

ought also to possess expert advisers in many branches of science. Some kind of scientific service will therefore be needed, but this should not be allowed to engross the whole field; and the best results are sure to be obtained in the future, as they have been in the past, by untrammelled men of capacity working as they please.

RONALD ROSS.

IN discussing the best ways of fostering research work it is important to remember that the word "research" is used in two widely distinct senses: it may stand either for the careful collection of observations, or for the deduction of the principles expressing the relationship between one set of phenomena and another. The difference between them is like that between the discovery of a new country and the careful mapping of one known in a general way but not in full detail.

It would be unfair to set either of these kinds of research above the other; each is indispensable to the other. Experience shows, however, that the power to collect careful observations can be imparted to a large number of men and women, while the power to utilise the material and deduce from it anything more than the comparatively obvious is rare and cannot be imparted. Further, this ability is not equally divided as between different classes of men or as between men and women.

The recognition of the necessity for each kind of ability is essential to the proper conduct of a research institution, and one of the great difficulties is to find deducers of new ideas and to ensure that they shall work harmoniously with the equally necessary, but less rare, collectors of observations. The difference between the two groups of workers is fundamental and far-reaching, manifesting itself even in trivial daily actions. One difference is particularly important for the present discussion: the first group greatly resent immediate direction; the second do not, provided they see advantages therein. In all research institutions of any size the chief problem is to keep both groups of workers as nearly abreast as possible. Deductions made in advance of facts are often wrong and sometimes harmful. Facts and observations accumulated without any illuminating hypothesis or general principle are rather dreary and soon forgotten. It is one of the tragedies of a life devoted to science that so often the fruit falls stillborn and is entombed in some journal, never again to see the light. We have all known such workers:

And, as year after year
Fresh products of their barren labour fall
From their tired hands, and rest
Never yet comes more near,
Gloom settles slowly down over their breast.

The only way of avoiding the tragedy and its accompanying waste is to ensure that both groups of workers keep together.

It is not only between these two groups, however, that co-operation is necessary; under modern conditions there must also be close relationship between the workers in different subjects. Science is becoming increasingly specialised; no one man now knows much of any subject except his own. For the investigation of phenomena such as those of agriculture, which lie outside the present arbitrary divisions of science, recourse must be had to team-work; a body of young workers whose minds are still elastic must be interested in the problem and induced to work together for its solution.

Experience shows that successful co-operation is achieved only when a deliberate attempt is made to secure optimum conditions for each individual worker.

How can a State system be adapted to fit these various necessities? For financial reasons complete elasticity is impossible; Treasuries must know their liabilities. In any Civil Service system promotion is almost inevitably by seniority. Individual action and thought would be intolerable; everything must go through a chief, while anything repugnant to him must be suppressed. In all these directions the State system is absolutely incompatible with living research, although it might be consistent with much careful accumulation of facts, with survey work, and with the establishment of some central collecting institute. For these reasons I cannot believe that the intensely centralised system proposed for India could succeed. One man may organise work in one institution where he is accessible to the staff morning, noon, and night; but he would indeed need to be a superman of most exalted degree if he aspired to direct the research work of a country.

The system devised by the English Ministry of Agriculture is, in my view, much better. It possesses some degree of financial elasticity. While it contains the inevitable regulation about promotion by seniority, this is qualified by clauses under which the best man available can, nevertheless, be appointed to fill a vacant post. There is no attempt to govern from Whitehall; no general director, deputy director, or other official to run the research workers, but only occasional friendly gatherings of the chief officers to discuss common problems. Could not some such system be tried in India?

E. J. RUSSELL.

Rothamsted Experimental Station, Harpenden.

THE question of reorganising and developing scientific work in India discussed in the leading article in NATURE of February 19 is of the utmost importance to all concerned with the welfare and scientific reputation of the Empire. Now that there is a prospect of recognition by the Government of India and the Secretary of State of the necessity for increased expenditure on scientific investigation, it is essential that the new era should be inaugurated under the most favourable conditions. Two policies are apparently under consideration, which may be referred to respectively as centralisation and decentralisation; these are clearly defined in the article of February 19. The advantage of organising research within certain limits is generally admitted; facilities should be afforded for supplying information, for suggesting problems, and for the co-ordination of the activities of individuals or institutions, but it would seem that the policy of centralisation advocated by the Indian Industrial Commission, presided over by Sir Thomas Holland and "favoured by a number of administrators," is much more than this. It is, in short, a proposal to bring scientific investigation into line with routine official work—a procedure which, one learns with surprise, has the support of several scientific witnesses examined by the Commission. If there is one thing vital for the successful prosecution of scientific research of the best type and for the encouragement of the full development of a researcher's capacity, it is freedom of action.

It is safe to predict that very few men possessing what may be called the research temperament would consent to submit to a bondage that would be not only irksome and irritating, but also fatal to individual initiative and enthusiasm. If adequate remuneration is offered and reasonable laboratory facilities are provided, good men will be easily secured. Given the right sort of men, I venture to think that the only rational course is to trust them to work out in