present war, the Foreign Office, the Admiralty, the War Office, and the Ministry of Munitions, have all been concerned with the collection of information bearing on the sources of supply of minerals and the production of metals. There does not appear, however, to have been any serious attempt to co-ordinate and render available even such information as has been collected by these departments, and it is certain that there have been considerable overlapping and duplication of effort with corresponding waste and confusion.

It is, we submit, obvious that the overlapping and confusion will be seriously increased if the various technical committees appointed by the Advisory Council attempt to collect the information which is essential to enable the beneficent object of the committee of the Privy Council to be attained, in its wider aspects, in regard to the mineral and metal industries.

We respectfully urge this view upon the serious attention of the Advisory Council, as already there are evidences of increasing overlapping and consequent waste of time and energy, which we believe it is one of the main purposes of the committee of the Privy Council to eliminate so far as possible.

In the opinion of the institutions represented by us the organisation of a central Department of Minerals and Metals is imperatively necessary in the public interest, and the work of organisation, which will necessarily take much time to complete, should be commenced at the earliest possible moment.

It cannot be doubted that if a properly organised and efficiently conducted Department of Minerals and Metals had been in existence, much valuable time, many lives, and vast sums of money would have been saved to the nation in the conduct of the present war, and much of the cost and inconvenience to British industries depending largely for their raw materials on mineral products would have been saved, with corresponding advantages to the prosecution of the war and to many industries.

A Department of Minerals and Metals should not only be in intimate relationship with the Geological Surveys and Mines Departments of the Dominions, but also with the organisations representing the different branches of the mining and metallurgical industries, whose co-operation in the work of the department should form a vital part of its machinery.

The Geological Surveys of Great Britain and Ireland and the Museum of Practical Geology should also form an integral part of the department.

The functions of the department should be active and constructive. All overlapping by other Home Government departments, and also by the institutions representing the industries, should be absolutely prevented.

The duties of a Department of Minerals and Metals would include :—

(1) Arrangements for expediting the completion of mineral surveys of the United Kingdom and of the Crown Colonies and other British possessions.

(2) The systematic collection and co-ordination of information bearing on the occurrence, uses, and economic value of minerals and their products, special attention being devoted to securing industrial applications for newly discovered minerals or metallurgical products and to finding mineral materials required for new metallurgical products or inventions. Some of this information should be promptly and widely disseminated in summarised form to those interested in the industries, through the medium of the existing publications of the institutions directly concerned.

(3) The investigation of all questions and problems relating to the utilisation of the mineral or metallurgical resources of the Empire.

(4) The co-ordination and dissemination of information on mining laws, development of mineral areas, output, processes of extraction, plant, capital employed, markets, etc.

(5) A general review from time to time of the developed and undeveloped mineral resources and of the position of each mineral or metal, to ensure that the mineral wealth of the Empire is being exploited with due regard to Imperial interests.

(6) Generally, to advise the Imperial Government on all questions bearing on the mining and metallurgical industries. To perform this function efficiently, it is essential that complete information should be available, and also that the industries concerned should be consulted through their respective organisations.

We feel sure that the Advisory Council will fully appreciate the urgency of the question and the necessity for prompt action, so that the process of co-ordination may be inaugurated at once.

WM. BEARDMORE, *President.* G. C. LLOYD, *Secretary.*	The Iron and Steel Institute.
GEORGE BEILBY, *President.* G. SHAW SCOTT, *Secretary.*	The Institute of Metals.
W. THORNEYCROFT, *President.* L. T. O'SHEA, *Hon. Secretary.* P. STRZELECKI, *Secretary.*	The Institution of Mining Engineers.
EDGAR TAYLOR, *President.* C. MCDERMID, *Secretary.*	The Institution of Mining and Metallurgy.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS (ABRIDGED) BY PROF. A. R. CUSHNY, M.A., M.D., F.R.S., PRESIDENT OF THE SECTION.

On the Analysis of Living Matter through its Reactions to Poisons.

I WISH to-day to discuss an aspect of pharmacological investigation which has not been adequately recognised even by pharmacologists themselves, and which it is difficult to express in few words. In recent years great advances have been made in the chemical examination of the complex substances which make up the living organism, and still greater harvests are promised from these analytic methods in the future. But our progress so far shows that while general principles may be reached in this way, the chemistry of the living organ, like the rainbow's end, ever seems as distant as before. And, indeed, it is apparent that the chemistry of each cell, while possessing general resemblances, must differ in detail so long as the cell is alive. No chemistry dealing in grams, nor even microchemistry dealing in milligrams, will help us here. We must devise a technique dealing with millionths to advance towards the living organism. Here I like to think that our work in pharmacology may perhaps contribute its mite; perhaps the action of our drugs and poisons may be regarded as a sort of qualitative chemistry of living matter. For chemical investigation has very often started from the observation of some qualitative reaction, and not infrequently a good many properties of a new substance have been determined long before it has been possible

to isolate it completely and to carry out its analysis. For example, the substance known now as tryptophane was known to occur in certain substances and not in others long before Hopkins succeeded in presenting it in pure form. And in the same way it may be possible to determine the presence or absence of substances in living tissues, and even some of their properties, through their reaction to chemical reagents—that is, through the study of the pharmacology of these tissues. I do not claim that pharmacological investigation can at present do much more than the qualitative testing of the tyro in the chemical laboratory, but even a small advance in the chemistry of living matter is worthy of attention.

All forms of living matter to which they have free access are affected by certain poisons, and some of these have obvious chemical properties which suggest the method of their action; thus the effects of alkalies and acids and of protein precipitants scarcely need discussion. Others, such as quinine and prussic acid, which also affect most living tissues, have a more subtle action. Here it is believed that the common factor in living matter which is changed by these poisons is the ferments, and quinine and prussic acid may therefore be regarded as qualitative tests for the presence of some ferments, notably those of oxidation, and, in fact, have been used to determine whether a change is fermentative in character or not.

In other poisons the action on the central nervous system is the dominating feature, and among these the most interesting group is that of the simple bodies used as anæsthetics and hypnotics, such as ether, chloroform, and chloral. The important use of this group in practical medicine has perhaps obscured the fact that they act on other tissues besides the central nervous system, though we are reminded of it at too frequent intervals by accidents from anæsthesia. But while they possess this general action, that on the nervous tissues is elicited more readily. Not only the nerve-cell, but also the nerve-fibre react to these poisons, as has been shown by Waller and others. And even the terminations are more susceptible than the tissues in which they are embedded, according to the observations of Gros. The selective action on the nervous tissues of this group of substances has been ascribed by Overton and Meyer to the richness in lipoid substances in the neurons, which leads to the accumulation of these poisons in them, while cells containing a lower proportion of lipoid are less affected. In other words, Overton and Meyer regard these drugs as a means of measuring the proportion of lipoids in the living cell. This very interesting view has been the subject of much discussion in recent years, and, in spite of the support given it by several ingenious series of experiments by Meyer and his associates, no longer receives general acceptance. Too many exceptions to the rule have to be explained before the action of these bodies can be attributed wholly to their coefficients of partition between lipoids and water. At the same time, the evidence is sufficient to justify the statement that the property of leaving water for lipoid is an important factor in the action of the bodies, although other unknown properties are also involved in it. And whatever the mechanism of the characteristic action, these substances in certain concentrations may be regarded as tests for the presence of nervous structures, and have been employed for this purpose.

More interest has been displayed in recent years in the alkaloids which act on the extreme terminations of various groups of nerves. These are among the most specific reagents for certain forms of living matter which we possess. Thus, if an organ reacts to adrenaline, we can infer that it contains the substance characteristic of the terminations of sympathetic fibres with almost as great certainty as we infer the presence of a phenol group from the reaction with iron. And this sympathetic substance can be further analysed into two parts by means of ergotoxine, which reacts with the substance of the motor sympathetic ends, while leaving that of the inhibitory terminations unaffected. Similarly, the endings of the parasympathetic nerves are picked out with some exceptions by the groups represented by atropine and pilocarpine, and here again there must be some definite substance which can be detected by these reagents.

Further, some light has been thrown on, at any rate, one aspect of these nerve-end substances by the observation that they all react to only one optical isomer in each case. Thus the dextrorotatory forms are ineffective in both atropine and adrenaline, and this suggests strongly that the reacting body in the nerve-ends affected by these is itself optically active, though whether it bears the same sign as the alkaloid is unknown. This very definite differentiation between two optical isomers is not characteristic of all forms of living matter. For example, the heart muscle seems to react equally to both lævo- and dextro-camphor. The central nervous system contains substances which react somewhat differently to the isomers of camphor and also of atropine, but the contrast is not drawn so sharply as that in the peripheral nerve-ends.

The tyro in the chemical laboratory is not often fortunate enough to be able to determine his analysis with a single test. He finds, for example, that the addition of ammonium sulphide precipitates a considerable group of metals, which have then to be distinguished by a series of secondary reactions. The pharmacologist, as an explorer in the analysis of living matter, also finds that a single poison may affect a number of structures which appear to have no anatomical or physiological character in common. But as the chemist recognises that the group of metals which react in the same way to his reagent have other points of resemblance, so perhaps we are justified in considering that the effects of our poison on apparently different organs indicate the presence of some substance or of related substances in them. A great number of instances of this kind could be given, and in many of these the similarity in reaction extends over a number of poisons, which strengthens the view that the different organs involved have some common reacting substance.

One of the most interesting of these is the common reaction of the ends of the motor nerves in striated muscle and of the peripheral ganglia of the autonomic system. It has long been known that curare and its allies act in small quantities on the terminations of the motor nerves in ordinary muscle, while larger amounts paralyse conduction through the autonomic ganglia. These observations appear to leave no question that there is some substance or aggregate common to the nerve-ends in striated muscle and to the autonomic ganglia. Other analogies exist between the ganglia and the post-ganglionic terminations of the parasympathetic, as is shown by their reactions to the tetramethyl ammonium series; between the heart muscle and the cardiac inhibitory centre, as shown by digitalis and aconitine; between kidney-cell and ordinary muscle, as shown by caffeine and other purine bodies.

Many other examples might be cited in which organs which are apparently not related, either morphologically or in function, react to poisons in quantities which are indifferent to the tissues in general. And this reaction in common can only be interpreted to mean that there is some substance or group of related substances common to these organs. The reaction may differ in character; thus a drug which excites one organ to greater activity may depress another, but the fact that it has any effect whatever on these organs

in preference to the tissues in general indicates some special bond between them, some quality which is not shared by the unaffected parts of the body. I have, therefore, not differentiated between excitation and depression in discussing this relation. It seems probable that in this instance and in others the difference in the effect of these bodies in the tissues arises from differences in the behaviour of the molecule as a whole rather than in differences in the affinities of its special parts; that is, that the action of these poisons is due to their physical properties rather than to their chemical structure, although this, of course, is the final determining cause.

In the same way the common reaction of tissues, which I have so far ascribed to their possessing some substance in common, may arise from community of physical relationship, and I wish to avoid the implication borne by the word "substance," which I have used in the widest sense. The reaction of living tissue to chemical agents may arise from a specific arrangement in its molecule, but may equally be attributed to the arrangement of the molecules themselves. And the curious relationships in the reactions of different tissues may indicate, not any common chemical factor, but a common arrangement of the aggregate molecules. We are far from being able to decide with even a show of probability which of these alternatives is the correct one, and my object to-day has been to direct attention to these relationships rather than to attempt their elucidation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Vice-Chancellor, Lieut.-Col. Gilbert Barling, has been appointed consulting surgeon to the British Forces in France, and left Birmingham on November 1 to take up his duties. For some time past Col. Barling has acted as a consulting surgeon in the Southern Command. During his absence from Birmingham, which will extend over some months, his duties at the University will be discharged by Alderman F. C. Clayton, pro-Vice-Chancellor.

CAMBRIDGE.—The Vice-Chancellor has appointed Dr. R. T. Glazebrook to the office of reader on Sir Robert Rede's foundation for the ensuing year.

Mr. W. G. Palmer, who obtained first-class honours in both parts of the Natural Science Tripos 1913–14, with distinction in chemistry, and was awarded the Hutchinson Studentship, has been elected to a fellowship at St. John's College.

Capt. E. Hindle, assistant to the Quick Professor of Biology, and formerly Beit Fellow for Medical Research, has been elected to the recently founded Charles Kingsley Lectureship in Natural Sciences at Magdalene College.

LONDON.—Lieut.-Col. H. R. Kenwood, professor of hygiene and public health in the University of London, will deliver a public lecture at University College, Gower Street, on "Hygiene: Some Lessons of the War," on Friday, November 17, at 5.30 p.m. The chair will be taken at this lecture by Surgeon-General Sir Alfred Keogh, Director-General, Army Medical Service. The lecture is open to the public without fee or ticket.

OXFORD.—The Rhodes Estate Bill, having now passed the Committee stage, has been reported to the House of Commons in its original form. Lord Hugh Cecil's suggestion, which met with some approval in Oxford, that the trustees should be left free, if they thought fit, to establish scholarships available to persons within or without the British Empire, did not prove acceptable to the trustees, who preferred to be left without discretion in the matter. It was explained by Lord Milner that unless it were clearly laid down that the new scholarships should only be tenable by students within the Empire, much disappointment would be caused to applicants from other countries. Many will think this scarcely a sufficient reason for the trustees to wish to have their hands tied in the way proposed by the Bill.

WE learn from Wednesday's *Times* that Mr. H. Laming has just given 10,000*l.* to Queen's College, Oxford, to establish four scholarships of 100*l.* per annum, tenable for either three or four years, one to be offered each year. The scholars will, as a rule, be expected to take the Russian language for their honours degree. The idea is to provide a university course for candidates intending to follow a business career or to enter the consular service, and it is hoped that the scholarships may lead to a higher social and intellectual standard prevailing in those careers.

NOTICE has just been given of the next triennial prize at Guy's Hospital under the will of the late Sir Astley Cooper. The prize, the value of which is 300*l.*, will be awarded to the author of the best essay or treatise on "Gunshot Wounds of the Lungs and Pleura." The competition is open to all, with the exception of the staffs of Guy's and St. Thomas's Hospitals and their relatives. The competing essays, written in English, must be sent to Guy's Hospital on or before January 1, 1919. Further particulars of the competition may be obtained from Mr. C. H. Fagge, Guy's Hospital, S.E.

THE main thesis put forward by Mr. James Swinburne in a lecture on "Science and Industry," delivered at King's College, London, on November 1, Lord Moulton being in the chair, was that technology or applied science was outside the province of university teachers, who should concern themselves with imparting a knowledge of properties and principles, which they are eminently capable of doing, and leave the manufacturer to work out his own problems, of which academic people can have only second-hand knowledge. Mr. Swinburne understands, of course, that many great industrial advances have had their origin in what he called academic science, but what he wished particularly to emphasise was the difference between laboratory conditions and operations on an industrial scale brought to the point of commercial success. Purely scientific research must be free and independent, with the advancement of knowledge as its sole aim; but the manufacturer is only interested as a man of business in research which will give him financial advantage. Scientific knowledge is gained for the benefit of whomsoever may care to make use of it, whereas trade processes are kept secret or protected from adoption by industrial competitors by means of patents. The university should train workers in research methods, but the practical needs of industry can be understood only in the works themselves. Lord Moulton, in his remarks upon Mr. Swinburne's address, said that Mr. Swinburne was "picturesquely wrong" in the sharp distinction made by him between academic and technological science. It may also be suggested that the view that manufacturers are able to look after their own problems and interests assumes that they possess the necessary scientific knowledge, which, to say the least, is an assumption that will not admit of general application in this country. Instead of insisting upon the divorce between university science and technology, what should be encouraged is systematic exchange between academic and industrial posts, so that men may leave professorial chairs