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THE SOLDIER AND THE SCIENTIST*

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To an average soldier the very name of a scientist conjures up strange visions of grey haired old gentlemen who spend their lives in back cellars bending over flasks and tubes, looking for things which are not there, their brain brimming with ideas, their enthusiasm always worked up to a high pitch. To a scientist the modern soldier is no less intriguing when he realises the complexity of the modern army which uses intricate weapons. The soldier makes a demand on the scientist who not only satisfies this demand by producing a machine which is simple to operate but even suggests to the soldier the possible developments that may help to achieve his object in war—to destroy the "WILL to fight" of the opposing nation. A definite relationship therefore requires to be established between the soldier and the scientist to achieve this object and that relationship can only come with a better understanding of the organisation to which each belongs. Unless one can fully appreciate the problems and the requirements of the other, progress is likely to be protracted, delayed and possibly even end up in frustration with time and labour wasted. Today therefore I propose to talk to you from the soldier's angle that is from the user's point of view, a point of view which a scientist must bear in mind as the demand initiates from the user and after the scientist has translated it into a concrete form ends there for his final approval.

The terms User and the Scientist

A practical user of a particular type of service equipment is one who has learnt to make the best use of the weapons supplied to him under certain conditions. From his practical experience the user knows the essential requirements that his weapons and equipment must possess; he should be able to appreciate both their advantages and disadvantages. It is by a clear statement of his requirements that the practical user helps those charged with research, design and development for meeting those requirements. For the user to be able to appreciate the scientist's or the designer's aspects he must be well versed in the basic principles governing the design of the instrument used. And I may emphasise that the user's opinion of new equipment is not merely the collation of the consensus of opinions of experienced soldiers but is an opinion arrived at a result of trials conducted by a team of experts with a definite object and with the background of practical design, knowledge and experience.

The scientists played a larger part in the late war than in previous wars, and by their continued research work and keeping ahead of enemy helped in achieving the ultimate victory. After the late war all the famous military leaders are unanimously agreed that for a modern war machine to keep pace with the scientific

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developments there should be very close co-ordination between the soldier and the scientist. And the scientist to be of use to the services must know the general background of the services and be able to appreciate their requirements by a study of the user background of the weapons.

The first essential for a scientist to know is the organisation on which the army is based. Perhaps few people realise that modern army organisation is a complex set up. Its ramifications within its own organisation are so wide and intricate that even some of those who are in it know little of the functions of the various organs. Therefore I will explain to you this lay-out in the form of a simple analogy used by Lt.-Gen. K. M. LOCH, who was the M.G.O. in India during the last war. He compared a campaign to a stage production calling for rehearsal, direction, a suitable cast, stage management and adequate provision of properties. In the army set up the production and direction is the affair of the Commanders and the General Staff, cast that of the Adjutant General, stage management of Q.M.G. and lastly the property man is the M.G.O. As suggested by him the essential difference from a normal drama is caused by the development of unforeseen, disconcerting conditions such as :

(a) The syndicate backing the venture, that is, the Government, may be vague as to the nature and the scope of the drama they require and may not be clear as to where and when they wish to open up—a problem for the General Staff.

(b) When the curtain eventually goes up, the actors may find themselves in a different play from the one they rehearsed ! a headache for the A.G. and the Q.M.G.

(c) When Act I has gone a bit wrong and the audience becomes restive the actors call for entirely new properties to sustain Act II—this is where the M.G.O. comes in.

So you see although the general organisation looks simple on paper its functions are not very simple.

Secondly, the scientist must study the users' background. He is not required to be a weapons expert but he must understand the operation and working of instruments. Last but not the least he must have a working knowledge of tactics and strategy to be able to produce for the Command and General Staff scientific data which they may call for on matters they control. Let us probe a bit more deeply into this relationship between the user and the scientists.

Relationship between User and Scientist

The success in the development of weapons in the late war has been ascribed to correct group relationship between the fighting man, the scientist, the industrialist and not to mention the economist. In the technical field the co-operation between the fighting services and the technologist-cum-scientist was a wonderful achievement. You will notice that I have mentioned the technologist between the soldier and the scientist. The technologist is a service technical officer with a high measure of technical training directed towards

design and development of military equipment. He translates the users' qualitative requirement into a technical specification and on the other side he interprets into practical ideas the result of the scientist's research. These practical ideas give the services equipment they require for fighting battles. The scientist has in general a consultative role and is concerned more in general concepts and their application to war. So you see the technologist permeates both the scientific field and the services field. He works with the scientist, behind the scientist so that he guides him on lines which will ensure that the fighting services can instal and maintain the equipment when they take it into the field.

In his role as a consultant to the user, that is, the General Staff, the scientist plays a very important part. The War Office found that unless a scientist who is fully informed of the Army's point of view, is consulted in time, the General Staff demands may lead to wasted efforts particularly if the General Staff is "crying for the moon" in demanding scientific impossibilities. In the tempo of war the General Staff have a tendency to have everything produced almost overnight. As expert consultants the scientists established links with the technical arms—the Armoured Corps, Artillery, Engineers and Signals and soon found that in a variety of matters concerning tanks and infantry weapons a knowledge of scientific principles determining the design of the weapon was of great value. Of course they have spread their field of activities still wider and now apply science also to the study of warfare generally which we now call 'Operational Research'.

General Weeks, DCIGS, War Office in his book on "Organisation of Equipment for War" after discussing the use of scientists within the War Office concludes with a very pertinent remark:

> "(a) The necessity for the scientist never to allow himself to be considered a technical or weapons expert when he would tend to lose his position as an independent adviser or critic.
>
> (b) The necessity for Government departments to have available and use scientists wherever scientific problems exist or scientific analysis is applicable."

Birth of a new weapon

Having now established the relationship between the user, that is the General Staff and the Scientist that is the interpreter, let us see how the requirement of the General Staff is translated into an equipment by the scientist. Generally the process is as follows:

(a) A General Staff specification is produced in simple terms as to what is required to meet the tactical requirements.

(b) A technical specification is drawn up whereby the General Staff specification is translated into a suitable form for development to proceed.

(c) The development of equipment either by a service establishment or by a manufacturing concern,

(d) The technical examination of pilot models and field trial of pilot models.

(e) Completion of final specification and placing of orders by the Government.

The whole process is not so simple as it looks. Perhaps (a) and (b) are finalised as a result of discussion between the user and the scientist and the technologist. Then the designer gets to work and produces a sheaf of designs. Each of the components of the equipment concerned must be thought out and drawn separately. For a 6 pounder gun 1000 blueprints were required; for a tank 90,000 blueprints were required. From these prints a few pilot models are produced which are tested by the technical staff who may introduce modifications from the technical point of view and the second pilot model is prepared. Then the equipment is sent for user trials in the field. Once approved, production is ordered.

Users problems for the Scientist

Generally from the General Staff point of view the scientists perform three main functions:

(a) keep the military operational staffs in touch with scientific developments which may offer a solution to a military problem. Research over the whole field of science needs a close study in this respect.

(b) General Staff requirement may call for specialist knowledge which involves basic research. This is where his advice and possibly further research comes in.

(c) Trained scientist's mind is required to study what may be called the "behaviour" of the equipment, that is, to produce an analysis of the happening over the whole field of military activities making use of past experience to guide the future action.

Our attention is at the moment focussed on:—

(a) making the best use of the existing weapons.

(b) study, improvement and modification of existing weapons and equipment.

(c) research and development in conventional weapon design.

Our scientists' efforts should be concentrated on these matters. Our immediate problems should have immediate attention and we have no dearth of immediate problems. What we want our scientists to get on with is something which we cannot get from outside, something which is proving a limitation to our indigenous production, for exmaple, certain propellants are required to be developed; tropical conditions have a great effect on the operational efficiency of all equipment: we require a light weight version of body armour; we have a requirement for a heating device to keep personnel accommodated in tents warm for 8 hours at one time; conventional fuels are bulky, we want a fuel in a solid form. The closer the understanding between the user and the scientist gets the more of these problems can be passed on to the scientist. With our fast developing research and development organisation in the country,

most of the problems of basic research could conveniently be passed over to them. The Defence Science Organisation can thus concentrate more on applied research to the benefit of the services.

Summary

To briefly recapitulate :

(a) I have discussed the urgent need for the scientist and the user to get closer together by a study of each other's organisation and a study of each other's problems.

(b) Just as much it is essential for the user to know the basic principles governing the design of the instrument used, it is as much important for the scientist to keep in touch with the development in weapon design and technique and keep the user informed of any scentific developments which may offer a solution to a military problem.

(c) Besides the study of development of weapons, our scientists have a new role, and a very important one and this is providing scientific data to 'user' with regard to any operational problem on which a decision is required. I am refering to 'Operational Research'.

(d) And lastly let us all concentrate on our *immediate* problems first to the exclusion of developments which are engaging the attention of fully developed countries. We cannot ignore the latter, but from our point of view the pressing problems should receive priority.

Conclusion

In our military organisations the scientist has come to stay, his representation is essential to our military welfare, his full value in our military organisation will be realised more and more with better understanding between the user and his potentialities. For the user there are always multifarious problems to solve, immediate, big and small. As one of the great military leaders has said "Scientists should look inwards into our habits to know us better and outwards over the field of scientific development to keep us informed of the possible solution to military problems."