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SOLDIER AND SCIENTIST.*

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Most military libraries contain a number of works regarding the soldier's relationship with his colleagues, such as: "Soldier and Sailor", "Soldier and Airman", "Soldiers and Statesmen" and so on. It is curious perhaps that no work has so far appeared entitled "Soldier and Scientist". Yet, from this fact the point emerges that whereas in the past, the combination of the soldier and the scientist was uncommon, it is now being appreciated that such is indeed desirable and people are perhaps wishing to improve their knowledge on the subject.

Soldiers of 20 years' standing or so must admit that during their early days in the Army, they heard little or nothing about "Defence Science". Today, however, all soldiers must be conscious of its importance, and soldiers and scientists, if still comparative strangers to one another before World War II, were certainly thrown into one another's arms before that war was ended. The assessment of the relationship which should obtain between a soldier and a scientist is a fascinating study. The fact that today they get on so well together is perhaps because in the recent past each has changed in some degree. The Scientist, if one may say so, is less remote, more forthcoming and indeed more human. He no longer hides himself from the view of the ordinary man in the obscurity of scientific formulae but emerges into this rough and ready world, slaps the soldier on the back, and tells him to regard Science not so much as something obscure, lofty and unattainable but rather as systematized investigation and knowledge. The soldier for his part no more withdraws to brood in his military shell but comes forth prepared to cooperate and to learn: in fact, has started to think!

The relationship between a soldier and a scientist is perhaps not unlike that between a patient and a specialist. The patient must say what is wrong or what he requires put right: the specialist must prescribe. Such a system, however, does not preclude the specialist, if he is on friendly terms with his patient, from coming forward with certain suggestions of his own, such as: "if you go on sleeping at night without using a mosquito net, you will get malaria" or "if you continue to drink two bottles of port after dinner every night, you will have an apoplectic fit". Such advice may be regarded by the patient as unwarrantable interference in matters of personal routine; yet if he is wise, he will take the remarks to heart and profit by them. So with the soldier and the scientist. The first move is with the soldier who says what is wrong and what he wants put right. The scientist produces something to meet the requirements but like the specialist with his patient, he should be on such good terms

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with the soldier that he can come forward at any time with advice and ideas. We all know the old cliche that the scientist must be on tap but not on top. That is not entirely correct. He must not be on top. At the same time, he must be rather more than on tap. He should be able to turn himself on.

If we delve into military history, we see that the scientist appeared upon the military stage many years ago, as for example: Leonardo da Vinci and the scientists who accompanied Napoleon to Egypt. Cesare Borgia employed Leonardo as his Chief Engineer about the year 1500. Three hundred years later, Napoleon took a bunch of scientists with him when he went to Egypt. What the relationship between the soldier and the scientist was in those days, history does not relate. It would be interesting to know. One suspects, however, that the scientists were something of a race apart and that it is only in recent times that they and the soldiers have taken to moving forward in step with one another on equal terms. Each has his function to perform and he would be a foolish scientist who fancied he was a soldier, and perhaps a still more foolish soldier who fancied himself a scientist. But we do know today what is meant by the military scientist and the scientific soldier.

It was said a little earlier that the soldier's attitude to Science must have changed when he began to think. This remark may well suit neither the soldier nor the scientist, for the former will maintain that he has always had the habit and made a practice of thinking, whereas the scientist may ask when did he start? Let us take a glance at Military History which shows us the private armies of the feudal barons growing through the years into small, then larger, professional armies until we reach the stage of a nation in arms. Compare, for example, the small professional army of the Duke of York. "The good old Duke of York who had ten thousand men. He took them up the hill, and brought them down again." That "jingle" may perhaps not be fair to the Duke of York's tactical prowess but it goes at least to show what his country thought of him during his campaign in the Low Countries. That he was able to find any tactical feature worth the name in such terrain must remain a mystery or be regarded as poetic licence. Then take the case of the Duke of Wellington in days which might be described as "I order, you obey". The Iron Duke's despatches to the Secretary of State for War disclose a relationship which today would not be tolerated, and perhaps for that reason make most amusing reading. His attitude to his own Generals was startling, when one remembers that he once addressed them thus "What effect you may have, Gentlemen, upon the enemy I know not; but you frighten me". Then Balaclava: "Their's not to reason why, their's but to do and die". Do and die, of course, for that is a soldier's duty; but not to reason why should not be asked of any soldier, however, dreadful the duties which he is commanded to perform may be. But when did the soldier first start to think? So far we have not noticed it! Perhaps the answer is to be found in the Franco Prussian War. How was it that Molke was able to defeat an army of approximately the same number as his own and bring France to her knees in a little over six weeks? Was it not because for the first time in history, the junior leader on the spot was encouraged to take action according to the situation as it presented itself to him

rather than follow slavishly the orders which he had received: in fact, as we would term it now the use of 'instructions' rather than of orders? That is when the officer at every level down to the most junior was encouraged to think for himself, and it is a point in military history which is worth noting. Consider, in this connection, what tremendous advantage Lord Montgomery derived from taking his soldiers into his confidence. He would not let them go into battle until every man had had explained to him the object of the operation and knew precisely what was expected of him and to what end.

All this development is merely a feature of Democracy, but it makes an interesting study.

Now let us consider in greater detail how the scientist can help the soldier. It has been said of the British Army that in every war it makes sure of winning at least one battle, and that that battle is always the last. Be that as it may, the fact remains that the British Army never seems to start very well, and this was particularly true of World War II. Yet, in a way, this was a blessing in disguise for it had the curious effect of placing British scientific thought and development ahead of that of the enemy. While Germany was thundering across France, knocking hell out of everything and everybody that stood in the way of her armour and her aircraft, Britain was striving desperately to work out her own salvation. Germany felt that nothing could stop her; Britain felt that unless every means and every device was used to the full, nothing could save her. Take the magnetic mine; how near it was to sweeping Britain's Navy and Merchant Fleet from the seas. Catastrophe was averted as if by a miracle by the degaussing girdle. Invention was indeed the mother of necessity ! The result was that early in the War, the soldier and the scientist were thrown together striving towards the common purpose of avoiding disaster while Germany charged on, confident through her initial successes. This gave a lead to Britain in the scientific field which she never lost. What might not have happened, had the Allies not beaten Germany to it with the Proximity Fuze and Atom Bomb?

So far as the Army is concerned, there is no branch of it which does not receive assistance from scientific development. Let us first be sure that we know the background correctly and we may take the Indian Army as our example, though most armies have a similar basic organization. It consists of Arms, like the Armoured Corps, Gunners, Engineers, Signals, Infantry and so on, and the Services, such as: Medical, Ordnance, Mechanical Engineers, and Supply & Transport, etc. The Services make it possible for the Arms to fulfil their functions. The Services are all combatant soldiers but they rather resemble the chauffeur, the loader, the game keeper and the picnic basket when one is, say, duck shooting; not many duck would be shot without them. The Commander-in-Chief issues his orders and instructions to the Army through his Principal Staff Officers, of whom he has four. The Chief of the General Staff, whose main concern is operations and preparations therefor; the Adjutant General responsible for personnel; the Quartermaster General for creature comforts or the means of subsistence, and the Master General of the Ordnance for material. Here are a few examples: the development of Science has helped the Adjutant General in his scientific selection of personnel; the Quartermaster General in his food problem with

dehydrated and canned food and in his supply problem with synthetic petrol; the Medical Services with Mepacrine, Paludrine, D.D.T. and Penicillin; and the Chief of the General Staff and the Master General of the Ordnance in the development and use of new weapons and equipment such as the Bazooka, Amphibian Vehicles, Radar, W.T., Synthetic Rubber, Tropic proofing, to mention but a few.

Just as important as the invention and preparation of offensive weapons is the development of the antidote to the weapons which the enemy may use. A few instances of these where Science has played its full part are: protection against gas; armour against the armour piercing shot; the development of anti-aircraft methods and devices against the aeroplane; fighter against the bomber; and as already mentioned, the degaussing girdle against the magnetic mine.

Let us now examine for a moment what has been achieved and what are our immediate plans for further development of Defence Science in India. The Government of India are establishing a number of national laboratories, such as the Physical, Chemical, Metallurgical, Fuel, Food and Drugs, in important centres throughout the country. The Ministry of Defence has its Scientific Adviser who ranks as a Principal Staff Officer while the Master General of the Ordnance also has his Scientific Adviser ranking as a Director. It is the intention that from this small nucleus shall be raised a Defence Science Organization of scientists working at the centre and with the Army in its various Technical Development Establishments. These latter are controlled by the Director of Technical Development who is a Brigadier in the Master General of the Ordnance Branch and who, under the Master General of the Ordnance, is responsible for Design, Development, Research and Inspection. Under the Director of Technical Development are the three Controllerates of (i) Armaments, Weapons & Ammunition; (ii) Vehicles and (iii) General Stores. At present, the Establishments are spread out all over India with main centres at Kanpur, Jubbulpore, Kirkee, Ahmednagar and Dehra Dun, comprising Design, Development, Research and Inspection. This set-up perhaps needs some elucidation. Up till the end of 1946, what is now the Directorate of Technical Development was responsible only for Inspection, and what was then called an Inspectorate was established in most Ordnance Factories as well as elsewhere for the acceptance of all new stores into Service. It was realized, however, that, in due course, India would undertake Design as well. So the Directorate of Technical Development was formed comprising the amalgamated Directorates of Armaments and Mechanization and the Controllerate General of Inspection. The result was that the erstwhile Inspectorates became responsible for Design and Development as well as for the normal Inspection of outturn, and upto the present time, it has not been possible to make any hard and fast division of responsibility in Technical Development Establishments.

It is intended to separate the Inspection side completely from Design and Development. The former would have a H.Q. at any suitable location and would control Inspectorates as before at Ordnance Factories and Trade Centres, while the latter would all be concentrated probably in one locality where provision would be made for a Central Design Drawing Office, Laboratory, and all facilities for applied research.

It might at this stage be interesting to consider the process which is followed when something new has to be produced. We may suppose that it is some new sort of weapon or perhaps a major modification to a weapon. The requirement would have been made known by the General Staff, discussed at the General Staff Equipment Policy Committee, of which the Chief of the General Staff is the Chairman, and a General Staff specification formulated. It would receive consideration by the Defence Science Policy Board whose chairman is the Secretary, Ministry of Defence and whose members include the three Service Chiefs and the Scientific Adviser, also at the Science Advisory Committee of which the Scientific Adviser to the Ministry of Defence is the chairman and the Master General of the Ordnance a member, and would also, no doubt, find a place on the agenda of the New Weapon and Equipment Production & Supply Committee, whose chairman is one of the Joint Secretaries with the Master General of the Ordnance and the Director General of Ordnance Factories amongst its members. The discussions having taken place, and agreement having been reached with soldier and scientist as we have seen working in close collaboration, one may imagine that the Chief of the General Staff asks the Master General of the Ordnance to come up and see him sometime and explains to him that after due consideration in Committee, the Commander-in-Chief wishes a prototype of such and such a weapon to be produced. The Master General of the Ordnance then sends for his Director of Technical Development and his Scientific Adviser. He explains what is required and tells the Director of Technical Development to table a blue print for the M.G.O. Development Committee. When this first blue print is approved in Committee, the Director of Technical Development goes out to the Technical Development Establishment concerned for example: if it is a weapon it would be Jubbulpore, or Ammunition, it would be Kirkee. The Establishment produces an elaborated blue print from the original which is presented at a subsequent meeting of the M.G.O. Development Committee by the officer of the Establishment in person. This passes through Committee and is then discussed by the Chief of the General Staff and Master General of the Ordnance who, let us assume, accept it. Requisition is then made for a prototype, that is to say the first of its kind, to be produced in the workshop attached to the Technical Development Establishment. This is then examined by the Chief of the General Staff and the Master General of the Ordnance and, if approved, the Chief of the General Staff tells the Master General of the Ordnance what numbers are required for user trials and the order is placed on the Director General of Ordnance Factories. This stage is very necessary as it is no use going into full production until an examination is made of what actually happens to the new requirement, whatever it may be, when it is in the hands of the users, that is to say, the troops. On conclusion of the user trials, an order is placed on the Director General of Ordnance Factories for production of the full number required.

We may now make a further examination of the organization of the Master General of the Ordnance Branch. Three Directors are controlled by the Master General of the Ordnance. In addition, there is the Scientific Adviser to the Master General of the Ordnance, who, as we have already seen, ranks as a Director. The Directors are: the Director of Technical Development, the Director of Ordnance

Services and the Director of Mechanical Engineering. The functions of the various Directors, generally speaking, are as follows:—

The Director of Ordnance Services is responsible for procurement, holding and issue, while the Director of Mechanical Engineering is responsible for maintenance and repair. That is to say, the Director of Ordnance Services places the order for what is required, having obtained from the General Staff information as to the size of the army and the reserves which are to be maintained over any given period. On receipt, the Ordnance is responsible for holding the material and for issuing it to troops as required: once issued, it is for the Corps of Indian Electrical and Mechanical Engineers to maintain and repair it. The process then is: firstly procurement, the responsibility of Ordnance then Inspection, the responsibility of the Director of Technical Development; then holding and issue, the responsibility of the Ordnance and finally maintenance and repair, the responsibility of the Director of Mechanical Engineering. Design, Development and Research is a continuous process under the Director of Technical Development with the Scientific Adviser closely collaborating.

The material is either produced indigenously which is the responsibility of the Director General of Ordnance Factories who controls the Ordnance Factories or is obtained from abroad, if India cannot produce the required material herself. The actual ordering of the goods, so to speak, is done by the Director of Ordnance Services through the Ministry of Defence and the Ministry of Industry and Supplies where the most important assessments have to be made as to whether the requirements can or cannot be produced in this country. As industrial development is continuous and is gaining momentum, so the correct assessment of what to order from abroad becomes more important and complicated. Any country which depends upon and uses war material which it cannot itself produce is in a precarious and difficult position. Take, for example, the Armoured Fighting Vehicles and the ordinary Transport Range of Vehicles in the Indian Army today, none of which can be produced indigenously. Think also of the difficulty of enrolling and training sufficient technical personnel in the maintenance and repair of all these vehicles. For the most part, the youth of India grows up in the villages and the fields and not, as in many industrialized countries, in garages and factories.

Upto now, we have principally discussed the development of Defence Science in war. But what of peace? War is a stimulus, and in these modern times when wars are waged by whole nations in arms, every man and woman is in some way concerned with the prosecution of the campaign. But in peace, the stimulus is no longer there and we may recall, to take one example only, the years between World War I and World War II when the British Defence Forces practically ceased to exist. The soldier's voice in fact was like unto one crying in the wilderness. Will this happen again if and when we enjoy real peace? At any rate, this time there will be two voices, and we hope they may be in unison for the scientist will have joined the soldier. But perhaps we shall be wise enough not to allow our Defence Forces to become so ineffective and inconsiderable. Surely, we must have learnt that one must at least retain the technical framework into which the manpower of the country can be quickly poured. We must not continue to believe that armies can be

created overnight: the framework must be ready there. We may be reminded of Rudyard Kiplings' lines:

> "It's Tommy this, and Tommy that, and Tommy run away;
> But it's thank you, Mr. Atkins, when the band begins to play."

Today, though the world is not at war, we can hardly be said to be at peace. It is more an armed truce or, as it is sometimes called, a cold war. Is this symptomatic of the end of real war? Will periods of armed truces and cold wars finally obviate the necessity of human beings literally destroying one another? It is an interesting speculation. During the cold war period, obviously one is not tempted to disarm and disband beyond a certain point. Should peace again break out, we should be well advised to remember that the retention of the technical framework and the ability to switch from peaceful to warlike production are matters of first importance.

In many ways, the sameness of warfare throughout the ages has been remarkable whether wars have been fought with bows and arrows, cannon balls, automatic rifles, or the atom bomb. The principles, generally speaking, have remained immutable. The study of war is sometimes described as the science of war and sometimes as the art of war. But whether a science or an art, the principles themselves, have remained much the same. The science of war seems to imply an unfailing knowledge of the principles and the art of war the application of those principles. But whatever the means employed whether it be the bow and arrow or the atom bomb within the principles of war, one fact regarding warfare waged by nations in arms has emerged. This is that vanquisher and vanquished, as a result of total war, seem equally to suffer and this may prove in time to come to be a point in favour of the cold war rather than the killing war. May I remind you of the words of Professor Horace Urey who said that whether the next war would be fought with the atom bomb he could not tell. But that if it is, then the war after that would be fought with bows and arrows.

And how does the scientist come into all this? The soldier can think of many ways where help is needed, for example: cannot we mark our stores so that the markings do not rub out and can be read at night? Cannot we have a mine which is non-detectable? Cannot there to be found a substitute for the pneumatic tyre? Can we not learn how to rotate projectiles without rifling; and cannot we devise means for halting track vehicles in their tracks by the application to the earth of some sort of slime? These and many other requirements suggest themselves to the mind of the simple soldier. No doubt, the scientist will find an answer to all these little problems. But what is he doing about the big problems and what would the scientist say if a Commander asked him to make it rain so hard on the other side of the hill that the enemy would be unable to move; or to snow so heavily over a certain hostile area that his vehicles would all be buried; or to turn on the heat in such a way as to reduce materially the enemy's efficiency.

There is a curious paradox about war. War which is essentially destructive always produces something on the positive as well as on

the negative side. The last war is full of instances of this, such as, the paid development in antidotes, for example : D.D.T. and Penicillin, and the improvements in radar and wireless. All of these serve our needs in peace as they do in war but they have, through war, received a stimulus which gives them to us, so to speak, years ahead of their time. So the preparation for war is not always wholly destructive. These preparations may well give us things which are of advantage to us also in peace. The soldier and the scientist working together, as they are now, during the period of peace or rather during the period of cold war have one common purpose. This is to place material and means of waging war in requisite quantities and quality in the hands of the troops to enable them to, it is hoped, prevent war, or should that not be possible, then to win war.