

Organisation of Scientific Work.

I HAVE not read the report of Sir Thomas Holland's Commission which has led to a discussion in the columns of NATURE, and I do not wish to express an opinion on its conclusions. Those who know something of the conditions of India and of the many economic problems awaiting attack will at least agree that the country offers a great field for the investigator, and a difficult one from the point of view of those engaged in the administration of funds for research.

My purpose in writing is to support Dr. Russell's views on the importance of team-work in scientific investigations (NATURE, March 4, p. 7). It seems to me that in discussing the proper relation of the State to scientific work our conclusions will depend chiefly on the precise meaning which we attach to "research."

Prof. Bateson writes (*ibid.*, p. 6): "Research, like art, literature, and all the higher products of human thought, grows only in an atmosphere of freedom." But should not the word used here be "science"? Is not "research" the art by which knowledge is advanced? And is it not the case that in this art there is need for the co-operation of men differently endowed? "Bricklayers" may be wanted as well as "architects" in the building up of knowledge, nor are delays in programmes, other than housing, necessarily due to the lack of a plan.

If by "research worker" one meant only the "master," then I should agree with Sir Ronald Ross (*ibid.*, p. 6) that the policy of organising institutes for scientific research and institutes for the writing of poetry might be considered together. But research workers are not all "masters." There are other grades essential to progress in certain branches of knowledge, never likely to make great discoveries, perhaps, but, since the State needs them, it must enable them to live; and it is the function of the "official" not to direct their work (that must be left to the "master"), but to see that they live under conditions likely to promote efficiency. I am not sure that I agree with Prof. Bateson. There may be danger in State action, but it seems to me to be safer than inaction.

While arguing for the recognition of the importance of co-operation in research, let me add that, whatever part the worker in a research laboratory may be called upon to fill, it is essential that he should recognise clearly that he is part of a team for the advancement of knowledge, and that he should regard himself as a potential discoverer. I welcome Dr. Russell's analysis of the functions of the staff of an institution maintained for research, as it brings out what seems to me a fundamental point in this discussion, but I feel sure that he would agree with me in deprecating any rigid classification of workers as tending to cause discouragement. Whatever the natural qualifications of the members of a team of workers may be, two are essential for real progress: the desire to learn more and the willingness to help others.

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March 19.

Science and the New Army.

YOUR leading article of March 18 on "Science and the New Army" directs attention to some hopeful features in our future military organisation, but many will share with you the doubt whether any real fundamental reform has yet been effected. The new policy of "farming out" research work to civil institutions sounds suspiciously like the old policy, so well practised in the past, of getting technical work done and advice given without the obligation of paying anything for it.

Doubtless it may be argued that so long as scientific men are complaisant enough to work for nothing a Government Department which paid them would be guilty of extravagance. Ultimately, however, it will be found good policy and sound economy to recognise that skilled knowledge is worth its hire, and scientific men, in their turn, may perhaps learn that in attaching a low valuation to their own labour they help to confirm the widely held idea that expert training is a thing of small account. The Army would keep more closely in touch with all scientific progress in any remote degree affecting the conduct of warfare—and who can set limits to this qualification?—if it retained men of proved competence with the duty of posting the General Staff in all such advances of knowledge. These men need not, in fact should not, give their whole time to the work; it would be an essential condition that they should be in full activity as researchers, teachers, or professional engineers, chemists, etc., and it would be equally essential that they should be remunerated at adequate rates. No unpaid committee, however august the membership, will fill the want.

I must confess that I scarcely understand what is meant by "preliminary design of apparatus," stated to be part of the functions of the military institutions. Of what value is a preliminary design if the underlying principles are not understood, and wherein does it differ from a mere statement of what some un-instructed amateur thinks can be done by "electricity" or by "cog-wheels"? Furthermore, unless these military institutions are directed by trained specialists, the "applied researches" entrusted to them are not likely to be crowned with any conspicuous measure of success.

E. H. HILLS.

Cotton-growing in the British Empire.

IN NATURE of February 26 Sir George Watt reviews in a critical spirit the report to the Board of Trade of the Empire Cotton-Growing Committee. Much of his criticism is based on an expressed aversion to committees, which has misled him into stating that we propose our central (cotton-growing) research institution should be staffed by a "committee of voluntary workers." This is quite erroneous. The report itself describes in some detail the permanent staff which is suggested.

Some of the criticisms are due to the reviewer not having realised that the Committee was dealing with cotton-growing alone, and that the British Cotton Industry Research Association is working in co-operation with the Empire Cotton-Growing Committee through a joint body (of which I happen to be chairman), so that his desire for the Cotton-Growing Committee to establish its central research institution in Manchester, where no cotton will grow, is invalid.

Nor do I think that his suggestion of a programme for the members of the research institution as being "research, education, and cotton production" makes a sufficiently clear discrimination between means and ends; but chiefly I regret that the reviewer has missed our main thesis, which concerns the need for knowledge, based on pure science, as the essential to progress in this matter. Indeed, he seems to be completely antagonistic to this view of ours when he states that "general principles of education must never be allowed to take the place of specific training and definite results." It is no little thing that a utilitarian body, representing all aspects of the cotton trade, from the native cultivators to spinners and manufacturers, should have come into the open with such a plea for the encouragement of pure science, as being the basis of useful development, and it is indeed un-

expected to find this plea condemned by a reviewer in the columns of NATURE.

Nevertheless, Sir George Watt makes a legitimate criticism when he says that our proposals "do not seem to resolve themselves into the promulgation of a concrete scheme of increased and improved production." I would like to explain why we deliberately avoided advancing such a scheme in this report.

The consideration of actual steps to be taken in cotton production is the next stage in the Committee's work, to which it has already settled down. When this report was issued we were penniless, and could not with any utility consider how money should be spent until we were assured of:—(a) Annual financial support from Lancashire. (b) Regular financial support from H.M. Government. (c) Approval of policy from the Governments of the Dominions, Colonies, and Protectorates.

Since our report was issued (a) the home industry has agreed to make a voluntary annual levy on itself; (b) our maintenance charges are assured, so that our executive can be built up, while the question of further support is under consideration; and official information as to (c) is awaited. A large income is already in sight, and the way is becoming clear for practical planning and guidance as distinguished from the enunciation of principles. It should be noted that the capital required actually to grow the cotton which this country now purchases outside the Empire is of the order of 250,000,000*l.*, being more than a thousand-fold the sum asked for in our report.

But those principles had to be settled first, and I for one regret that Sir George Watt should have missed their significance through misunderstanding the present stage of our development and our inability to be anything else hitherto but a "committee," if we were to represent the native peoples abroad as well as the operatives at home, with all the intervening stages of industry, of administration, and of knowledge.

W. LAWRENCE BALLS.

Edale, Derbyshire, March 8.

I AM obliged for the opportunity given me to read Dr. Lawrence Balls's reply to my review in NATURE of February 26 of the report issued by the Committee on Cotton-Growing, within the British Empire, appointed by the Board of Trade. Dr. Balls seems to me, in the main, to admit my contention, namely, that the Committee's report, as it stands, does not resolve itself into a concrete scheme of increased and improved production of cotton. In fact, it may be said to be unfortunate that the Committee did not anticipate such criticisms as mine by giving the public some hint of the possible future stages of its operations. The public were anxiously awaiting a full scheme, and one that would give distinct prospect of success, but in place of getting such we are now told we have only seen (as it were) the first instalment, and must look for better results in the future.

But, turning to some of Dr. Balls's observations on my review, I do not find that I have stated that the report contemplates the staffing of the central research institution by committees of voluntary workers. It is surely self-evident that there would have to be permanent officials appointed to the central research institution, as also to the branch institutions. But what I did object to was that these officials should be put under a panorama of six committees, as seemed contemplated by the authors of the report. I am old enough to recollect the great Cotton Commission in India. Indeed, my official connection with that country might be said to have commenced with having to try to pick up the dishevelled threads of that futile expenditure of public

money. The late Mr. C. B. Clarke, in the preface to his edition of Roxburgh's "Flora of India," alludes to the issue of one of the Commission's reports as follows:—"We have had plenty of Government and other reports, some very large and expensive ones, it is true, but we have very little economic work by persons competent as botanists; and with reference to one large and expensive report lately issued on an Indian economic plant it was discovered after it was printed that the Commission never learnt what the plant was."

The result of the great Cotton Commission of India was officialism, Cotton Frauds Acts, and other such utilities. It is the knowledge of past failures having very largely proceeded from officialism that makes me urge with all the earnestness I possess that the staff of the central and branch research institutions should be as free and independent as the professors of a university. They need no supervision more than is exercised by Departmental control in the allocation of funds and in the laying down of general rules and political instructions. Official control should be with the principal or principals of the college or colleges of cotton, but with no one else.

I am at a loss to understand Dr. Balls when he says I have missed "our main thesis, concerning the need for knowledge, based on pure science, as the essential to progress in this matter." The Committee, as I understood the report, recommends that certain universities should be asked to establish lectureships and readerships; my scheme was that the research institution or institutions, in addition to conducting research, should undertake the entire education of both the experts and the practical planters, and thus have their own professors of plant physiology, plant genetics, mycology, entomology, and the like.

My recommendation is thus to concentrate all effort in the hands of a body of highly trained scientific and practical experts, to place all the funds available in their hands, and to hold them responsible not only to increase the supply, but also to improve the quality of the cotton produced within the British Empire.

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with the Government of India).

Annandale House, Lockerbie, March 13.

The Separation of Isotopes.

IN a recent discussion (*Phil. Mag.*, vol. xxxvii., p. 523, 1919) of a number of methods of separating isotopes Prof. Lindemann and Dr. Aston have shown that there is little prospect of effecting by the methods considered a separation which will yield pure samples of the isotopes in a reasonable time. Dr. Aston has recently announced the discovery that chlorine consists of a mixture of at least two isotopes having atomic weights 35 and 37. It appears that there is here a possibility of effecting a separation of the isotopes by a direct method which does not seem to be applicable in the case of most other elements. The method proposed depends on the assumption that in the absorption spectrum of chlorine, which contains a vast number of narrow lines, there is a difference between the wave-lengths of the absorption lines due to molecules containing different isotopes.

Supposing that ordinary chlorine contains the isotopes Cl_{35} and Cl_{37} in the ratio 3 : 1, the molecules will consist of $\text{Cl}_{35}\text{Cl}_{35}$, $\text{Cl}_{35}\text{Cl}_{37}$, and $\text{Cl}_{37}\text{Cl}_{37}$ in the ratio 9 : 6 : 1. It follows that if white light traverses a column of chlorine of such a length that the radiations absorbed by $\text{Cl}_{37}\text{Cl}_{37}$ are reduced in intensity by a factor $1/10^3$, the corresponding factors in the case of $\text{Cl}_{35}\text{Cl}_{37}$ and $\text{Cl}_{35}\text{Cl}_{35}$ will be $1/10^{18}$ and $1/10^{27}$ respec-