SCIENCE AND WAR

OSLER

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SCIENCE AND WAR

FOR more than a year tongue and pen have served as safety-valves for the seething emotions of our hearts and heads. The time to keep silence is at hand when all shall be too busy to speak or to write. This was the feeling in my mind when your kind invitation came, but I yielded, interested in your school and its old associations, and, moreover, I had many warm friends here, particularly that Mosaic veteran, our distinguished colleague T. Pridgin Teale. The race is in one of its periodic attacks of acute mania, a bad one, too; Jeremiah of old would say the world is drunken and the nations are mad. So respectable and self-respecting had we become that the bout is a great shock. To discuss the causes would be out of place, but as the effects of the malady concern us directly I propose to speak briefly of the influence of the new dispensation of science on the old practice of war. Let me clear the ground with a few preliminary remarks.

War and History.

'Omnes homines ex natura hostes' is an old saying, and it was the reluctant admission of Plato

that the world was foolish 'in not understanding that all men are always at war with one another'.

Montaigne qualifies the statement that war is 'the greatest and most magnificent of human actions' with the remark that 'this science of undoing and killing one another and of ruining and destroying our own kind has nothing in it so tempting as to make it coveted by the beasts', and at the best it is but a testimony of our weakness and imperfection. In a memorable passage he gives a true estimate 'how this great body with so many fronts, and so many motions, which seems to threaten heaven and earth—

Not thicker billows beat the Lybian main,
When pale Orion sets in wintry rain;
Nor thicker harvests on rich Hermus rise,
Or Lycian fields, when Phoebus burns the skies,
Than stand these troops; their bucklers ring around;
Their trampling turns the turf, and shakes the solid ground—

(*Aeneid* vii)

this furious monster with so many heads and arms is yet man—feeble, calamitous and miserable man. "'Tis but an ant hill disturbed and provoked."' What would the great essayist have thought had he known what ultra-microscopic

Lilliputians we really are, dwelling on a mustard seed in the great universe.

Every page of history is red with blood. The primary object of war is to kill or to maim so as to put out of action as many as possible on either side. Read Walter Bagehot's chapter, 'The Use of Conflict,' in *Physics and Politics*, if you wish to get at the essence of the matter: 'The savage virtues which tend to war are the daily bread of human nature.' And he quotes Carlyle: 'The ultimate question between every two human beings is, Can I kill thee or canst thou kill me?'

Our young minds are trained to regard warfare as one of the prerogatives of Jehovah, the Lord of Hosts, who 'teachest my hands to war and my fingers to fight'. With man's conception of a great war in Heaven has passed into current belief one of the strongest of popular dogmas—that of a personal devil. Nurtured on the Old Testament, I recall as a child my terror at the recital of the slaughter of the thousands by the Israelites, when they spared neither man nor beast, woman nor child. After the ears of my understanding were opened it was but small comfort to know that these countless thousands existed only in the imagination of the historian of petty tribes of Palestine. The pride, pomp, and circumstance of war have so

captivated the human mind that its horrors are deliberately minimized. The soldier embodies the heroic virtues, and the camp is the nursery of fortitude and chivalry. The inspiration of the nation is its battles. Crecy and Agincourt, Trafalgar and Waterloo, are more notable events in history than Magna Charta, the execution of King Charles, or the Declaration of American Independence.

Mankind in the Childhood of Civilization.

The explanation of this distressing fact is that we are still in the childhood of civilization. Some millions of years divide the Tertiary period, when man broke away from the great ape stock, and the dawn of our modern era, when 'iron, cold iron,' became master of the world. Only with the working of metals did progress become possible. In Time our civilization is but a thin fringe like the layer of living polyps on the coral reef, capping the dead generations on which it rests. The lust of war is still in the blood, we cannot help it. There was, and there is as yet, no final appeal but to the ordeal of battle. Only let us get the race in its true perspective in which a thousand years are but as yesterday, and in which we are contemporaries of the Babylonians and Egyptians and all together within Plato's year. Let us remember, too, that war is a human development, un-

known to other animals. Though Nature is ruthless 'in tooth and claw', collective war between members of the same species is not one of her weapons; and in this sense Hobbes's dictum that 'war was a state of nature' is not true. The dinosaurs and pterodactyls and the mastodons did not perish in a struggle for existence against members of their own species, but were losers in a battle against conditions of nature which others found possible to overcome. In our own day the gradual disappearance of native populations is due as much to whisky and disease as to powder and shot, as witness in illustration of the one the North American Indian and of the other the Tasmanians.

The Dream that Wars would Cease.

And yet in what a fool's paradise many of us have been living, flaunting in the face of history our wish for peace—seeking it, ensuing it, with the war drums throbbing in our ears. But let us respect this pious wish since it was not without basis.

For more than a century the world had been doing well—everywhere prosperity and progress. The French Revolution and the founding of the American Republic seemed to lift humanity to a level on which might be realized practically the brotherhood of man. There had been bloody and

grievous wars in the nineteenth century, but there were such hopeful features that the new century opened with peace congresses and peace palaces. Remarkable and unheard-of incidents seemed to indicate a change of heart among the nations. Following the Spanish-American War, Cuba, the Pearl of the Antilles, fell to the United States by conquest, only to be restored to its rightful owners. The Philippine Islands remain in trust by the same nation to have and to hold for its inhabitants whenever they are ready. South Africa, conquered at the cost of much blood and money, was made a nation by its conquerors. There were other considerations; commerce knew no boundaries, and commerce was the uncrowned king to whom all paid homage. An intellectual comity had sprung up between the nations, fostered by a growing interchange of literature and maintained by gatherings whose Pentecostal character lent hope to the dream of Isaiah of a day when in the spirit of wisdom and understanding Ephraim should not vex Judah and Judah should not vex Ephraim.

And some of us had indulged the fond hope that in the power man had gained over nature had arisen possibilities for intellectual and social development such as to control collectively his morals and emotions, so that the nations would

not learn war any more. We were foolish enough to think that where Christianity had failed Science might succeed, forgetting that the hopelessness of the failure of the Gospel lay not in the message, but in its interpretation. The promised peace was for the individual—the world was to have tribulations; and Christ expressly said: 'Think not that I am come to send peace on earth; I came not to send peace but a sword.' The Abou ben Adhems woke daily from their deep dreams of peace, and lectured and published pamphlets and held congresses, while Krupp built 17-inch howitzers and the gun range of the super-Dreadnoughts increased to eighteen miles!

And we had become so polite and civil, so cultured in both senses of that horrid word, with an 'Is thy servant a dog?' attitude of mind in which we overlooked the fact that beneath a skin-deep civilization were the same old elemental passions ready to burst forth.

Professor Haverfield shocked me the other day by remarking that the Greeks, with all their refinement, were a match for the worst of us to-day. This drove me to Thucydides, where I found a parallel with Belgium in the treatment of Melos by the Athenians. He gives the wonderful dialogue in a cold, clear style befitting the hard

The Athenians and Melos.

barbarity of the transaction. The delegates from Athens urged: 'What is right is estimated by the equality of power to compel.' 'The powerful exact what they can, the weak grant what they must.' The Melians wished to remain quiet and to be friends, and to force them to take sides they said would only make enemies of all the neutrals—and then there were the gods! To which the Athenians replied: 'As regards the favour of heaven, we trust that we, too, shall not fall short of it: they always maintain dominion wherever they are the stronger.' It was the case of the Walrus and the Carpenter, and the Athenian delegates retired with the remark: 'We bless your simplicity; we do not admire your folly.' And Book V concludes in a twentieth century 'might is right' fashion: 'They surrendered at discretion to the Athenians who put to death all the male adults, and made slaves of the women and, children ... as for the country, they inhabited it themselves.'

In spite of unspeakable horrors war has been one of the master forces in the evolution of a race of beings that has taken several millions of years to reach its present position. During a brief fragment of this time—ten thousand or more years—certain communities have become civilized, as we

say, without, however, losing the savage instincts ground into the very fibre of their being by long ages of conflict. Suddenly, within a few generations, man finds himself master of the forces of nature. In the fullness of time a new dispensation has come into the world. Let us see in what way it has influenced his oldest, and most attractive occupation.

The Influence of Science.

Science is a way of looking at the world taught us by the Greeks—a study of nature with a view to utilizing her forces in the service of man. It 'arose from the simplest facts of common experience, and grew by the co-operation of the mass of men with human intellect at its highest. And when developed it returns again to strengthen the common intelligence and increase the common good. Above all, more perfectly than any other form of thought, it embodies the union of past and present in a conscious and active force.'[1] Man's latest acquisition, it has worked a revolution in every aspect of his life, without so far changing in any way his nature. He is still a bit bewildered, and not quite certain whether or not the invention is a Frankenstein monster. That is a splendid allegory of Kipling's—'The Four Angels' of

[1] Marvin, *The Living Past*, second edition, 1915.

the four elements, who offered themselves in vain to Adam while in Paradise ; but—

As Adam was a-working outside of Eden-Wall,
He used the Earth, he used the Seas, he used the Air and all;
And out of black disaster
He arose to be the Master
Of Earth and Water, Air and Fire.

The promise of Eden of full dominion over nature has only been fulfilled in our day. The flower and fruitage has come suddenly within a couple of generations. Even the seed time was but a few years ago, for to the Heidelberg man, looking down the ages from the Glacial period, Aristotle and Darwin are contemporaries, Galen and Lister fellow practitioners. Steam and electricity have upset our week-day relations, and the theory of evolution our Sundays. Like a beggar suddenly enriched man has not yet found himself; and the old ways and old conditions often sort ill with the changing times. New bottles could not always be found for the new wine.

Scientific Progress.

Organized knowledge, science, if living, must infiltrate every activity of human life. There was a difficulty in these islands, which of fruitful ideas, inventions, and discoveries have had the lion's share, but failed to grasp quickly their practical

importance. The leaders of intellectual and political thought were not awake when the dawn appeared. The oligarchy who ruled politically were ignorant, the hierarchy who ruled intellectually were hostile. Read of the struggles at Oxford and Cambridge in the 'fifties' and 'sixties' of the last century to get an idea of the attitude of the intellectual leaders of the country towards 'Stinks', the generic term for science. It was not port and prejudice, as in Gibbon's day, but just the hostility of pure mediaeval ignorance. Those in control of education were more concerned with the issues of Tract 90 and the Colenso case than the conservation of energy and *The Origin of Species*. To take but one example. What a change it might have wrought in rural England if, in 1840, when the distinguished Professor Daubeny was made professor of rural economy, Oxford could have had great State endowment for an Agricultural College. The seed was abundant, and the soil was good, and only needed the cultivation that has been given so freely by members of the past generation, with what results we see to-day at Oxford and Cambridge and in the new universities.

In Scotland, too, science had a hard fight to break the shackles of ecclesiasticism. It seems

scarcely credible that religious tests for professors of the physical sciences were demanded until the 'sixties'. I have a pathetic letter, 1852, to the Secretary of State for the Home Department from the late George Wilson, who wished to be a candidate for the chair of chemistry in Glasgow, but was debarred, not being a member of the Church of Scotland! No wonder science could not pass from the top through such Berkefeld filters.

But all this has changed, and everywhere an enviable academic freedom now exists. The problem of linking university work with the scientific industries is being solved by you here and elsewhere, as in Sheffield, with marked success, and is part of a great and growing movement to which the war has given a fresh stimulus. May I call the attention of those interested to a recent pamphlet, No. 30, of the Board of Education, by Thomas Lloyd Humberstone, entitled *An Experiment on Educational Research*, as it illustrates the type of work to which I refer. In the words of the foundation (which is connected with the University of Pittsburg) the object is: 'The increase of useful knowledge through the application of contemporary science to industrial processes . . . and providing

the opportunities for the training of men for high industrial appointments.' It is worthy of careful study. In forty years Germany made science infiltrate every activity of her life, and much good, you may say, has it done her. Well, if in this day of trial she can be independent of the importation of nitrates by the synthetic manufacture of nitric acid, it will pay her a thousandfold the millions she has spent in promoting the interdependence of science and commercial technology.

Scientific Methods of Destruction.

In two ways science is the best friend war has ever had; it has made slaughter possible on a scale never dreamt of before, and it has enormously increased man's capacity to maim and to disable his fellow man. In exploiting the peaceful victories of Minerva, Mars has added new glories to his name. More men are killed, more men are wounded, and consequently more men are needed than ever before in the history of the world's wars. From 1790 to 1913 there were 18,552,200 men engaged in the great wars, of whom 5,498,097 lost their lives (D. E. Smith). In the Balkan wars of 1912–13 there were 1,230,000 men engaged, of whom 350,000 were killed. In the Russo-Japanese War there were 2,500,000 men, of whom 555,900 lost their lives (D. E. Smith). It is estimated that in the present war more than 21 millions are

engaged! As weapons have improved the losses will be yet greater, and we may expect that at least five or six millions of men in the prime of life will be killed. Within a few years artillery and high explosives, submarines and air-craft have so revolutionized our methods of warfare that thousands are now destroyed instead of hundreds. The rifle and the bayonet seem antiquated, and one may go from hospital to hospital and not see a wound from the latter, and comparatively few from the former.

The Submarine.

In three directions science has scored in a mission of destruction. What a marvellous adaptation of physics, pneumatics, and mechanics is displayed in a submarine, with which the highest standard of wholesale destruction is reached. In a few seconds a vast battleship, itself a product in every part of scientific genius, is blown asunder and a thousand men and boys sent flying into eternity. Or a colossal liner like the *Lusitania*, laden with harmless non-combatants, is torpedoed without warning and above 1,200 perish miserably, to the inexpressible delight of a kultured nation, whose school children celebrated the event with a holiday.[1] How Mars and Neptune must chuckle at the

[1] Owen Wister, *The Pentecost of Calamity*, p. 55.

truly Olympian scale on which we do these things to-day.

The Modern Battleship.

And the new guns and modern explosives! Chemistry, electricity, physics, optics, mathematics, every aspect of the subtlest human study has contributed to their perfection. What a divinely adapted organism of destruction is a modern battleship! And the gusto with which we receive news of a naval triumph is only equalled by the keenness of the delight with which the spectacle is witnessed. Listen to these newspaper extracts:

After the action, to see our innocent-looking ships leave the spot where the German ships sank was a sight for the Gods. . . . It was a fine sight to see the *Lion* demolish one cruiser. . . . For fully ten minutes she belted away without getting a single hit. Then the *Lion*, which was leading the line, hoisted 'Open fire', turned slowly and majestically round and fired her broadsides—once. It was quite sufficient. Up went a cloud of smoke and steam from 'the target', and when it cleared off her aft funnel was at a rakish angle and a huge rent appeared the length of her side. . . . So once again the *Lion* turned, and this time fired but five shots from her huge turrets. Amidst a shower of splinters, smoke, and fire, the German disappeared. We steamed over the spot where she sank but . . . not a single living thing was to be seen.

Dante and Milton in their descriptions of hell are quite outclassed by the description of what happens on a battleship in action outclassed by an enemy's guns. Here is perhaps the greatest single victory for science in war, from one standpoint. In the making of a 15-inch gun that will throw with accuracy a ton of metal a dozen or more miles is found a combination of brains and machinery such as does not exist in any other human product, and, let us add, such a combination of brains and courage does not exist in the working of any other machine. And to us the courage seems to hallow the shambles!

This is the day of Nisroch, Chief of Ordnance to Satan in the great war of heaven, inventor of—

> Hollow engines long and round.
>
> . . . . . .
>
> Such implements of mischief as shall dash
> To pieces and o'erwhelm whatever stands
> Adverse, that they shall fear we have disarmed
> The Thunderer of his only dreaded bolt.
>
> (*Paradise Lost*, Book VI.)

The Enormous Power of Present-day Artillery.

On land the field-guns, howitzers, and machine-guns have increased enormously our killing capacity; so much so, indeed, that in self-defence the armies have taken to earth, and from the North Sea to the Alps Europe has become a rabbit

warren. High explosives, long-range accuracy, and quickness of fire have made the artillery arm the most effective of the Service. Every device of science has been pressed into use, and the aeroplanes with their observers and cameras have plotted the entrenched lines to checker boards, on to any square of which a rain of shell and shrapnel may be poured. The high-explosive shells, the 'Jack Johnsons', and the 'Black Marias' have played a great rôle in the present war, and not only do they kill and maim, but the shell-shock from commotion puts a large number of men out of action. Against the great Krupp howitzers the forts of Europe have gone down like card-board houses.

Artillery and quick-firing machine-guns follow hard upon the torpedo as agencies of destruction. Against an oncoming enemy 20 per cent. of men and 60 to 80 per cent. of horses are hit by separate bullets within the 'mown area'. There was a grim description the other day of the carnage at Novo Georgievsk among men advancing in close formation. A tract of land four miles long and one and a quarter miles broad was covered by thick layers of the dead, heaps upon heaps, with hundreds of men standing upright, stiffened in death among the

prone corpses. A super-Dreadnought could not do more.

But there are worse things than killing. At sea it is a short shrift—there are not many sailors in hospitals; but on land the shrapnel, shell, and hand-grenade fill the wards with maimed and mutilated men. A rifle bullet nowadays goes through a man, kills if it hits a vital spot, but very often leaves a nice clean wound which heals promptly, though head, chest, or abdomen may have been perforated. The shrapnel and the hand-grenade tear, bruise, and break, lacerating flesh and joints, blowing away limbs or parts of the face or head, causing wounds not only terrible in themselves but certain to become infected with clothing and earth. Even the bones of a man's comrade have been blown into him. Never since the primal tragedy, when man first shed man's blood, has there been such a carnival of carnage as that which science has made possible during the past year. And add the dumb and deaf, the paralysed, and the insane from shell explosions and shock!

Irrespirable Gas.

But there is worse to follow—the climax of the adaptation of modern knowledge to war. I had a dream not long since that explorers in Central Africa had accidentally opened a vein of deadly

radium which flowed slowly but imperceptibly like an unseen lava over the surface of the earth, killing by the exhalation of an irrespirable gas. It had crossed beneath the Mediterranean, swept through Europe, and had reached England. Convocation had been summoned by the Chancellor and the members of the University in academic cap and gown awaited the end of all things. On came the irresistible and deadly vapour, swept down the ranks, reached me, and I awoke—gasping for breath.

Theoretically all is fair in war, but by common consent certain practices regarded as cruel are tabooed, such as the use of explosive bullets. Not so in the present war. Never before has anything been used by man to kill his fellow man equalled in diabolical capacity for cruelty the use by the Germans of irrespirable gas. Had it been a suddenly asphyxiating vapour, such as may have been the breath of the angel of death as he passed over the host of Sennacherib, the action would not perhaps have been thought any more reproachful (in war) than wholesale drowning by the torpedo. But this was a very different matter —agonizing suffocation to those who could not escape; many for days gasped out their lives in a slow process of strangulation, others had a

lingering illness with urgent dyspnœa, cough, and inflammation of the lungs. The worst types of cases were, I am told, appalling to witness—some who reached England were bad enough.

Air-craft. It is not a little remarkable that the aspect of the war which caught the popular fancy and from which so much was expected has proved comparatively harmless from a killing standpoint. 'The rain of ghastly dew' of Tennyson's vision, which the Wright brothers and Zeppelin have made possible, is more destructive of property than of life. But the mastery of the air is one of the greatest of the conquests of science. How Leonardo da Vinci would have rejoiced, in this day predicted so confidently by him, to see flocks of wonderful bird-men as much at home in the air as eagles. The development of air-craft and air-guns has added a new arm to the Service, but battles of the airy navies grappling with each other or attacked by shells from land leave few wounded, and the total killed so far is small. An enormous value for observation and the shock of righteous indignation roused all over the world by the Zeppelin murders of women and children have been, so far, the chief assets of the air.

The bombarding of air-craft is a wonderful

sight. Motoring near —— the other day, one of my companions, Colonel McCrae, called out, 'Look up; there they begin.' His practised ear had caught the sound of an air-craft gun. Far up against a white cloud was a round puff-ball of black smoke, looking the size of the moon, and just beyond it a black speck moving swiftly by the edge of the cloud. Then near to it a spit of fire of an exploding shell, and another puff-ball of smoke. Flash followed flash, and within five minutes we counted forty-two black balls of smoke, silhouetted against a big cloud which resembled a huge slice of 'spotted-dog' bread. The shells seemed to explode all about the aeroplane and the gunners had the range, but it was impossible to say how close the shots came; evidently the aviator found the place too hot, as he disappeared into the cloud. Half an hour later we saw a still more exciting contest. The bird-man was evidently taking observations and moving in different directions. Many volleys were discharged at him and the whole sky in the neighbourhood was spotted with shrapnel puffs, among which the aeroplane moved in and out quite unconcernedly —so it appeared. On either side of the road were peasants working in the fields and close by a steam thrashing-machine with its staff, but no one

stopped work or even looked up at a scene that custom had made stale.

Science as a Beneficent Force.

Enough of this. Let us turn to the other side of the picture; let us see what science has done in a mission of salvation amid the horrors of war. Three things, first, in organizing the transport and care of the sick and wounded.

Care of the Wounded in Napoleon's Time and To-day.

In no work do we get such a picture of the grim details of war as in the *Mémoires* of the famous Baron Larrey, Napoleon's favourite surgeon (Paris, 1813). The retreat across the desert from Syria and the retreat from Moscow mark the most terrible sufferings ever experienced by armies. Larrey was not only a great surgeon, but a lover of the soldier and devoted to his comfort. From his campaign on the Rhine, in 1789, we may date the beginning of the modern rapid transport of the wounded from the firing line. Previously the custom was to collect the wounded as soon as possible after the combat, which meant that they were often 24 or 36 hours on the field without assistance. Let me give his own words, as they are memorable: 'La prise de Spire nous en ayant donné un assez grand nombre, j'eus la douleur d'en voir mourir plusieurs, victimes de cet inconvénient; ce qui me donna l'idée d'établir une nouvelle ambulance qui fût en état de poster de prompts

secours sur le champ de bataille même.'[1] This was the origin of the famous *ambulance volante*, from which have evolved our modern methods of rapid transport. What would Larrey think of the flying ambulance of to-day—motor and train? One thing could not but please him—the development of the ambulance corps on lines laid down by him and the big motor ambulance modelled on his *grandes voitures* with four horses which held four wounded recumbent.[2]

Through the bitter experiences of the Napoleonic wars, of the Crimea, of the American Civil War, and more particularly of the recent campaigns, there has been evolved a wonderful machinery, replete with science, for the transport and care of the sick and wounded. There must be suffering —that is war—but let us be thankful for its reduction to a minimum, through the application in every direction of mechanical and other pain-saving devices. We all know the work at the big base hospitals at home, and let us not forget the deep debt of gratitude due to Lord Haldane and Sir Alfred Keogh for perfecting their organization years before the war broke out. I wish the public could know more of the heroism and devotion of

[1] *Mémoires*, tome i, 58.

[2] Ibid., p. 150.

the men and women serving the field ambulances and casualty clearing stations, the perfect service rendered, the duties done in loyal and loving charity. Let us see what happens to the poor fellows on their way to a base hospital in France.

A Hospital Camp.

Come with me 'somewhere in France', to the top of a high down overlooking the sea. At our feet lies a city of tents, spread out for miles between the dunes and the downs, white and spotless against the evening sun. Lines are seen dividing sections of the encampment, and the scene reminds one of the description of the tents of Israel pitched in Moab and putting Balaam and Balak to sore perplexity. Figures in white and in khaki flit about, and now and again a motor lorry passes up the main line, but it is a peaceful scene on a summer's eve—in Picardy.

The camp is one of several big groups of British general and stationary hospitals. This one is made up of Durbar tents, in five or six separate units of from eight hundred to a thousand beds each. It was a novel experience, as I had never seen so many men under canvas, and the hospital wards were in big tents holding usually from twenty to thirty patients. The inner lining of the tent was of a coloured Cawnpore material with attractive patterns. More beautiful

wards cannot be imagined, so rich and varied in colouring, but I hasten to add that I did not see them in wind or rain. And to the call of country and humanity are come men and women from all parts of the English-speaking world—seasoned old veterans of the Army Medical Corps, consultants from London and Edinburgh, specialists of distinction, general practitioners, men from Australia and Canada looking after their special hospitals, with units of our brothers from Harvard University and from Chicago. Some of these groups, as that from McGill University, Montreal, have brought over a complete staff, with nurses and orderlies and all the necessary apparatus for a 1,040 bed hospital. Other Canadian University units have come from Toronto, Kingston, Laval, and Dalhousie. At home the members of these staffs are busy teachers and practitioners. The nurses have come from all parts of the Empire, and two groups from the United States—ministering angels all to the sick and wounded. Nothing could illustrate better the spirit of self-sacrifice and devotion which the great war has awakened all over the world.

Reception of a Convoy of Wounded.

But a message has come to the camp—'A convoy to-night!'—and word is sent to the wards to prepare beds for the number given in

the message. Promptly at the hour stated a magnificent ambulance train pulls up at the station near by—fifteen big steel hospital carriages of the latest construction, presented by the United Millers' Association of Great Britain. Twenty-eight motor ambulances are in attendance from the various hospitals, and the work of unloading begins. A more orderly, well-arranged business it is not possible to imagine. The cot cases are first lifted on their stretchers from the car and put in the ambulance—four in each, taking, as I timed it, a minute each. And all done so quietly, no talking, no fuss.

I went in the ambulance with the four men I had seen lifted out. Let us follow them to their beds. First, an Irishman with a bullet wound in the scalp. 'Begorra,' said he, 'I did not duck in time, but me mate 's in Paradise to-day—a Saxon got him in the ear'; a Londoner with typhoid fever; a Lancashire lad with appendicitis; and a Cheshire man with a bad shrapnel wound in the leg. By the way, all were smoking! They had been about six hours in the train, very comfortable and well fed; the wounded had been hit early in the morning. They reported that the only serious discomfort was getting to the dressing station. It took seven minutes in the ambu-

lance to the hospital. The patients passed quickly through the admitting tent, where their tallies were copied and the ward assigned. The four were in bed and the two wounded had had their dressings changed, and all had had hot *bouillon,* in just twenty-seven minutes from the time the first was lifted out of the ambulance train.

I mention these details as they illustrate one aspect of science in organization. And it is nice to know that in all stages of the transfer of the sick and wounded, both by sea and land, the arrangements have been as satisfactory as the exigencies of war have permitted.

Progress of the Wounded.

I saw the four again the next day. The Irishman's wound in the head only needed scouring and a few stitches; another inch lower and he would have joined his mate. The shrapnel leg was serious, torn flesh, broken bones, clothing and dirt in the wounds. He had been carefully dressed and was comfortable, but with a slight rise of temperature. An X-ray picture was taken to locate the pieces of shrapnel and the site of the fractures. In an operating room as well equipped as any in London the foreign bodies were removed, the bones placed in apposition, and the limb dressed. I saw him two days later, and though he had slight fever he was comfortable.

the wounds were healthy, and the outlook for his leg was good.

The appendicitis case was as simple as any in civil life. The typhoid case was not so simple. In the first place, the man had no right to have typhoid fever, as he had been inoculated twice within the year. And now came the test whether the hospital had an up-to-date scientific equipment. The laboratory was not large, but the man in charge knew his job. Just as a patient who has recovered from one attack of typhoid fever may have a second attack within a year, so an inoculated man may get a fresh infection, but this is rare. The reaction of the patient's blood serum to ordinary typhoid was present, as it should be in any one after inoculations—so that was no help. Only a set of cultures from blood and stools could determine whether he had a fresh attack of ordinary typhoid fever or an attack of a similar, indeed identical, disease, caused by an allied germ, either paratyphoid A or B. After all, bacteriology is only a department of horticulture, and with the new method of growth of germs on solid media the strains of the typhoid germs are as readily determined as are the strains of sweet-pea. They have what are known as agglutinative reactions with the blood serum that are perfectly

distinctive and to be seen with the naked eye. It was a tedious business, but plain enough at the end—a paratyphoid B infection against which the original inoculation was as powerless a protection as is small-pox vaccination against chicken-pox.

If the foes of our own household, the 'anti's', would spend a few days at a hospital for infectious diseases, see the modern methods, and learn a few elementary facts about immunity, they could not but be impressed with the applications of scientific horticulture to disease, and be lost in admiration of a technique of extraordinary simplicity and accuracy.

The Prevention of Disease.

The second great victory of science in war is the prevention of disease. Apollo, the 'far darter', is a greater foe to man than Mars. 'War slays its thousands, Peace its ten thousands.' In the Punjab alone, in twelve years, plague has killed two and a half millions of our fellow citizens. This year two preventable diseases will destroy more people in this land than the Germans. The tubercle bacillus alone will kill more in Leeds in 1915 than the city will lose of its men in battle. Pestilence has always dogged the footsteps of war, and the saying is true—'Disease, not battle, digs the soldier's grave'. Bacilli and bullets have

been as David and Saul, and at the breath of fever whole armies have melted away, even before they have reached the field. The fates of campaigns have been decided by mosquitoes and flies. The death of a soldier from disease merits the reproach of Armstrong:

> Her bravest sons keen for the fight have dy'd
> The death of cowards and of common men—
> Sunk void of wounds and fall'n without renown.

This reproach science has wiped away. Forty years ago we did not know the cause of any of the great infections. Patient study in many lands has unlocked their secrets. Of all the great camp diseases—plague, cholera, malaria, yellow fever, typhoid fever, typhus, and dysentery—we know the mode of transmission, and of all but yellow fever the germs. Man has now control of the most malign of Nature's forces in a way never dreamt of by our fathers. A study of her laws, an observation of her facts—often of very simple facts—has put us in possession of life-saving powers nothing short of miraculous. The old experimental method, combined with the new chemistry applied to disease, has opened a glorious chapter in man's history. Half a century has done more than a hundred centuries to solve the problem of the first importance in his progress.

Briefly, four things have been determined about the disease we call infectious. First, that there are specific germs, which breed true, often showing varieties, as is so common in nature. Secondly, these disease seeds, artificially grown, may be recognized by biological and chemical characters, and will reproduce the disease when injected into a susceptible animal. Thirdly, in the growth and multiplication of the germs there are changes in the body fluids, associated with the production of what is called immunity, and these changes may be artificially induced by inoculation with the germs or the products of their growth. And lastly, many important diseases are transmitted by insects—ticks, mosquitoes, flies, lice, and fleas.

The question was how to translate this knowledge into practical effect. Well, it has been done, and done in this war as never before in history. A victory had to be won first in the army itself, in insisting upon the importance of sanitary education for all officers, and here again we have to thank Lord Haldane. In a larger army than we have ever before had in the field the incidence of disease has often been lower than in times of peace. In the West there has been no great epidemic—neither dysentery, typhus, nor cholera; and

typhoid fever, the soldiers' foe, has so far been a negligible quantity. Think what it was in the German army in 1870–1, fighting over much the same ground and with an army of about the same size as our own, 74,204 cases and 8,904 deaths. Peculiar conditions have caused peculiar maladies, such as trench fever, trench feet, odd types of rheumatism and nephritis; but, on the whole, when the figures come out for the first year of the war we shall find a great victory in the low death-rate from disease. In the East dysentery and forms of typhoid fever are troublesome, but the graver camp diseases such as cholera and typhus have not prevailed, and are not, I think, likely to do so.

The Treatment of Wounds.

And lastly, in the treatment of wounds science has made great advances. The recognition by Lister of the relation of germs to suppuration, an outcome of Pasteur's work, has done away with sepsis in civil life. High explosives, shell, and shrapnel make wounds that are at once infected by the clothing and dirt, and are almost impossible to sterilize by any means at our command, but with free drainage, promotion of natural lavage from the tissues by Wright's method, and the use of antiseptics when indicated, even the most formidable injuries do well. The terrible laceration of soft parts and bones adds enormously to the

difficulty of treatment. The X-ray has proved a boon for which surgery cannot be too grateful to Röntgen and to the scores of diligent workers who have given us a technique of remarkable accuracy. Other electrical means for detecting foreign bodies have also given good results.

Of the germs blown into wounds from the soil and clothing and skin the pus-formers are the most numerous and most important. Two others have proved serious foes in this war, the germ that causes gas gangrene and the tetanus bacillus. I am told that methods of treatment of wounds infected by the former are giving increasingly good results. The soil upon which the fighting has occurred in France and Flanders is rich in the spores of the tetanus bacillus; the disease caused by it was at first very common and terribly fatal among the wounded. For centuries it has been one of the most dreaded of human maladies, and justly so, as it is second to none in fatality and in the painful severity of the symptoms. No single aspect of preventive medicine has been more gratifying in this war than the practical stamping out of the disease by preventive inoculation. In the first six months of this year only thirty-six of those who were inoculated within twenty-four hours of being wounded suffered from tetanus.

Is Science for or against Humanity?

And what shall be our final judgement—for or against science? War is more terrible, more devastating, more brutal in its butchery, and the organization of the forces of nature has enabled man to wage it on a titanic scale. More men will be engaged and more will be killed and wounded in a couple of years than in the wars of the previous century. To humanity in the gross science seems a monster, but on the other side is a great credit balance—the enormous number spared the misery of sickness, the unspeakable tortures saved by anaesthesia, the more prompt care of the wounded, the better surgical technique, the lessened time in convalescence, the whole organization of nursing; the wounded soldier would throw his sword into the scale for science—and he is right.

The War and International Science.

To one who is by temperament and education a Brunonian and free from the 'common Antipathies' and 'National repugnances'[1] one sad sequel of the war will be, for this generation at least, the death of international science. An impassable intellectual gulf yawns between the Allies and Germany, whose ways are not our ways and whose thoughts are not our thoughts. That

[1] Sir Thomas Browne, *Religio Medici*, pt. ii: 'I feel not in myself those common Antipathies that I can discover in others: those National repugnances do not touch me.'

she has made herself a reproach among the nations of the earth is a calamity deplored by all who have fought against Chauvinism in science, and a bitter regret to those of us who have had close affiliations with her, and lifelong friends among her professors, whose devotion to science has made every worker in every subject the world over their debtor. Even the philosophy of Rabbi Ben Ezra is strained in these days of passion—

> Now who shall arbitrate?
> Ten men love what I hate,
> Shun what I follow,
> Slight what I believe,
> Ten who in eyes and ears match mine.

With death war dies, and there is no hatred in the grave. The past is unforgiving, but we all may—

> With uncovered head
> Salute the sacred dead
> Who went, and who return not.

It was a noble motive that prompted the Warden and Fellows of New College to put upon the roll of honour in their hall the name of a German Rhodes scholar, one of her sons, though an enemy, who had fallen in battle for his country, an action resented by certain narrow-minded Philistines in the press. I should like to pay a

last tribute of words to Paul Ehrlich, one of the masters of science, who has recently passed away. Many will recall with pleasure his outstanding position at the last International Congress of Medicine. In micro-biology and in the bio-chemistry of cells he was a creator, and no one of his generation contributed so much to our knowledge of the relations of living matter and chemical compounds. His studies on immunity form a new chapter in pathology. The climax of many years of patient work on the specific affinities of chemical substances for certain cells and for protozoa was reached in the discovery of '606' as a cure for syphilis. The brilliant labours of such a man transcend national limitations, and his name will go down to posterity with those of his countrymen, Virchow and Koch, as one of the creators of modern pathology.

Conclusion.

I am afraid that the subject of my lecture has been what Robert Burton would call glucupicric —bitter-sweet. This old earth has rarely had a worse year than that through which we have just passed. Men's hearts are failing for fear, and for looking after those things which are coming upon it. Though final deliverance from strife will not be in our day, let us not despair. Only just awake, the race is sore let and hindered by

passions and practices, strong as animal instincts, which millions of years of struggle have ground into its fibre. I have just finished reading Henry Osborn Taylor's last book, *Deliverance*, in which he sketches the ways in which our ancestors of all times and countries have adapted themselves to the fears and hopes of their nature. From such a story of incessant and successful adjustments one may take a Pisgah-sight of a day when 'nation shall not lift up a sword against nation, neither shall they learn war any more'.

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