tective reaction, and this constitutes the chief urgency for further investigation not only of the pain mechanism itself, but of bodily responses to it.

It is still an open question whether human understanding of pain is sufficiently advanced to justify nature in further evolution, if not toward a happy faculty for self-hypnosis, at least in the direction of atrophy of the pain sense, before her recent experiments toward the increase of intelligence have had a more extensive try-out. This might inspire caution in neurologists who can now so successfully interfere with nature, as well as in readers of their researches who might be encouraged to invoke their more drastic expedients. In most fields of endeavor, technological advances tend to outrun discretion in their employment, and one may anticipate that by the time another volume on pain appears in this series, a section will be appropriate on the results of its abolition.

The discussions which follow each discourse should not be slighted by one who would get the full intimate flavor of the book.

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SOCIETIES AND MEETINGS

THE BRITISH SOCIETY FOR FREEDOM IN SCIENCE

MANY scientists have doubtless been disturbed by the growing tendency in this country to over-emphasize the socially utilitarian aspects of science, with resulting efforts to control and regiment all scientific activity, as exemplified most strikingly perhaps in the original Kilgore Bill. This tendency toward the "totalization" of science has grown to an even greater extent in Great Britain than here and has reached such proportions that a society has recently been formed, The Society for Freedom in Science, to combat the undesirable features of this tendency. The society feels that the time has now come to give as wide publicity as possible to its objects, and to enlist active support from scientists in all free countries, and in particular is desirous of enrolling members among the scientists of this country. The following is a statement of the objects of the society issued by the Committee of the Society for Freedom in Science in May, 1944.

I

Since about 1931 there has developed in Britain a school of thought which attacks the conception of science as a search for truth and denies the right to free research directed solely to that end. Three contentions underlie this movement:

(1) Science had its origin in efforts to satisfy the material needs and desires of ordinary human life.

(2) The legitimate purpose of science is to meet these material needs and desires on an expanding scale.

(3) Scientists can not be left free to choose their own subjects of research, but must submit to central planning so that their work will be specifically devoted to the satisfaction of human material needs and desires.

In this movement pure science is actually derided and compared in value with the solution of crossword puzzles.[1]

[1] J. D. Bernal, "The Social Function of Science." (Routledge, London, 1939). The reference to crossword puzzles is on page 97.

The effect of the movement was already apparent at the Leicester meeting of the British Association in 1933. The association's new outlook was reflected in Sir Frederick Gowland Hopkins's presidential address. As he said himself, "You may feel that throughout this address I have dwelt exclusively on the material benefits of science to the neglect of its cultural value." The movement first began to become really powerful in 1936, when the economist, Sir Josiah Stamp (later Lord Stamp), gave the presidential address to the British Association at Blackpool. For some years it looked as though the case of those who believe in pure science and freedom in science would go by default, through their continued neglect to state their own point of view. Professor J. D. Bernal's book, "The Social Function of Science" (1939), became a keystone of the movement against free science, which allied itself with Marxian politics. Certain scientific journalists joined the movement and spread its propaganda. The Association of Scientific Workers adopted the movement as a part of its policy, and has worked energetically on its behalf ever since, both privately and in public. Much publicity has been given to some of the meetings of the association, and the popular press has reported its deliberations as though they represented the voice of the general body of scientists.

In 1938 the British Association founded a new division, called "The Division for the Social and International Relations of Science," in which the voices of those who are opposed to pure science and to freedom in science have been particularly prominent. At a large and much-publicized meeting held at the Royal Institution, London, in September, 1941, the new movement reached the peak of its intensity. Pure science was repeatedly derided, speaker after speaker asking sarcastically whether applied science were "impure"; and some of the speeches were political and deficient in objective argument. No one was given the opportunity to speak during the three days of the

conference except those previously invited by the organizers, and only two voices were raised against the prevailing trend—those of Professor A. V. Hill and Professor M. Born.

II

For several years nothing was done to oppose the new movement apart from the publication of a few articles and the making of an occasional speech. Many scientists were disquieted, but not alarmed. There was little realization that the power of influencing public opinion was tending to pass from the hands of those who believe in pure science and freedom in science into the hands of those who do not. It was not until 1939 that a comprehensive and considered reply was made, in the form of Professor M. Polanyi's "Rights and Duties of Science,"[2] in which Professor Bernal's book was examined and the arguments contained in it answered.

In 1940 a letter was sent to 49 scientists, suggesting the formation of a new society to promote the causes of pure science and of freedom in science. A group of thirty was thus formed, and this became the nucleus of the Society for Freedom in Science. It may be remarked that conditions can be imagined under which the attempt would be made to foster pure science, while freedom of choice in subjects of research would be denied to the individual scientist. Nevertheless, it is a fact of experience that those who value pure science highly are commonly those who also value freedom in science, and thus it came about that a small natural group of like-minded people was formed.

A few of the original members who were seriously alarmed by the trend of events in the scientific world met together to draft a document which would draw attention to what was happening and would form a basis for a larger society consisting of those scientists who were willing to support a movement for the defence of scientific freedom. This document was circulated in May and June, 1941. It contained the following five propositions:

(1) The increase of knowledge by scientific research of all kinds and the maintenance and spread of scientific culture have an independent and primary human value.

(2) Science can only flourish and therefore can only confer the maximum cultural and practical benefits on society when research is conducted in an atmosphere of freedom.

(3) Scientific life should be autonomous and not subject to outside control in the appointment of personnel or in the allocation of the funds assigned by society to science.

(4) The conditions of appointment of research workers at universities should give them freedom to choose their own problems within their subjects and to work separately or in collaboration as they may prefer. Controlled teamwork, essential for some problems, is out of place in others. Some people work best singly, others in teams, and provision should be made for both types.

(5) Scientists in countries not under dictatorial rule should cooperate to maintain the freedom necessary for effective work and to help fellow-scientists in all parts of the world to maintain or secure this freedom.

The Society for Freedom in Science is an informal body, with no rules and no regular subscription. The first committee was self-appointed and provisional, but elections have since been held and the present committee consists of the following: Dr. J. R. Baker, Professor V. H. Blackman, F.R.S., Mr. R. Brown, Professor J. A. Crowther, Professor M. Polanyi, F.R.S., Dr. L. E. Sutton, Professor A. G. Tansley, F.R.S., and Professor A. E. Trueman, F.R.S. The society has no official president.

A general meeting was held in London on July 2, 1942, but the society's business has mainly been transacted by correspondence and by the circulation of typewritten and printed papers. The present membership is 134. Although a few reside so far away as Alberta, Uganda and Iraq, and quite a number are connected with the applications of science to practical affairs, the great majority are members of the scientific staffs of universities in Britain. (An attempt to found a sister-society in the U. S. A. broke down because almost at once that country became absorbed in the consequences of the Pearl Harbor attack.) The committee has made connection with like-minded people attached to other intellectual pursuits, by drawing into membership several distinguished philosophers and historians, including Sir Ernest Barker and Professor Sir J. H. Clapham, P.B.A., who form a valuable link with a wider field of ideas. The society is non-political in the sense of including members who are socialists, liberals and conservatives, but it is openly opposed to totalitarianism of all kinds in science.

III

The main function of the society is to form a solid body of opinion ready to present the case for freedom if the threat to suppress scientific liberties should develop dangerously in the period of reconstruction after the war. Those who lay all the stress on the applications of science and consider that research should be centrally planned are not only highly organized and extremely active, but also influential in certain political circles. Only a state of preparedness can make it certain that the case for freedom in science will get a proper hearing if and when such a crisis arises.

[2] M. Polanyi, "Rights and Duties of Science." (Manchester School of Economics and Social Studies, October, 1939, p. 175.)

Meanwhile, the society develops its case by fostering the publication of books, articles and letters on the subject, and circulating some of these among its members and among others who seem likely to be interested. The question whether scientific research flourishes best under freedom or under central planning is only part of the wider subject of scientific method in a broad sense. The society supports the publication of articles on scientific method and on the philosophy of science, so far as these bear upon the subjects in which it is interested.

It is believed to be better to concentrate on limited objectives rather than to make feeble efforts over too wide a range. The securing of freedom in the choice of subjects of research for members of the staffs of universities is considered one of the most essential of these limited objectives. In many university departments there is already considerable freedom, even in universities whos statutes do not grant it. In such cases the society wishes to conserve what it considers good, against the whole trend of totalitarianism which is so influential in the modern world. In some departments, however, the newcomer is expected to join a team already engaged on a definite scheme of research. In many cases newcomers are well fitted and perfectly willing to follow such a course and their freedom is therefore not compromised. But room should always be found in a department for independent investigation on any subject within the scope of the department by members of the staff or by postgraduate students who desire to choose their own subjects and are qualified to pursue them. It is recognized, of course, that freedom must necessarily be limited by the funds and apparatus available in the department in which the research is done.

It is felt that if freedom can be attained and maintained in universities, the effect of that freedom will be felt over a much wider field. It is held to be essential to the well-being and progress of science at large that those who desire and are qualified to undertake independent research should be given opportunity to do so.

The society fully recognizes that owing to the complexity of modern science, organized team-work is often necessary; and it is inevitable that a considerable proportion of the funds assigned to research should go to the support of such work. But substantial sums should also be made available for qualified individual investigators, whose independent discoveries often lead to the most important advances in knowledge and in technique. It goes almost without saying that the society is strongly in favor of the spontaneous collaboration which so often arises from the free discussion of their problems and interests by those trained in different branches of science. This is probably the most fruitful of all kinds of collaboration.

It is no part of the society's policy to insist that every man or woman who has been appointed to a research post should be allowed, at the expense of the community, to occupy himself or herself indefinitely with trivial investigations. This however is a difficult question, because the opinions of scientists may differ as to what is trivial and what is not. It may be suggested that the pressure of the public opinion of his colleagues is likely to be sufficient to deter a scientist from the indefinite pursuit of researches which are regarded by those colleagues as of little importance in the advancement of science. In so personal a matter as independent research a large amount of individual freedom is essential, but the individual investigator ought not to escape, and in fact can not ultimately escape, the judgment of his colleagues. He must be given the maximum freedom possible, and it is suggested that no pressure should be put upon him, except in the most extreme cases, other than the inevitable moral pressure of the opinion of his colleagues; and scientists should recollect that young colleagues are often as likely to have useful opinions on scientific values as their elders.

IV

It is thought that the society has already had considerable influence. The totalitarian view does not now go unanswered, whether in conversation or in print, as it so often did in the thirties. There is an awareness of the existence of strongly held opinion contrary to the totalitarian view. The society has been a factor in the production of books, of articles and letters in journals and of addresses, in which the case for free science and pure science has been boldly stated and the totalitarian arguments contested. Many of the printed papers upholding the cause of free science have received a wide circulation through the society. In the present temper of the scientific world it is doubtful whether such a one-sided meeting as that of the Division for the Social and International Relations of Science held in September, 1941, could be held again.

Membership of the society is open to every established scientist who is in substantial agreement with the five propositions given above. It is thought desirable to increase the membership of the society, so that the movement for freedom in science may have the most influential backing possible, particularly lest a crisis should develop. Now that the end of the war no longer seems remote, it is necessary to be prepared to remind the community of the non-material ends to which science, as one part of the search for truth, must be directed; because material ends are bound to

appear of great importance in the period of reconstruction. Those who wish to join the society should complete an enrolment form and send it to the Hon. Secretary, Dr. J. R. Baker, University Museum, Oxford. Members are under no obligation except that of supporting the cause of freedom in science. It is assumed that all members will fight vigorously for this cause if an immediate threat develops.

My own connection with the society started about a year ago as a result of correspondence initiated by its secretary, Dr. John R. Baker, who had seen the part of my presidential address to the American Physical Society published in SCIENCE of February 12, 1943, in which I expressed concern over the growing tendency toward totalization of science. Dr. Baker has asked me to serve as the go-between during the initial stages of enrolment of members in this country; enrolment blanks may be obtained by application to me.

It is pertinent to mention that a book by Dr. Baker is shortly to be issued by Macmillan called "Science and the Planned State."

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SPECIAL ARTICLES

THE CORRELATION OF THE INSULIN CONTENT AND THE HISTOLOGICAL PICTURE OF THE PANCREAS AT INTERVALS AFTER THE ADMINISTRATION OF ALLOXAN[1]

IN 1937, Jacobs[2] showed that the intravenous injection of alloxan produced fatal hypoglycemia in rabbits. He did not report any histological studies. In 1943, Dunn, Sheehan and McLetchie[3] confirmed the hypoglycemic effect of alloxan in rabbits and found that it produced a selective necrosis of the islets of Langerhans. Bailey and Bailey[4] were the first to show that if animals were kept alive during the hypoglycemic phase by glucose administration, extreme hyperglycemia subsequently developed. Within a short time, this work has been confirmed and extended by a number of investigators (see E. P. Joslin, 1944).[5]

The way in which alloxan affects carbohydrate metabolism, particularly the means by which it induces a profound temporary hypoglycemia before it causes a severe and prolonged hyperglycemia, is a problem of considerable interest. Two hypotheses have been advanced to explain this action: (1) that alloxan overstimulates the islet cells, causing excessive liberation of insulin and subsequent death of islets perhaps from exhaustion, and (2) that alloxan primarily destroys islet cells and that there is a slow release of insulin from the dying or dead cells which is sufficient to account for the hypoglycemia (Hughes, Ware and Young).[6]

It was thought that experiments in which the insulin content of the pancreas was determined at different times after the administration of alloxan and correlated with the histological picture in the islets at these times might provide information to settle this point. An investigation of this kind has not previously been published, although Goldner and Gomori[7] have reported a low insulin content of the pancreas in two dogs after treatment with alloxan.

Experiments on Rats. Female Wistar rats (about 210 grams each) were used. These were divided into five groups and four of these were injected subcutaneously with an aqueous solution of 350 milligrams of alloxan per kilogram in 4 equal doses at 15 minute intervals. The insulin content of the pancreas was determined by the mouse method of assay, using from 200 to 240 mice for each solution (Table 1).

TABLE 1

Number of rats	Time after alloxan	Blood sugar	Insulin per group of 10 rats
	(hours)	(mgms. per cent.)	(units)
26	0	92	21.2
12	1.5	215	21.1
13	3.0	293	18.7
14	7.0	100	16.0
13	48.0	264	0.89

For each group of rats upon which insulin assays were made, 5 similarly treated rats were used for histological studies. In these the islets showed the following changes. At 1.5 hours after alloxan the islet cells bordering capillaries showed ragged disintegrating edges and the capillary spaces were widened; at 3 hours these changes were more pronounced and there were many pycnotic nuclei; at 7 hours there was a general disintegration of islet structure with most of the cells necrotic; and at 48 hours, although super-

[1] This research has been supported in part by a grant from the Banting Research Foundation.

[2] H. R. Jacobs, *Proc. Soc. Exp. Biol. and Med.*, 37: 407, 1937.

[3] J. S. Dunn, H. L. Sheehan and N. G. B. McLetchie, *Lancet*, 244: 484, 1943.

[4] C. C. Bailey and O. T. Bailey, *Jour. Am. Med. Asn.*, 122: 1165, 1943.

[5] E. P. Joslin, *New Eng. Jour. Med.*, 230: 425, 1944.

[6] H. H. Hughes, L. L. Ware and F. G. Young, *Lancet*, 246: 148, 1944.

[7] M. G. Goldner and G. Gomori, *Jour. Am. Med. Asn.*, 124: 802, 1944.