerous military medical officers, but very few had paid much attention to the matter.

During the first meeting in 1865 the Committee examined a large number of equipments, including the issue Prussian and French models, and decided finally that four equipments were worthy of trial. These were Lieut.-Colonel Sir Thomas Troubridge's yoke valise, Lieut.-Colonel Carter's plan, the Prussian pack, and a system devised by the Committee (Fig. 3). Large numbers of these four equipments were distributed to nine regiments, including Marines stationed at Woolwich, Chatham, Portsmouth and Plymouth. In August, 1867, a physiological trial was carried out by medical officers. Twelve men were used as experimental subjects, and pulse and respiration rates taken before and after a two hours' march wearing the various equipments, and before and after "a double" of 500 yards, with and without packs. A table of results is given in the Minutes of the Committee, but owing to changeable weather conditions (temperatures are recorded, but not relative humidity), and other uncontrollable factors, it is not possible to draw clear-cut conclusions as to differences between the equipments. During the troop trials, a series of 23 questions was given to the men using the various equipments, but a perusal of these suggests that it must have been sometimes difficult to give unbiased answers.

During the various lengthy discussions, the Committee put forward certain principles required of an ideal personal load carriage equipment. These were as follows: (1) The weight to be distributed over a wide area; (2) the weight of the knapsack behind to be balanced by the weight of the pouches in front; (3) all loads to lie as close to the body as convenient, and as near to its centre of gravity as possible; (4) no compression of the armpit or the chest; (5) the total load carried to be of the order of 45 lb. The equipment produced by
FIG. 4
Valise equipment of 1871.
Professor Parkes had part of the weight thrown on the hips by two straight iron rods. The Committee's equipment was a modification of that of Troubridge, who in 1857 became first Director of Army Clothing at the establishments at Weedon and Pimlico, and who had been experimenting for some fifteen years on the problem of load carriage by the soldier. The original Troubridge valise plan was based on the principle of the milkmaid's yoke, the weight being again transmitted to the hips by metal rods. However, the Committee decided that metal rods in any form were unacceptable for military equipment.

The new equipment designed by the Committee received very favourable reports during the troop trials and answered the Committee's requirements. It consisted of a black waterproofed canvas bag or valise, worn over the small of the back, and supported from the shoulders by straps (Fig. 4). Pouches, straps and waist belt were pipe-clayed. The ammunition pouch was removed from its inaccessible position on the back, and replaced by two pouches (holding 20 rounds each) which, when filled, approximately balanced the contents of the valise behind. A further 30 rounds was carried in a ball bag. The load was thus borne by both the shoulders and pelvis; and in full equipment was so well balanced between the front and back that, it was claimed, the waist belt could be unbuckled on the march. There were no binding straps in the armpit, and the chest was at last completely freed from its constricting bands. An objection noted by the Committee was the large area of the back covered in Marching Order, with consequent poor ventilation and excess sweating. It was pointed out, however, that this defect had to be accepted, and with suitable adjustment of the side straps, sufficient ventilation could be obtained. For the first and last time in British military history the valise (or knapsack) was carried low on the back. We are told that "after several years' experience, the Committee believe that they have found the best, and perhaps the only, way in which military loads can be carried with perfect freedom to the chest."

In 1869 appeared the third edition of a textbook by Professor Parkes (11). This contained a valuable and enlightening section on the problem of marching and load carriage by the soldier. A detailed description of the new valise equipment was given, together with an analysis of various methods available for military load carriage. Parkes fully realized the importance of clothing and footwear in connection with personal equipment and load carriage; as well as the significance of foot hygiene, rest, sleep, food, training, climate and terrain, in relationship to the rate of marching and distance covered. In fact, there is little known nowadays of the problems of the marching soldier that was not well understood by this acute observer of Military Hygiene, whose work may be regarded as the most important in the early history of load carriage.

In the same year, letters appeared in the Lancet, by Assistant Surgeon Myers and Surgeon Major Robinson, dealing with the relative importance of organic disease, and heavy knapsacks, tight tunics and collars, in the causation of aneurism of the blood-vessels in army personnel (17, 18). Although the observations appear somewhat naive in the light of modern knowledge, they are nevertheless to be regarded as minor landmarks in medical history. The ideas of
McLean and Aitkin on the soldier's load as an important causal factor in the "Soldier's Heart" were soon refuted by a book published by Myers in 1870 (19) and by a report in the following year by Da Costa (20) of Philadelphia. The former based his conclusions on observations made on British troops in India, and the latter on cases studied during the American Civil War. Both showed that the commonest cause of so-called cardiac disease of the soldier was the "Irritable Heart," a disorder due, not to organic disease, but to the physical and psychological stresses of Service life. Strangely enough, this view did not receive general acceptance, and was forgotten for some forty years, to be rediscovered as "Disordered Action of the Heart" of the First World War and the "Effort Syndrome" or "Combat Exhaustion" (American terminology) of the Second World War.

The issue of the valise equipment was delayed by the trials of the new Martini-Henry rifle, and did not make its appearance till 1871. Nevertheless, we are told by a commentary in the Lancet of 1873 that "it is difficult to understand why there should be so much delay in replacing a portion of the soldier's accoutrements which is as unsuited to the present day rapid movement of war as Brown Bess (the fire-lock abolished in 1838) to a rifle range" (21). In 1876, Regulations still mention regiments in possession of the valise equipment, and others having the knapsack equipment (8).

Valise Equipment on the Continent

During the next few years the work of the English Committee and of Professor Parkes became well known on the Continent and in America. Morache, in France, in his textbook on Military Hygiene, published in 1874 (22), mentioned the current work of Judée on military accoutrements (23), and gave a complete description, including diagrams, of the British valise equipment—le sac-valise anglais. He described a trial of this equipment carried out by French troops, with very favourable results: "La poitrine se trouve complètement dégagée." Both Morache and Parkes were conversant with the dynamics of load carriage, with the work of the Weber brothers (24) and Meyer (25) on the mechanics of the human body, and the classic work of Duchenne (26) on the mode of action of the muscles of the body shown by electrophysiology.

Shortly after the appearance of the work of Morache, an important textbook on Military Hygiene was published in 1877 by the German hygienists Roth and Lex (27). This gave a long and detailed description of all military clothing and equipment of the period, both German and of other nations. As in the text of Morache, a great deal of space was taken up by the work of Professor Parkes and the British Committee of 1865-1868, and a detailed description with diagrams was given of the valise equipment of 1871. This was highly regarded, and in return for the compliment paid to the Prussian equipment in England, a trial was carried out on the valise equipment—Die Englische Gepäck—in Germany by a Prussian and a Saxon regiment, and with results similar to those obtained in France: "Die Brust durchaus nicht drückt, und das Schiessen im Liegen sehr bequem zulässt" (27).
In spite of the satisfaction expressed by the Eyre Commission with its work, the valise equipment soon came up for criticism, and during the period 1879-1881 there appeared two reports by another Committee on Equipment. The new president was now Major-General Steele. Professor Parkes had been replaced by Surgeon General McKinnon, and during the interim period Sir Thomas Troubridge had died. The Committee were asked to investigate the criticisms, and to examine carefully two new equipment designs that had been placed before them; one by a Colonel Barratt, and the other by Surgeon Major Oliver, whose plan had been praised in Canada. The two equipments were put out to trial together with the valise equipment, and the units concerned were given 23 questions to answer, similar to those used in the trials of 1865-1868. An objective test used during the trials was that of rifle fire, but the results were not appended and it does not appear that the accuracy of fire was measured. One notes with tolerance, tempered by experience, that the two units issued with Barratt and Oliver equipment gave completely contradictory opinions. Furthermore, a rift between the soldiers and physiologists made its appearance for the first time; and during the trials, Dr. Oliver made frequent complaints to the chairman, and later to the president, that his equipment was not receiving a fair test.

At the end of the trials, the Committee came to the conclusion that neither of the new equipments was suitable for acceptance, and recommended retention of the valise equipment, with the following modifications: (1) The valise to be of brown waterproof canvas, and to open at the back as recommended by Barratt; (2) the equipment to be made of brown leather; (3) the “havresack” to be carried in the valise; (4) the ball bag to be dispensed with; (5) in order to free the valise from the back, and to prevent the straps slipping down the shoulders, the supporting straps to be attached to the valise close to the mid line and below its upper edge (as in a rucksack) instead of to its upper corners. The following rider was added to the second report: “I do not agree with the Committee that the present valise equipment be retained for the present issue. I consider the principle faulty, and that the principle of Oliver, as modified, is far superior. Signed: Surgeon-General McKinnon.”

In spite of the judgments of the two Committees, we find that a somewhat different personal load carrying equipment appeared in 1882. This was essentially the same as that of 1871, but the valise was now carried in its earlier position high on the back, with the great-coat below and the canteen (or mess-tin) in between. The pouches were flatter, set rather higher on the waist belt, and were pipe-clayed. As a natural consequence of this new position, supporting straps again passed through the armpit and the lateral view somewhat resembled the arrangement seen in the present 1944 equipment. The valise measured about $15 \times 12 \times 3\frac{1}{2}$ inches, and had the disadvantage of not being detachable. In each pouch there were 40 rounds of ammunition.

By 1888 yet another improvement—known as the “Slade-Wallace” valise equipment—had appeared. The valise was now smaller, detachable, and the
The armpit was freed of annoying supporting straps; but it seems clear that the valise was not stable during "the double." Lack of supporting straps led to poor balance between valise behind and the pouches in front. The shoulders were pulled back, and stability could be obtained only at the expense of a very tight waist belt which was nevertheless dragged up on the man's stomach. At every halt, men could be seen hitching up the shoulders in an endeavour to get the pack in its proper place and the buckle of the belt down again. This fault, apparently absent in the 1871 equipment, was to be seen, and complained of, in most forms of British equipment which followed, even up to the present day. With the appearance of the Lee-Metford rifle in 1892, the number of rounds was increased to 100, equally divided between the two pouches.

**END OF NINETEENTH CENTURY**

Towards the end of the nineteenth century there was a determined effort in Germany to reduce the load carried by the infantry soldier. In 1894 a formal invitation was extended by the military authorities to the medical students and professors at the Frederich Wilhelm Institute to put on uniform and carry the campaign load of the infantry soldier. A series of marches was carried out, over distances up to 28 miles a day, in various weathers and with loads of 22-31 kilos. As a result of the trials it was concluded that, for the maintenance of health and efficiency, the total load carried should not exceed 22 kilos (48 lb.); and following a Cabinet Order of 1895, the weight was decreased from 31 to 27.8 kilos. These German trials are to be considered the first serious attempt to investigate the physiological background of the soldier's load.

During the period that work on load carriage was proceeding in Germany, Laveran, Professor of Military Hygiene at Val de Grâce in France, found time to write a textbook on Military Hygiene whilst continuing his renowned researches on malaria. This was published in 1896 (28) and, like its predecessors, gave an excellent analysis of the various factors concerned in the requirements of military clothing, marching and of load carriage. Laveran quoted the German trials, and gave a description with diagrams of the valise equipment of 1871. A great deal of reference was made to this text by succeeding authors, particularly in America.

*End of Part I*

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