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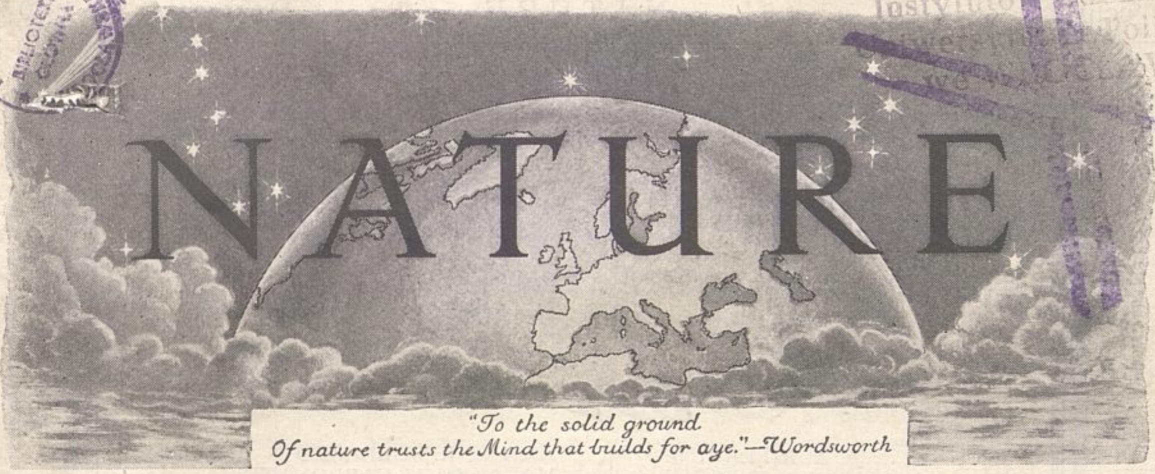

NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—*Wordsworth*

Vol. 146, No. 3713 SATURDAY, DECEMBER 28, 1940 ONE SHILLING

NATURE

Vol. 146 SATURDAY, DECEMBER 28, 1940 No. 3713

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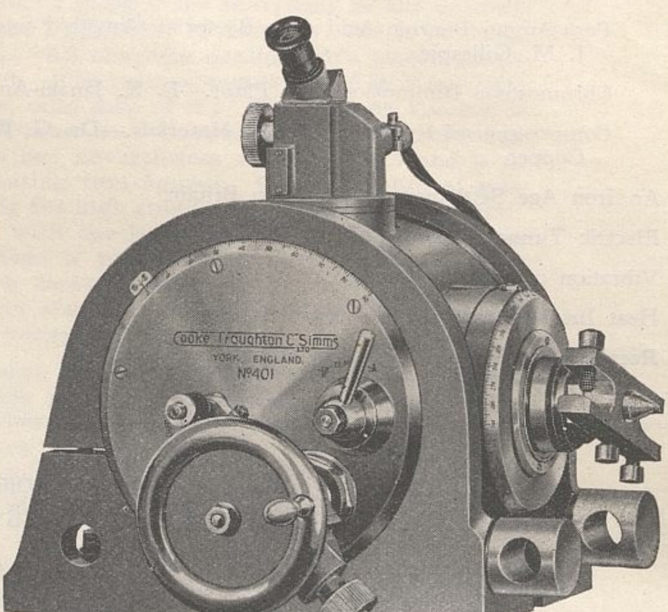
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CULTURAL SIGNIFICANCE OF SCIENTIFIC METHOD

FEW things have contributed more to consolidate the unity of the nation and to fortify its resolve to persevere until victory is achieved than the realization that the present struggle is between two fundamentally opposed ways of living—between an order in which the individual is crushed and in bondage to a monstrous conception of the State, and an order in which personality is respected, the great traditions of Western civilization are cherished and the human spirit is free to enrich that heritage by further creative work in art, in literature, in science and other spheres of culture and thought.

Although democracy and totalitarianism are fundamentally opposed ideals, we should not make the mistake of assuming that the democracies have nothing to learn from the totalitarian regime. On the contrary, it is of the utmost importance that there should be a clear understanding of the causes which led to the rejection of democracy, and the emergence of the totalitarian States during the two decades following a war which was to have made the world safe for democracy. Unless we are willing in these fields also to learn from our opponents and to seek to eradicate the weaknesses of democracy as they are brought to light, we may once again experience the frustration which followed the War of 1914–18.

"The serious threat to our democracy is not the existence of foreign totalitarian states. It is the existence within our own personal attitudes and within our own institutions of conditions similar to those which have given a victory to external authority, discipline, uniformity and dependence upon the Leader in foreign countries." This warning of John Dewey in his recent study of "Freedom and Culture" (London : Geo. Allen and Unwin, Ltd., 1940. 7*s*. 6*d*.) is the more timely when there are already appearing articles even in the technical Press attributing our economic troubles to State interference with private competitive effort for gain, and advocating an immediate return to untrammelled *laissez faire*.

Whatever may be the nature of the social and world order after the War, it is certain that a return to the position of August 1939 with a minimum of disturbance is both illusory and dangerous. To desire no nobler prospect than a perpetuation of the disparities and injustices, the inertia and complacency of the period 1918–39 is a Maginot complex in the social realm, and treason to the spirit which the nation has displayed in the last nine strenuous months. A hide-bound persistence in methods and doctrines which were sound enough fifty or a hundred years ago may easily prove as costly in the financial, economic and social field as in the field of actual warfare. It might not lose the War ; it would almost certainly once again lose the peace.

A foremost need is an unprejudiced review of conditions as they are now and as they are likely to be after peace has been won, with an open and unprejudiced mind, ready to accept any changes which are shown to be necessary, however unpalatable, and to abandon any preconceptions, however deeply cherished, which have become unpalatable. Even this, however, is not enough. If we are to build an enduring order we must go even deeper. We must establish right relations between democratic institutions and human relations, with all that is understood by culture in the truest and widest sense of the word.

Democracy, as Sir Richard Livingstone has reminded us, like patriotism, is not enough. It is indeed a way of life and it affords men the best opportunity of leading the good life; but it is no guarantee that they will lead it. We have yet to realize that democracy is a way of personal life and one that provides a moral standard for personal conduct. Unless we can find that moral power, both the value and the very existence of democracy are in peril.

It is well that there should be no mistake as to the tremendous moral or even religious challenge thrown down to democracy at the present time. That internal challenge must be met if the external threat of the totalitarian States is to be overcome, and in his study of freedom and culture Prof. Dewey leaves no room for complacency, for all his confidence as to the ultimate issue. That will be assured so long as we face our problems in detail as they arise, with all the resources provided by collective intelligence in co-operation.

This question of the relation of freedom and democracy to culture involves not merely spiritual and moral issues but also those of science. As Prof. Dewey points out with respect to means for understanding social events, we are still living in the pre-scientific epoch, although the events to be understood are the consequences of the application of scientific knowledge to a degree unprecedented in history. It is this that gives such significance to Mannheim's recent attempt to develop a theory of planning for freedom and the technique of social control. No democracy has ever made complete or adequate use of scientific method in deciding upon its policies, although freedom of inquiry, toleration of adverse views, freedom of communication, and the distribution of what is discovered to every individual as the ultimate intellectual consumer, are involved in the democratic as in the scientific method.

Prof. Dewey's reminder of the potential alliance between scientific and democratic method is indeed timely, and not irrelevant to the organization of our war effort as indicated in a recent leading article (see NATURE, Oct. 12, p. 469). When democracy openly recognizes the existence of problems and the need for probing them as problems as its glory, political groups which refuse to admit incompatible or unpalatable opinions will be relegated to the obscurity which is already the fate of such groups in science.

Prof. Dewey has more to say about the interaction of science and society to-day and its relation to the future of democracy. One of the most stimulating chapters of his book is that in which he discusses the relation of science and free culture. We can no longer assume that the assured advance of science will lead to free institutions by dispelling ignorance and superstition. Some of the new powers with which science has endowed mankind, such as the radio and the Press, have proved potent tools of oppression and servitude. The question is raised whether science, like propaganda, can shape ends.

Prof. Dewey gives an admirable survey of the different points of view from which are approached the questions of the extent to which the shaping of science, and the determination of the direction of its advance, are determined by the social environment, and the social responsibilities of the scientific worker. This leads him not merely to raise the question whether a democratic society can exist without regulation, exercised by a public authority on behalf of social unity, of scientific pursuits, but also whether it is possible for the scientific attitude to become such a weighty and widespread constituent of culture as to shape human desires and purposes. This latter question involves the direct issue of the kind of culture in which scientific method and scientific conclusions are integrally incorporated.

It may be argued that one of the reasons why men have been willing to accept conclusions derived from science in place of older ideas has been their serviceability in some aspect of culture or industry. On this ground we might well hold that the kind of serviceability which is capable of generating the highest esteem for science is serviceability for social welfare. The development of economic and agricultural policy in post-War Europe to secure the maximum utilization of scientific knowledge of nutrition might be an important factor of this type in one special field.

The influence of science upon both means and ends is not exercised directly upon individuals but indirectly through incorporation within culture. Moreover, science is not simply a body of conclusions; even more important from a cultural point of view, science is an attitude of mind which resolutely employs certain methods of observation, reflection and test. Scientific inquiry indeed has a morale of its own, including willingness to hold belief in suspense; ability to doubt until evidence is obtained; willingness to proceed on evidence rather than on a personal preference; ability to hold ideas in solution and use them as hypotheses to be tested instead of as dogmas to be asserted ; and the enjoyment of new fields for inquiry and of new problems.

As Prof. Dewey points out, each of these traits is contrary to some embedded impulse, and accordingly the mere existence of the scientific attitude and spirit is evidence that science has created a new morale—equivalent to the creation of new desires and new ends—and is capable of developing a distinctive type of disposition and purpose. This service of science may far outweigh its serviceability in the social field. The development of a scientific outlook is of fundamental importance for the preservation of democracy, and the transformation of educational content and method to encourage that development and not the mere inculcation of scientific facts is one of the most pressing problems in education to-day. The fate of democracy is bound up with the spread of the scientific attitude. More important even than the contribution of science to the solution of immediate and practical problems, the scientific attitude is the sole guarantee against wholesale misleading by propaganda. It is the only assurance of the possibility of a public opinion intelligent enough to meet present social conditions.

The democratic extension of the scientific morale in this way until it is part of the usual equipment of the ordinary individual involves moral problems also. The scientific worker must acknowledge his moral responsibility for wider communication of the results of his work to others besides those engaged in specialized research. The need, however, is not for scientific men to become crusaders in special practical causes. It is recognition by scientific workers of their social responsibility for contagious diffusion of the scientific attitude.

That task will not be achieved without abandoning once and for all the belief that science is set apart from all other social interests as if it possessed a peculiar holiness. Without sacrificing professional standards, we must find means of securing that the influence of science and respect for its followers are based, not on a sense of mystery or something apart, but on firm understanding of its outlook and ways of working. Much more than the mere dissemination of the facts ascertained in different branches such as physics, chemistry, biology, geology and the like is required.

Science, through the physical consequences of its technical applications, is determining the relations of human beings, whether individually or in groups, one with another. If it is incapable of developing moral techniques which will also determine these relations, the rift in modern culture may involve the doom of democracy and all the values of civilization. Whether science is capable of influencing the formation of ends for which men strive, or whether it is limited to increasing their power of realizing aims which are formed independently of science, depends on the intrinsic moral potentiality of science. A culture which permits science to destroy traditional values but distrusts its power to create new ones, is a culture which, as Dewey remarks, is destroying itself.

The contribution which science can make to the war effort and to the reconstruction which must follow the War in the physical and material realm is gradually becoming more widely appreciated, even if we have far to travel before its full measure is realized. The chief merit of such publications as "Science in War" (see NATURE, July 27, p. 112) is indeed the way in which they direct attention to such possibilities and stimulate thought in that field. The contribution which science can make in the cultural field is equally important but far less widely appreciated even among scientific workers themselves. Prof. Dewey's little study is accordingly the more timely and welcome. If scientific workers are stirred by it to think more deeply upon such issues and to concern themselves with this question of diffusing the scientific outlook, they may well make an all-important contribution both to winning the War and building the peace to follow.

Science requires a tradition of freedom of thought, investigation and teaching such as is inherent in a democratic system, if it is to flourish and exert its creative powers ; in the same way, democracy has no less need of the spirit and work of science. While cherishing individual freedom and initiative, the whole democratic system must be rigorously scrutinized ; we must approach it in an unprejudiced scientific manner, showing ourselves willing to discard whatever is outworn or has served its purpose, ready to learn even from its opponents and to take pains to incorporate new methods or new ideas while safeguarding those to which its own vitality is due. The fundamental thinking which is a prelude to a closer alliance between democracy and science, as a condition of a new and richer world order of freedom and plenitude, must be undertaken now. It may well issue in an era of creative thought and power in science no less than in those other branches of culture of which democracy is alike nurse and champion.

WEATHER AND WEATHER PROPHETS

(1) Weather Prediction
By Major R. M. Lester. Pp. 256. (London: Hutchinson's Scientific and Technical Publications, 1940.) 10*s*. 6*d*. net.

(2) Forecasting Weather
By Sir Napier Shaw. Third edition, with a Supplementary Note on Sixteen Years' Progress in Forecasting Weather, by R. G. K. Lempfert. Pp. xliii + 644. (London: Constable and Co., Ltd., 1940.) 42*s*. net.

THESE two books deal essentially with the same problem, that of forecasting to-morrow's weather, but they will appeal to different classes of readers. According to the publisher's note on the cover, Major Lester's book combines the functions of supplying the serious student of meteorology with an introduction to the deeper study of the subject and of supplying the amateur forecaster with an infallible guide. Some experience of trying to forecast to-morrow's weather has, however, convinced the present reviewer that no infallible guide to forecasting can be provided, either for the professional or the amateur meteorologist. Sir Napier Shaw has produced a third edition of his "Forecasting Weather", which appears to be intended for the scientific student of the subject. It is, perhaps, not unfair to say that while Major Lester has described the observed phenomena and their associations, Sir Napier Shaw has endeavoured to describe and to explain the phenomena in which he is interested.

(1) Major Lester's book is intended for the general reader who takes an intelligent interest in the weather, without having any specialized scientific training. It describes the national and international organizations in meteorology, the instruments and methods used at the observing stations, the codes used for reporting to the central office, the representation of the observations on synoptic charts, together with graphical methods for representing local observations, and comparing them with the conditions over a wide area. All stages up to the drawing of the synoptic chart are described clearly, but the reader does not gain from this book a clear conception of the use of the synoptic chart for the specific purpose of forecasting to-morrow's weather. Much information is given on the occurrence of certain types of weather; but it is doubtful whether the average reader will be able to absorb this information without some connecting threads of explanation. There are some very attractive cloud photographs, with very clear descriptions of the weather conditions in which such clouds occur. A chapter headed "Weather Forecasting" is, surprisingly, devoted to long-period weather forecasting, mainly by the use of cycles, and to weather maxims, from neither of which is the author able to draw much comfort. Later chapters survey the climates of the world and the variations of climate since the last Ice Age, and a final chapter is devoted to weather in war-time, with special reference to air-raid weather. The march of events since this book was written has modified some of our ideas on the subject of weather in war-time.

Anyone who reads through Major Lester's book will acquire a considerable knowledge of the facts which have been accumulated concerning the weather, but he will also unfortunately acquire some rather questionable ideas. When the author states "it is now believed that the secrets of the weather lie above the 20-mile limit", he deviates widely from the accepted opinion of meteorologists. He mentions the close correlation between the levels of Victoria Nyanza and the sunspot numbers, shown by Brooks to be very close over a little more than one sunspot cycle, without adding that the correlation disappeared almost completely in subsequent cycles. Major Lester quotes from an eminent meteorologist the statement "we are now in a period of decreasing solar radiation"—a statement which it is possible neither to prove nor to disprove. We are told that below 72,000 ft. will be found only a small fraction of the ozone in the atmosphere, whereas Dobson's observations indicate that, at least in middle and high altitudes, about one half of the ozone is below the limit stated. On p. 145, Major Lester states "Soviet Scientists have found how to make and disperse fog", giving an air of certainty to an achievement which is extremely doubtful. The statements to which objections are here raised take up relatively little space in the book, but they leave the impression that the vigorous use of a blue pencil would have improved Major Lester's book considerably.

(2) Sir Napier Shaw, in producing the third edition of his well-known book, "Forecasting Weather", has reproduced the second edition unrevised, asking his friend and former colleague, Mr. R. G. K. Lempfert, to write six short chapters on the progress in weather forecasting since the appearance of the second edition. As the second edition was published in 1923, the bulk of this edition may be said to represent the meteorological point of view of 1923. Meteorology has made some progress since 1923, and it would have been an

advantage to have that progress incorporated in the main body of the text, and not in chapters added at the end. But the point of view of 1923 is not without a special interest to-day. It centres upon types of weather, rather than upon the idiosyncrasies of the individual weather chart. It gives the beginnings of the development of the physics of the atmosphere, and leaves the reader with the wish that Sir Napier had devoted more space to the explanation of the physical processes of weather. The too short chapter dealing with this topic explicitly is a leisurely introduction to the functions of water vapour in the atmosphere.

It is not possible to summarize here the thirty-two chapters of this book. It does not pretend to be a systematic discussion of the physics of the atmosphere; but it covers a very wide field, so much so that essential information which we should hope to find is frequently omitted. Thus, although some sixteen pages are devoted to the discussion of barometric gradient and wind force, and the "gradient-wind" equation is given, the reader is not able to gather from this book why one solution of this quadratic equation is adopted, while the other is rejected as meaningless. On p. 241 we find the statement: "By instability in the atmosphere I mean a condition of affairs where a lighter layer is found with a heavier layer above it, so that the lighter layer breaks through the layer above and thereby causes an upward current that is violent until stable equilibrium is reached". This definition does not take account of the compressibility of the atmosphere, in consequence of which the condition for instability is, not that the density should increase with height, but that the temperature should not decrease with height at a rate exceeding a critical value of 1° C. per 100 metres. The correct definition is used in Chapter xxx. Density increasing with height requires that temperature should increase with height at a rate exceeding $3\frac{1}{2}$ times the critical value. The present reviewer cannot recall having seen a single observation of so great a lapse-rate in the free air. Sir Napier's discussion of hail gives some very interesting facts relating to the breaking up of rain drops, but we should have been glad to have the author's views on the physical causes of the structure of a hailstone, which consists of alternate coatings of clear and white ice. Sir Napier defines fog as a cloud on the ground, as also does Major Lester, and the reviewer questions the value of this definition, in view of the fact that the dynamical conditions necessary for the formation of fog and cloud are usually widely different.

The author intersperses some very pertinent facts and figures. Thus, on p. 322 he illustrates a depression, the formation of which required the removal elsewhere of 190,000,000,000 tons of air. This very illuminating figure appears to the present reviewer to afford the appropriate answer to the question so frequently asked by one's friends —"When shall we be able to control the weather"? —the answer being "When we are able to stop a mass of air of 190,000,000,000 tons from going on its own way".

There are chapters on squall lines, sea fogs, warm water fogs and thunderstorms, and a summary of the work of Shaw and Lempfert on the life-history of surface air-currents. If this chapter will only stimulate the young meteorologist to read the original memoir thus summarized, it will have served a most useful purpose. That memoir contains many fruitful ideas which have not received due attention, and others which have been ascribed to other authors. The chapter on gales and gale-warnings contains summaries of the frequencies of winds of gale force and over, with a particularly interesting list of those gales during 1908 for which no warning was issued. We should like to see more frequent detailed discussions of these forecast failures, since the first step in learning to forecast the weather of to-morrow should be explaining the weather of yesterday.

There are chapters on forecasting for aviation, coal-mining, and agriculture. In dealing with the subject of forecasting for agriculturists, Sir Napier summarizes facts concerning the distribution of temperature in hilly country which should be, but are not, familiar to every agriculturist.

The space in which Mr. Lempfert summarizes the advances made since 1923 is insufficient to do justice to those advances. He contrives, however, to give the reader a conception of the growth of ideas on the structure of the depression, as well as of the changes of procedure in forecasting and reporting. Synoptic developments are illustrated by the Daily Weather Reports for May 1, 1939, and since Mr. Lempfert has used the chart issued at Bergen on the same day to illustrate the occluded stage of a depression, we are enabled to compare charts issued by London and Bergen based on exactly the same information. The differences shown in the fronts drawn in the two services serve to show how far from being impersonal is the drawing of fronts on a chart. The utilization of upper air data in the daily work of forecasting is illustrated by the use of a tephigram, which is the form of temperature-entropy diagram used in the British meteorological service. The tephigram was first devised by Sir Napier Shaw, and has become the standard form of upper air diagram in the British service. In his last chapter, Mr. Lempfert discusses the problem of forecasting for long periods, but holds out no immediate prospect of a solution of the problem for the British Isles.

Much of the progress which meteorology has made during the last thirty years has owed its origin to the stimulus which Sir Napier Shaw brought to the subject, with an interest which he himself describes as that of the experimental physicist, in marked contrast with the essentially statistical point of view of most of his predecessors. Indeed, his attitude is so essentially experimental, that at times he tends to shun even the simplest algebra. Algebra has its uses, and it is moreover essential in any science which aspires to be metrical. But, however much one may wish Sir Napier had chosen to model parts of his book in another form, it is, and will long remain, a book worth having and reading.

D. BRUNT.

PLACE-NAMES OF NOTTINGHAMSHIRE

The Place-Names of Nottinghamshire
By J. E. B. Gover, Allen Mawer and F. M. Stenton. (English Place-Name Society, Vol. 17.) Pp. xlii + 348. (Cambridge: At the University Press, 1940.) 21*s*. net.

IN the study of place-names, as in archæology, the interest of the early history of the county of Nottingham centres in the valley of the Trent. The one place-name which is recorded earlier than the ninth century, Tiouulfingacaestir, is identified with the Roman station of Segelocum at the point where the river was crossed by the main road from Lincoln to Doncaster; and the rock of Nottingham, which was of military importance throughout the period of the Danish War, overlooks the junction of the Leen and the Trent at the southern end of Sherwood Forest. The names of these rivers themselves, as so frequently in Britain, are relics of British settlement, and the Angles, using the rivers as their highway to Derbyshire and Staffordshire, established themselves here and there on either bank.

On the whole, however, the editors of this latest issue of the valuable surveys of English place-names point out, few place-names of an ancient type occur within the county. This indeed is not surprising in the Forest area, and the ancient word *beosuc* which occurs in Bestwood and probably in Bescar, is among the most definite among the pieces of evidence which point to an early penetration of the Forest by the English settlers in the Trent valley. Clumber and the river-names Clun, now Poulter, and Mann show that at least a small number of Britons remained in the Forest. The name Nottingham, the ham of the people of Snot, a personal name which appears again in the adjacent Sneinton in the form Snotengaham, is identified by Asser with the British *Tiggnocobauc* in reference to the ancient cave dwellings in the red sandstone hill at Nottingham; but the editors regard this as an invented Welsh name to suit the site.

The special interest of the place-names of Nottinghamshire lies in the fact that in the ninth century this region of eastern Mercia was divided among the members of a great Danish army. As the editors point out, Nottinghamshire is not one of the counties in which the results of Danish colonization appear most clearly on the modern map. The familiar mark of Danish occupation in the termination *by* appears much less frequently than in a number of other counties, and indeed there are twenty-one names only with this identification mark, as against 260 in the county of Lincoln. Closer investigation, however, brings out the fact that the series of Scandinavian village names is longer than that of any district, outside Yorkshire, which has as yet come under the observation of the survey. Widely distributed Danish personal names, compounded with *Thorpe*, such combinations as *eik-hringr* (oak-ring; eakking), *Hrafner* or *Hrafner skialf* (the raven's shelf; Ranskill), Leake in early forms suggesting derivation from Lœkr "stream", with a number of others widely distributed, indicate the extent of Danish settlement within the county. The evidence is particularly strong in the western districts where that of Anglian settlement is weakest.

Yet there is evidence, in the modification of an earlier English name by its adoption by Scandinavian usage (Screveton; sherif's village which should have become normally Shrewton or some similar form), and in hybrid names, for example, by composition of the English *tun* with a Scandinavian personal name (Aslockton, Clipiton, Rolleston, etc.), that settlement had taken place in country well covered by English settlement before invasion began, and that these names indicate villages which became the property of a Danish owner, the English peasantry remaining for the most part unevicted.

On historical evidence it may be presumed that the population was predominnatly Danish, but the occurrence of the place-name Normanton, of which there are five examples in the county, implies settlement of the Norwegians, who predominated beyond the Humber.

An interesting light is thrown on social and funerary custom by that of Granehou among minor names (Grane's *haugr* or Grane's mound) which occurs among parcels of land in the east field of Barnston. It was close by Granby and the names must be connected, suggesting that the *hou* is the burial mound of the man who lived at the place of which the name ends in *by*.

Of the care which has been expended in the editing of this volume it is unnecessary to speak. In its method and arrangement, it follows the plan of the recent volumes of the survey, except that in this instance the editors have been able to rely in greater degree than usual upon expert local knowledge.

TRISTAN DA CUNHA AND ITS BIRDS

Tristan da Cunha: the Lonely Isle
By Erling Christophersen. With Contributions by P. A. Munch, Yngvar Hagen, S. Dick Henriksen, Reider Sognnaes, Erling Sivertsen, J. C. Dunne, Egil Baardseth, Allan Crawford. Translated from the Norwegian by R. L. Benham. Pp. xii + 244 + 15 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1940.) 12*s*. 6*d*. net.

On Tristan da Cunha 188 men, women and children live healthy, happy lives on what has sometimes been called the Lonely Isle—for Tristan is 1,400 miles from the African coast and 1,700 miles from the nearest point of South America. This very remote island received its name from the Portuguese mariner Tristão da Cunha, who was the first man to look upon its 6,000 ft. volcanic mountain which rises, sheer and frowning, from the tumultuous ocean.

The history of the colonization of the island is interesting. When Napoleon was exiled to St. Helena, the British Government sent a detachment of Hottentot soldiers to guard the island against Napoleon's friends, who, it was rumoured, were to use it as a base from which to rescue him. The Hottentots left Tristan da Cunha after a year, but their Scottish corporal, William Glass, remained behind and was the founder of the present colony. To Tristan, in 1938, a Norse expedition, not without considerable difficulties, made its way, and the book under review, a translation from the Norwegian, gives an account of the scientific work carried through by the members of the expedition. The book is on the whole well translated, but here and there, in the naming of birds, difficulties occur. For example (p. 77) it is mentioned that "the small isles of the Tristan group are the only known breeding grounds of the petrel in the world". It is obvious that the translator has fallen into error here. It would seem probable that for "petrel" the translator should have written "great shearwater" (*Puffinus gravis*). This shearwater has a remarkable history. It has been shown in Murphy's "Oceanic Birds of South America", on the authority of Wynne-Edwards, that in the northern hemisphere spring the great shearwater leaves the South Atlantic, crosses the tropical oceanic zone with great swiftness, reaches Davis Strait by early June, and in August arrives at its most northerly limit, in Greenland waters. This is a vast flight to carry through each year, but there is reason to suppose that the great shearwater may nest at a longer interval of time than a single year, and that each bird may not return to its nesting islands in the Tristan group with each recurring season.

Although we are left in doubt as to the exact identity of the birds, there is a graphic account of the petrel's song (p. 72 *et seq.*):

"An immense flight was coming in from the sea that evening, first a few thousand which began the song accompanied by the birds which had remained at home and which now greeted the newcomers. But the song rose until tens of thousands were curvetting above our heads before the sun went down. In the twilight hundreds of thousands reached the island and their song rose to a roar.

"The concert reached its highest pitch before darkness set in. We had to admit that there really was a beautiful musical effect in these voices, which first seemed near when a solitary petrel flew low over the tent, delivering the whole verse so that we heard each word, and then far away, when the murmur of the hundreds of thousands blended into one song beneath the stars."

On p. 112 is an account of the small flightless bird known as Atlantisia which, we are told, lives only on Inaccessible Island of the Tristan group and has not before been described in a book. The small bird is nocturnal, and in its home in dense vegetation is most difficult to see, let alone capture. One could wish that the account of the first meeting with Atlantisia were more full.

"First of all only two fiery, deeply-set eyes were visible, then the light of my torch suddenly shone on so tiny and frail a creature that I felt I must be dreaming. Had I dared I would have pinched my arm. . . . I was reminded of a little photograph of a kiwi."

Seton Gordon.

Babes in the Darkling Wood

By H. G. Wells. Pp. 399. (London: Martin Secker and Warburg, Ltd., 1940.) 9*s*. 6*d*. net.

MR. H. G. WELLS has done much to raise the prestige of science among the people. Here, at the age of seventy-four, he is still trying, with the intensest energy, to communicate to the generality of mankind the implications of science. In his latest book he has used the technique of the novel of ideas to represent the attitude of young people to current events, and suggest what line they should pursue in the light of modern psychology. The ideas of Pavlov and Freud are discussed at length through the dialogues of the characters, but though an impression of their importance is conveyed successfully, they are not very clearly explained.

Mr. Wells recommends that the problem of modern life should be approached in the spirit of the sculptor who contemplates a block of uncarved marble. The possibilities in it should be conceived by a flexible imagination, and all should hack away at it until they have carved out the figure of society that they desire. The advantage of this approach is that it precludes doctrinaire planning. The sculptor is unable to make a finished preliminary draft of the three-dimensional end at which he aims, and must trust to the guidance of intelligent imagination in the course of his work. But this does not prevent him from having some drafts, and a model in his imagination which undergoes continual adaptation and is therefore living. Though Mr. Wells tends to become ever more discursive, his belief in the future and continual wrestlings with the present are still a major inspiration. J. G. CROWTHER.

Qualitative Organic Chemistry

By Neil Campbell. Pp. ix+213. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

THE isolation of pure organic compounds and the common criteria of purity are first discussed. An account of preliminary tests for classifying the unknown compound is then followed by details of more specialized confirmatory tests. Next, a review of the properties of various organic types is associated with information on the choice of derivatives suitable for the identification of specific members of each class. Practical methods for preparing thirty-two kinds of these derivatives are then given, this chapter in particular being provided with many references to the literature. A short note on the examination of mixtures concludes the first part (100 pp.) of the book. The second part (98 pp.) consists of a series of classified lists of various groups of organic compounds, with summaries of the properties of the individual substances and useful derivatives. A short bibliography and indexes are also included.

This is a thoroughly sound and up-to-date little book; besides acting as a handy and dependable *vade mecum* in the laboratory, it will stimulate its users to refer to standard works and original papers, and in general to turn to full account the educative value of this important field of practical organic chemistry. J. R.

L'Origine des cellules reproductrices et le problème de la lignée germinale

Par Prof. L. Bounoure. (Collection des actualités biologiques.) Pp. xii+272. (Paris: Gauthier-Villars, 1939.) 100 francs.

WHILE, perhaps particularly in Great Britain, most of the recent work on the reproductive cells has been concerned with the intimate structure of the chromosomes and their behaviour during fertilization and division, and with the consideration of certain extra-nuclear structures, Golgi bodies, etc., the questions of the history of the germ cells themselves and their relationship to the corresponding cells of their parents have continued to occupy the attention of zoologists. The time was ripe, therefore, for a review of these lines of research, and it has been provided by Prof. L. Bounoure, who is well known for a succession of papers in this field. Previous workers, including Jäger, who first used the expression "Continuität des Keimplasmas" in 1877 and not Weismann as is generally believed, had put forward speculative theories on the subject. The first to realize the problem definitely and to investigate it scientifically was M. Nussbaum in 1880. The present volume, after a historical introduction, reviews the whole subject of the origin of the germ cells and germinal continuity in an exhaustive manner throughout the animal kingdom. The account is fully documented by quotations of the crucial statements and contains discussions of the theoretical questions involved. It is a most useful and readable publication.

Special Surgery in Wartime

By D. W. C. Northfield, Dr. Douglas McAlpine, Dr. V. Zachary Cope, T. Holmes Sellors, A. B. Wallace. (*The Practitioner* Booklets.) Pp. vii+74. (London: Eyre and Spottiswoode (Publishers), Ltd., 1940.) 6*s*. net.

THIS little book provides a concise but comprehensive description of the most important types of war injury. Mr. D. W. C. Northfield has given an excellent clarification of the relations between the clinical picture and the underlying pathological changes in head injuries, and his summarization of the treatment is most helpful. Dr. Douglas McAlpine has surveyed spinal cord lesions well, but although he quotes Watson Jones, he has failed to emphasize the types of injury in which it is dangerous to reduce the deformity by manipulation and in which open reduction is necessary to prevent either the onset or progression of a paraplegia.

Mr. Zachary Cope and Mr. Holmes Sellors, on abdominal and chest injuries, should be read by all.

The treatment of burns at the moment is undergoing startling changes, and, although Mr. A. B. Wallace has written along the orthodox lines, his article will quite soon be out of date. For example, he still recommends tannic acid in the treatment of burns of the hands, and no mention is made of more modern methods of treating third degree burns by saline baths, irrigation in Bunyan-Stannard bags, etc.

Finally, a most useful appendix summarizes the uses of the sulphonamides in war surgery.

Starch and its Derivatives

By J. A. Radley. (Monographs on Applied Chemistry, Vol. 11.) Pp. x+346. (London: Chapman and Hall, Ltd., 1940.) 22*s.* net.

Of vital interest to the plant and animal physiologist and to the biochemist, starch has assumed a position of great importance also in applied chemistry and industry. To this latter domain this monograph properly belongs, and it is the latest of a series initiated by Dr. E. Howard Tripp with the intention of bringing together into one volume the mass of scattered literature, both old and new, which is of real value to the technologist in selected fields of chemical industry. This is a service which is widely acknowledged, and the present volume will be welcomed by many readers.

The subject of starch touches numerous and varied industries which are often exceedingly remote from one another; and the uses to which starch and its derivatives are put is some index of the very diversified character of the researches on this subject. The original literature is perhaps more voluminous than that of any other natural product. Those who have an interest in this field will therefore be grateful to the author for collecting into a single volume a body of knowledge on the manufacture and industrial applications of starch and the products derived from it.

Those sections devoted to dextrins and gums and to the general examination of starches, including their detection and chemical evaluation, are especially noteworthy, as are also the plates contributed by Mr. E. Young reproducing photomicrographs of starches of different origin.

The interests of the textile and paper industries, and the preparation of adhesives, receive more attention in this monograph than does the fermentation industry, which is a field too specialized for intensive treatment in a volume of this kind. A valuable and welcome feature is provided by the wealth of original references which are printed at the end of each chapter. It will be recognized that the merit of the different sections, treated so comprehensively, is a little unequal. That devoted to the structure of starch includes a review of some experimental data which have been superseded and could preferably have been excluded; and generally one wishes that the author's selection of material had been more critical.

A Handbook of Malaria Control

By R. Svensson. (Published by the Shell Group of Oil Companies.) Pp. viii+74+6 plates. (London: Ross Institute of Tropical Hygiene, n.d.) n.p.

This useful little book by an assistant director of the Ross Institute of Tropical Medicine is primarily intended for laymen, especially planters, engineers and others, who have to undertake anti-malarial work in the tropics, but it may also, as Sir Malcolm Watson remarks in the preface, be of use to medical practitioners. Within a small compass the book contains a generous quantity of valuable information, including not only an account of the different forms of malaria control but also a general survey of the malaria problem, notes on the various species of anophelines, laboratory equipment and methods, and a bibliography of recent British writers on the subject. The publication of the work has been undertaken by the Shell Group of Oil Companies.

Organic Syntheses

An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 20. Pp. v+113. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 10*s.* 6*d.* net.

Some forty substances are handled in this volume, of which one (sodium amide) is inorganic. Preparations of open-chain compounds include those of acetylacetone (by the boron trifluoride and sodium ethoxide methods), fumaryl chloride, tertiary butyl acetate (using acetyl chloride in presence of dry ether and magnesium), and the methyl esters of myristic and palmitic acids from the wax of the bayberry (*Myrica cerifera*). Among substances of biochemical importance, preparative details are given for the *dl*-forms of cysteic acid, serine, threonine, and valine; moreover, glucose is used as the basis of penta-acetyl-*d*-gluconoñitrile, *d*-arabinose, and 2,3,4,6-tetramethyl-*d*-glucose. Some of the most interesting heterocyclic items are 1,2,3-benztriazole, dehydro-acetic acid, 5,5-dimethylhydantoin, 5-nitroindazole, and picolinic acid hydrochloride. A useful selection of aromatic substances includes terephthaldehyde (from *p*-xylene), 2,2′-dinitrobiphenyl (from *o*-chloronitrobenzene and copper bronze), diphenylketene (from benzil monohydrazone), monoperphthalic acid, and mandelamide (from the acetone condensation product of mandelic acid, by ammonolysis with liquid ammonia in Dewar flasks). From the fact that the index covers volume 20 only, we infer hopefully that Collective Volume II, including annual volumes 10 to 19, is now in course of preparation.

J. R.

Plant Physiology

By Meirion Thomas. Second edition. Pp. xii+596. (London: J. and A. Churchill, Ltd., 1940.) 21*s.*

The first edition of this valuable text-book was reviewed in Nature of June 20, 1936, p. 1012; we are pleased to know that the book was so well received as to make a reprinting necessary in 1937 and now a second edition appears.

The general arrangement of subject-matter remains unaltered, though, of course, certain recent advances in plant physiology have been incorporated in the new edition. The chief of these include respiration, oxidation enzymes, the zymase-complex, absorption of solutes, translocation and storage of solutes in the cotton plant, mineral nutrition, composition of chloroplasts, reactions in photosynthesis and plant hormones.

Although certain deletions have been made, about a hundred pages have been added to the text and the price has been increased from 14*s.* to 21*s.*

ENGINEERING PROGRESS AND THE SOCIAL ORDER*

By Dr. Frank B. Jewett and Dr. Robert W. King

Bell Telephone Laboratories

THE recognition is universal that a systematic investigation of Nature and a practical application of the resultant knowledge have placed new tools and new weapons of great potency in man's hands. The importance of science in shaping the daily course of events has been made known to all, partly through the literature of technology, but chiefly by the instrumentalities themselves and their omnipresence in our daily lives.

One of the incidental results of modern scientific research is that it has emphasized as never before the gulf which separates the remarkable powers and the equally remarkable shortcomings of the human mind. In the face of these shortcomings we must all have wished at times that they were not immutable, so that something might be done to improve the breed, as it were. Some people have an implicit, if not indeed an explicit, faith in the pliability or tractability of human nature, which leads them to believe that peoples as a whole can be raised morally and therefore be made less willing to engage in the type of conduct of which the world to-day displays too many illustrations. But our own experience—concededly limited—has forced us to the conclusion that human nature, in the aggregate and on the average, is about as unchangeable as any of the quantities and forces with which we have been surrounded and with which we have to deal. If there is any way out from the morass of conflict and doubt in which we now struggle, it would be our opinion that it must involve changes elsewhere than in the fundamental unit which man himself constitutes.

As a result of some two centuries of evolution, scientific method has become the most powerful intellectual tool in man's possession. It is based upon the principle of consciously controlling experimental conditions, to the end that only selected factors or parameters are allowed to vary simultaneously. Long success has demonstrated that such a method supplies the firmest foundation, not alone of exact measurement but even of meaningful measurement. Controlled experiment has brought to light prolifically the exact interrelationships manifested by natural forces. The procedure is one which eliminates all speculation and guesswork from the end-results of science, while still permitting ample play to these processes of thought in the exploratory operations which comprise the chief work of the man of science and engineer. Surrounded as we are with detailed supporting evidence, it is not necessary to emphasize that the experimental method as employed in modern science has met the most stringent pragmatic tests, and that only through it could the full measure of usefulness—and, conversely, of harm—which resides in the agencies of Nature have been made available with the rapidity which is now historic fact. While the logical and practical justification of the scientific method is so universally recognized in itself to call for no particular comment, the human mechanism which has evolved *pari passu* for the more effective carrying out of the method does provide much material for profitable reflection.

Immutability and irrevocability are fundamental characteristics of the facts of science, and facts once brought to light do not change, nor is it possible, once they are understood, to force them back into the limbo of the mysterious and the unknown. It would seem to follow that to the extent to which the evolution of science has demonstrated the need for certain types of human organization and human collaboration in order to be effectively conducted, these also might find a permanent, even an expanding part, in our daily affairs. In fact, it seems inevitable that through the evolution of the various sciences we will be led to create a new science—that of human organization. A considerable amount of empirical information is already at hand, but there is urgent need that it be expanded and made suitable for wider application. The recent course of events in the study and application of the exact sciences reveals what may well be a most significant trend, which of itself is innocent enough but when we come to envisage its counterpart in another field of activity, namely, that of military affairs, and on a much larger scale, forces us to the conclusion that a very difficult situation has already been created.

As science has expanded, carrying with it the range of human knowledge—an expansion which within a single century has reached fabulous proportions—the limitations of the individual mind have become more and more apparent. The pressure of these limitations has in turn expressed itself in the instigation of organized effort on the

* Substance of an address delivered on September 18, before the Section on Natural Sciences of the University of Pennsylvania Bicentennial Conference.

part of those engaged both in fundamental science and in its applications. More and more, due to his inherent limitations, the individual worker is being replaced by a carefully chosen corps, the various talents of which dovetail together and the collective knowledge and collective analytical powers of which greatly exceed those of any single member of the group. When working as a unit, the capabilities of such a group, measured by results, are likely to exceed by a considerable margin the sum of any individual achievements possible to its members. In essence it is the principle of the division of labour applied in the intellectual field, a principle that has long characterized that of manual labour.

It is in the field of the practical applications of science that the need of machinery for collaborative effort has been longest felt and most recognized. We surmise that this has in part been due to the fact that many of the problems which present themselves in the application of science are extremely complex, with respect to the detail they involve, and in part to the fact that a profit motive has added incentive to their accelerated solution. The chemical industries and electrical communication are among the outstanding examples that display the need and the possibilities of group attack.

It might be mentioned that the laboratory which functions within the Bell Telephone System comprises about 4,500 employees, one half of whom are skilled scientific workers and technicians, while the remainder include laboratory assistants and the necessary service groups of various sorts. Experience speaks so strongly that to-day no verbal argument is needed to justify the existence of such a centralized research and development organization.

But it becomes increasingly apparent every day that problems of so complex a nature as to demand organized attack are not peculiar to industry. Problems of this calibre are indeed becoming more and more the substratum of our daily lives and in increased proportion as we base our livelihoods upon the closely inter-related routines demanded by an industrialized society, and as we augment human effort at every turn with the facilities of the machine, as well as the involved chemical and physical processes which Nature has placed at our disposal. In the face of our growing involvement in the results of our own activity, our choice must either be to run the risk of temporizing, or to undertake purposively to improve our organizational forms with the aid of which we may entertain a reasonable hope of matching our analytical powers to our problems as they grow in intricacy.

Recent experience shows that these problems are by no means limited to the domestic range, and that frequently they will arise as a result of conflict between domestic and international relationships. Isolation in to-day's mechanized world is as unattainable as it would be impossible to extract the detonating force from an enemy's explosives or lifting power from the atmosphere that now supports his aeroplanes. Current events prove clearly enough that unless the peoples of the world can by universal agreement impose an artificial simplicity upon our social, economic and political problems, those groups and nations who are backward in the development of organizational techniques and who choose to try to cope with their problems by outgrown methods, must expect to suffer the unenviable consequences of inefficiency. Barring the ratification and enforcing of such artificial restrictions—and the possibility of so doing seems forlorn indeed—we must recognize that the urgent need is to adopt and exploit all modern fact-finding instrumentalities to their full capacity.

In support of such a programme we would urge that the method of the industrial laboratory is already proving productive when thus transplanted. We may now witness it in action on a nation-wide scale. Germany, under the Nazi regime, has become none other than a vast laboratory dedicated to the perfection, not of the arts of peace, but of the arts of war. It is not necessary to postulate any unusual skill at organization to explain the startling character of recent Nazi military achievements. The answer lies in the simple fact that the present German technique applies systematically and energetically to the affairs of a nation at war the precise methods which have characterized much industry for a generation or more. We frequently refer to it as German thoroughness. It does, of course, represent thoroughness—the kind of thoroughness which characterizes the well-managed industry with adequate research facilities. In the case of the Nazis, their organization includes virtually the entire home population plus their numerous agents abroad. We have the strongest possible proof that to wage a modern war successfully involves detailed co-operation between all a nation's population groups.

We are acquainted in general terms with the uniformity of control that the war effort exercises over every activity of German life. It is not a prospect which appeals to those of the liberal persuasion. But however much we rebel at the thought of complete submersion of our individual lives and privileges in a war-making machine, we must recognize that what we are witnessing is a battle between types of organization. In war the totalitarian State is proving itself a most potent adversary. It may, in fact, go farther than this and prove also to have great survival power following war, unless perchance experience ultimately discloses that every branch of the human race without exception is so constituted as not to submit for long to the degree of dictation and regimentation that totalitarianism involves.

But for the moment we cannot safely assume that mankind will shortly, or even in the long run, display such uniformity of taste. All we know is that dictatorship has never long endured, but has always proved the prey of disruptive forces working either from within or from without, or both. However, we must not be guilty of an over-optimistic assumption at the present time, for it is being forcefully brought to our attention by current events that through science and engineering the essential paraphernalia of dictatorship are much more readily to hand than ever before and are much more effective.

Recognizing these manifestations of modern technology, it is abundantly clear that the peoples of the world are faced with the need of making certain momentous decisions, and making them quickly. No longer can we regard with indifference the effort needed to overthrow an established dictatorship, even after it has become utterly repugnant to its subjects. We face two very unpleasant potentialities in the fact that a small but well-organized and equipped minority can impose its will on a much larger majority. We have already seen this happen within national boundaries in the case of each of the totalitarian States. But what is more significant, we are now beholding such an entrenched minority extend its sphere of conquest to much larger circles beyond its own national boundaries.

The future consequences of these recent developments are not easy to gauge. It does seem essential, however, that we make a new accounting of political methods and instrumentalities to the end that we are enabled to select those best suited to the conditions imposed by present-day technology. Our inherited social techniques give evidence of having lost an important measure of contact with reality. In an ideal sense we may still applaud Franklin when he said, "They that give up liberty to obtain a little temporary safety deserve neither liberty nor safety." But the vital fact for us who live to-day and which has asserted itself since Franklin's time is that a minority who are willing to sacrifice their own liberty—or who perhaps have been so unlucky as unintentionally to sacrifice it—can compel a majority who cherish it to lose theirs. The only effective avenue of escape seems to be to find some way of preventing the minority from giving up their liberty. If this is not done only a Hobson's choice remains, so far as the majority is concerned. They may elect either to lose their liberty by being worsted in a struggle for which they are improperly prepared, or they may, by submitting in large measure to totalitarian methods, put themselves in condition to resist attack successfully. Hence, the mere existence in the world of a totalitarian State of any magnitude, when coupled with the threat of war which history shows is always inherent in the concentrated power of dictatorship, constitutes a death threat to all liberal forms of government. Now that mankind is in possession of the weapons made possible by modern technology, the planet has suddenly grown too small to support simultaneously the type of totalitarianism and the type which we associate with liberalism. To combat the Nazi 'total war', there is only one possibility—that of *total peace*.

The foregoing argument would only be strengthened were we to consider such additional factors as wage, price and profit controls. Here again the liberal State as it now operates is at a distinct disadvantage. The authority necessary to establish such controls is entirely repugnant to the democratic way of life, except in so far as they can be worked out by voluntary acquiescence on the part of the individual. Yet the energetic waging of war—and in fact the energetic waging of commercial war in times of nominal peace—must involve the equivalent of these authorities in the highly integrated modern industrial State and also in the world at large. In a word, unless the democracies and would-be democracies can dictate and control the rules of the international game of give-and-take, they are likely to prove but pawns in the hands of the totalitarian powers, *if any such there be*.

To us who have, as we have, witnessed the rise of modern technology and who have been intimately associated with the rapid development of technology, it seems transparently clear that we of the free nations must alter in a fundamental fashion our methods of solving social and political problems. We would urge upon those who would preserve liberalism that it must make available to itself the type of instrumentality which has been found so prolific of results in science and engineering, and which in Germany we see turned so effectively to the destructive operations of war.

As to whether the State founded upon dictatorial authority represents a continuing type, it seems only safe to assume that at least potentially it will remain a serious menace to all democracies. In the first place, it and the planned economy are essentially one and the same thing. It has frequently been pointed out that national planning, irrespective of the innocence with which it is launched or the beneficent ends held in view, will inevitably lead to dictatorship provided the political authority is created to enforce the plans when once they have been made. Time does not permit our retracing the argument to-day; we will say, however, that it appeals to us as having strong presumptive validity, and the conclusion immediately deducible therefrom is significant as regards our present discussion. The increased complexity of function which is being imparted to our social, industrial and political life by a growing technology, demands on one hand a wider variety of specialized training and skill, while on the other it calls for closer co-ordination between these specialized groups to the end that more rigidly guided and more narrowly confined spheres of action are imposed upon the individual, be he human or corporate. Such expanding specialization connotes planning, while the expanding need of guidance suggests dictatorship. We see, therefore, that the two conditions are likely to merge *unless* great care is exercised to hold them apart.

A great deal hinges upon that word 'unless'. What procedure is at once compatible with freedom of action on the part of the individual and yet with the need of circumscribing and directing his activities ? The field of choice cannot be a broad one. In fact, it seems to resolve itself into one single possibility, that of voluntary and educated guidance imposed by the individual himself, and therefore in turn by public opinion.

Whenever we make the attempt, dispassionately, to contrast the extremely casual, not to say misinformed, methods usually employed by representative Governments in transacting their public business, with the painstaking studies which underlie most operations of private business, we cannot but be amazed. It is probably safe to say that, as concerns the United States, our Federal Government frequently spends tens or even hundreds of millions of dollars after less examination of the merits and ultimate soundness of a scheme than a private corporation would put into the planning of a very minor mill or factory. The lack of any threat that the supply of public money would run short has, of course, permitted the continuance of such a casual policy long after it became apparent for other reasons that the operation of Government on the basis of popular whim and fancy and political self-interest could only end in absurdity, if not in disaster.

Suddenly the evidence has swelled to such a volume that we are perhaps in some danger of being confused and misled by its very bulk. As never before, it seems that liberally inclined peoples must put their faith in the more effective pursuit of knowledge and the possibility of popularly interpreting this knowledge once it is obtained. Quite obviously, this second point is as important as the first ; knowledge in possession of a few who are without authority is powerless, while knowledge in the possession of a few with power to employ it is totalitarianism. Understanding must be the possession of the people if they are to retain their sovereignty.

As to an agency to be employed in the more effective pursuit of the knowledge which efficient and effective public management presupposes, we have already intimated that the modern industrial laboratory offers an admirable starting-point. It is the function of such an institution to bring together in intimate association a considerable number of experts and technicians whose professional knowledge and skills, when merged in harmonious co-operation, possess a productive capacity of proved merit. In fact, it seems to hold the one and only key to such enigmas as baffle the world to-day. Blocked by Nature in any effort to add materially to human intellectual capacity in a sufficiently short space of time, the alternative is to resort to the development of an organizational device for achieving the same end —a process not inappropriately termed superorganic evolution.

Nor should we be discouraged by the very obvious fact that the methods of attack in regard to problems of State must in one fundamental respect differ from those employed in technology. As previously pointed out, the basis of the experimental method is deliberate control of the factors and parameters which enter into any problem. This is quite possible when dealing with the inanimate forces of Nature, but there will be scant opportunity for the employment of such arbitrariness when studying the questions set by her animate creations. This limitation assuredly makes the approach more difficult, but certainly does not rule out the attractiveness of the mass attack ; if anything, it makes it more imperative. By the same token we must not be discouraged by the observation that while the problems of technology are in considerable measure quantitative and therefore susceptible of being stated in concrete and uncontrovertible terms, the problems of government, in proportion as they are difficult, defy reduction to simple methods of measurement. Here again, as the challenge mounts, the need for organized study and analysis surely increases.

We come now to a process that would be common to the duties of all properly directed laboratory groups, namely, that of reducing their findings to terms suited to general consumption. One of the commonest charges against the man of science is that while he may be very successful in discovering new facts, he is likely to fail or be indifferent to the description of them in terms which the so-called popular audience can comprehend. Whether the fundamental scientist who is primarily engaged in charting unexplored territory is justified in more or less disregarding the charge—and we must all agree that in large measure he does disregard it—the problem is one which the successful industrial laboratory cannot set aside. Its principal duty, in fact, is so to interpret its findings and conclusions that management, who while highly skilled in many essential ways is not likely to be skilled in scientific principles and terminologies, can make its decisions intelligently in so far as they ought to take the work of the laboratory into account.

It is obvious that in all matters relating to technical consideration the laboratory is, or ought to be, supreme. Its purpose is clearly not to attempt to carry out the whims of management; its duty and prerogative are to develop and urge new instrumentalities and to advise management in its technical capacities as to what projects may be embarked upon with reasonable assurances of technical success. In a very real sense, therefore, orders go from the laboratory up to management. Nevertheless, the duties and responsibilities of management remain clearly defined. In the last analysis, all decisions are within its province and are its proper function. Aside from the aspects of the business which the work of the laboratory does not touch, it is the duty of management to decide what products of research shall be introduced into circulation, and when, as well as what in general, the future projects of the laboratory shall be. Decisions such as these are clearly of vital importance to the welfare of any business, and a management that is well advised will earnestly solicit the full co-operation of the laboratory before pronouncing final judgment in the fields in which it possesses an informed opinion.

The analogy between the manner in which a modern corporation employs its laboratory and the manner in which an equally modern State might employ a similar investigative and advisory body, is surprisingly close. The only outstanding difference—and it is one which would not appear to be especially significant—is that in this hypothetical modern State the public is served by a corporation around whose board it occupies all the directors' seats, and the democratic tradition therefore prescribes that it shall select its own management. There need be no resulting confusion. This is precisely the allocation of powers and duties which is contemplated in the formula, "Government of the people, by the people and for the people". Whatever advisory and investigative bodies the management of the State—which is therefore Government—is authorized to create, the public as its own board of directors will be in possession of the findings of such bodies and, moreover, can demand that management properly employ them in its acts and policies.

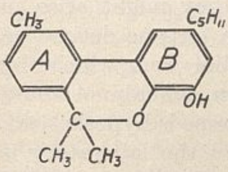
The purpose of this very brief discussion is to accomplish a twofold objective: first, to suggest that in the present confused state of world politics there is an acute need of the fullest understanding attainable; secondly, to point out that an instrumentality of demonstrated efficiency is available as a pattern. It is not our intention to venture any detailed suggestion as to the various organizational mechanisms which might be set up to accomplish the results which we envisage must be accomplished if the liberal form of government is to maintain its workability. At the same time we would not imply that the organizational mechanism to be created is anything short of being extremely difficult. Its solution will quite obviously call for a very high order of statesmanship and political invention. Certain models and experience are already available. As regards certain fields of science, routines are now in existence whereby an independent and highly competent group of experts may render advice to the Federal Government. These routines had their origin in problems arising during the Civil War, and with certain additions the routines have remained in effect. The group of experts who are on call as consultants are members of the National Academy of Sciences, or are such other experts as the Academy may choose to select. During 1917 the pressure of war work became such that need of closer advisory routines led to the creation of the National Research Council, a body subsidiary to the National Academy of Sciences and one which has remained in existence. Finally, as a result of the present crisis, the machinery of co-operation between the Federal Government and American men of science has been further enlarged by an Executive Order creating the National Defence Research Committee.

It is interesting that it has been war or the threat of war which has led to the creation and the elaboration of this machinery as well as to the periods of its extensive use. Our own view is that we are now well launched upon an era during which all of the existing advisory aids to the Government, as well as others still to be created, will have to function almost continuously. Thus, a prototype is already available, and when urgently needed enlargements are made, the Government, as well as the public which it serves, ought to be in a position to summon throughout the entire gamut of its civil activity the aid of the recognized experts of the nation. Such an arrangement need not savour of bureaucracy. But sovereign people will still remain sovereign. The belated and constructive recognition will be given to the fact, now abundantly clear to all, that the day is gone, and probably for ever, when a successful State can base its policies upon clamour of pressure groups or upon the uninformed beliefs of the majority, even though measured numerically by tens of millions.

CHEMISTRY OF THE HEMP DRUGS

By Prof. A. R. Todd
University of Manchester

THE resinous exudate from the female flowers of the hemp plant (*Cannabis sativa*) has for centuries formed the basis of a variety of narcotics known under a host of names (charas, hashish, ganja, etc.) according to locality and mode of preparation. The hemp drugs are eaten or smoked, the effects varying somewhat accordingly. Recently the smoking of hemp under the name of marihuana has attained particular prominence in America, where strenuous efforts are being made to combat its spread. Of all the common addiction drugs, least of a scientific nature is known about Cannabis, and this despite the fact that it has quite remarkable pharmacological properties. The isolation and characterization of the active principle or principles might well prove of considerable medical importance.



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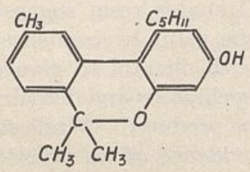
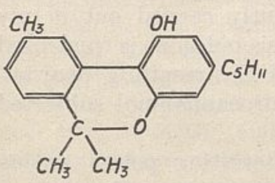
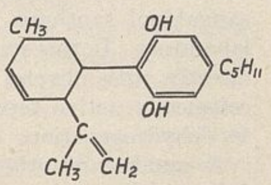


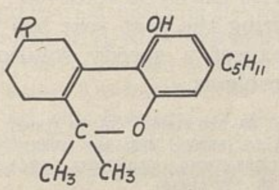
II



III



IV



V

The reason for this lack of precise knowledge lies mainly in the intractable nature of hemp resin, although the difficulty of accurate biological assay and wide variations in the potency of various drug samples have in the past also contributed. The active constituent is contained in the high boiling portion of the resin, is nitrogen-free, and can be distilled in a high vacuum without decomposition. Much of the work done by earlier investigators was invalidated by their failure to realize that this distilled product, despite its fairly constant boiling point, is not homogeneous but contains a mixture of closely related substances. The first definite advance in the chemistry of the resin was made by Wood Spivey and Easterfield[1], who isolated from it, as a crystalline acetate, the compound cannabinol. Cannabinol is a cryptophenol of formula $C_{21}H_{26}O_2$, and it was investigated, later by Bergel[2] and Cahn[3]. The latter, in a series of elegant investigations, went far towards the elucidation of its structure; he was able to propose for cannabinol the structure (I) in which only the positions of the *n*-amyl and hydroxyl groups in ring *B* of the dibenzopyran system remained uncertain.

Following the work of Cahn, several years elapsed during which little chemical advance was made, although much valuable work on distribution and potency was carried out in various laboratories. The subject was reopened by Work, Bergel and Todd[4], who showed that cannabinol could readily be separated from Indian hemp resin (ganja) as a crystalline *p*-nitrobenzoate. They established, using the Gayer test[5] on rabbits, that cannabinol was not the pharmacologically active component of the resin, and effected a considerable concentration of the active cannabinol-free material by chromatographic analysis. They did not, however, claim homogeneity for their most active products. In subsequent work in my laboratory concentration by the same means has been carried to a point where the products give a positive Gayer test at a dose of 0·05 mgm./kgm. It was also observed that the so-called Beam test (red-violet colour with alcoholic potassium hydroxide) commonly used as a reaction for Cannabis extracts is not given either by cannabinol or by the active constituents of the drug[7].

Meanwhile independent investigations by Adams and his collaborators in America were in progress. These workers used as starting material the 'red oil' of Minnesota wild hemp; Todd and his collaborators, like earlier workers, carried out their investigations on prepared drugs of Indian and

Egyptian origin, which differ somewhat in composition from each other and from marihuana. From 'red oil' Adams, Hunt and Clark[6] isolated a new substance cannabidiol $C_{21}H_{30}O_2$ as its 3 : 5-dinitrobenzoate, the same substance being isolated very shortly thereafter by Jacob and Todd[7], from Egyptian hashish, where it was accompanied by cannabinol; the latter compound has also been recently obtained from American hemp[8]. Cannabidiol, which gives a strong Beam test, is pharmacologically inert and its structure has been largely elucidated in a series of papers by Adams and his co-workers, who consider it to be (IV)[13], although rigid proof of the position of one double bond is lacking. Simultaneously with the isolation of cannabidiol, Jacob and Todd[7a] reported the isolation from Indian hemp resin of a substance cannabol isomeric with cannabidiol. This substance, which gives no Beam test and has at most a trace of pharmacological action, was thought to be a partially reduced cannabinol.

The similarity in the empirical formulæ of cannabidiol and cannabinol together with their simultaneous occurrence suggest a close structural relationship, and since cannabidiol (IV) was early found to be a derivative of olivetol (5-*n*-amylresorcinol) the American workers concluded that cannabinol was probably represented by (II) or (III[9]). Meanwhile the observation that cannabinol gives a positive indophenol reaction, taken in conjunction with the earlier nitration results of Cahn, led Jacob and Todd[7b] to conclude that cannabinol could only be (I) or (III). The obvious deduction that cannabinol is represented by (III) was confirmed by the independent syntheses of cannabinol carried out by Adams, Baker and Wearn[10] and by Ghosh, Todd and Wilkinson[11].

None of the natural compounds, cannabinol, cannabidiol and cannabol, accounts for the narcotic properties of the hemp drugs. Recently, however, Haagen-Smit *et al.*[12], have reported the isolation from marihuana of a crystalline substance cannin, showing the typical activity of the drug in dogs. No details as to the nature of this substance are available, but the isolation is of great importance, and further work by these authors will be awaited with interest. Meanwhile, developments have occurred on the synthetic side which are of considerable moment. Adams and his collaborators[13] have observed that cannabidiol undergoes cyclization with acidic reagents yielding substances which have the composition of tetrahydrocannabinols and which show strong hashish activity; catalytic hydrogenation of these gives a hexahydrocannabinol which is also active though in lesser degree. Furthermore, 3′ : 4′ : 5′ : 6′-tetrahydrocannabinol (V; $R = CH_3$) first obtained as an intermediate in the cannabinol synthesis of Ghosh, Todd and Wilkinson[11], is also active both in dogs[13] and in rabbits[14]; the hexahydro-compound prepared from it has again a positive, if weaker, action. On the pharmacological side, collaboration is being maintained by the American workers with Dr. S. Loewe of Cornell University and by the British workers with Prof. A. D. Macdonald of the University of Manchester. Work on analogous synthetic products is being pursued, and although not yet widely extended it is clear that some structural variation is possible; thus, synthetic tetrahydro-*nor*-cannabinol (V; $R = H$) is also active in rabbits[14].

The fact that a variety of synthetic tetrahydrocannabinols show hashish activity lends colour to the view also expressed by Adams[13] that there may be several active constituents of this type in hemp resin, differing from each other in the position of the ethenoid linkage; cannin might well prove to be a substance of this type. Further support for this view is perhaps to be found in the fact that cannabinol-free active fractions of Indian resin have a composition corresponding to that of a compound $C_{21}H_{30}O_2$ containing one ethenoid linkage[15]. It may be mentioned finally that a consideration of the formulæ of the substances isolated from Cannabis resin suggests that they might arise in the plant by condensation of a terpene derivative with olivetol to give cannabidiol from which, by cyclization and dehydrogenation, cannabinol would be produced[7]. While such a scheme is hypothetical, evidence of its practicability in the laboratory is available, partly from the cyclization of cannabidiol to tetrahydrocannabinol, from which cannabinol can in turn be obtained[13], and partly from a new cannabinol synthesis recently carried out in my laboratory. In this synthesis pulegone is condensed directly with olivetol and the resulting pharmacologically active tetrahydrocannabinol subjected to dehydrogenation.

A number of other interesting points arising from the recent work on Cannabis must be omitted from discussion in this article. Much remains to be done before clarity is achieved; but the rate of progress during the past year has been such that one may expect a speedy solution of the outstanding problems.

[1] *J. Chem. Soc.*, **69**, 539 (1896); **75**, 20 (1899).
[2] *Annalen*, **432**, 55 (1930); **493**, 250 (1932).
[3] *J. Chem. Soc.*, 986 (1930); 630 (1931); 1342 (1932); 1400 (1933).
[4] *Biochem. J.*, **33**, 123 (1939).
[5] *Arch. Exp. Path. Pharm.*, **129**, 312 (1928).
[6] *J. Amer. Chem. Soc.*, **62**, 196 (1940).
[7] (*a*) NATURE, **145**, 350 (1940); (*b*) *J. Chem. Soc.*, 649 (1940).
[8] Adams, Pease and Clark, *J. Amer. Chem. Soc.*, **62**, 2194 (1940).
[9] *J. Amer. Chem. Soc.*, **62**, 2197 (1940).
[10] *J. Amer. Chem. Soc.*, **62**, 2204 (1940).
[11] *J. Chem. Soc.*, 1121 (1940).
[12] *Science*, **91**, 602 (1940).
[13] *J. Amer. Chem. Soc.*, **62**, 2402, 2566 (1940).
[14] Unpublished results of Prof. A. D. Macdonald.
[15] Bergel and Todd; unpublished observations.

OBITUARIES

Prof. E. W. MacBride, F.R.S.

BY the death of Prof. E. W. Macbride on November 17, within little more than a month of his seventy-fourth birthday, British zoology has lost a vivid and colourful personality and a distinguished worker. To the younger generation he was a member of a remarkable group of zoologists whose encyclopædic knowledge of the morphology of the animal kingdom was a matter of wonder and admiration. His outstanding record as a student shows clearly his capacity for hard work, and his later writings indicate how well he mastered and remembered his subject.

MacBride was born in Belfast on December 12, 1866. His undergraduate training was received at Queen's College, Belfast, and St. John's College, Cambridge, at the latter of which he was exhibitioner and foundation scholar. In 1889 he graduated as B.Sc. of London and two years later obtained his B.A. of Cambridge. Nor were his energies entirely devoted to science, for in his graduating year he was president of the Cambridge Union, an honour that reflects the esteem in which he was held by his fellow students.

After graduating, MacBride went to Naples, where he came under the influence of Anton Dohrn, then at the zenith of his career, and doubtless acquired his deep love for marine zoology. In 1892 he returned to Cambridge to become University demonstrator in animal morphology and in the following year became fellow of St. John's and was the first man to be awarded the Walsingham Medal for biological research. It was doubtless during these years that he laid the foundations of his wide knowledge of zoology, his eminence in which was recognized in 1905 by his election as a fellow of the Royal Society.

In 1897 he was appointed to the Strathcona chair of zoology in McGill University, Montreal, and in this city he met and married in 1902 a daughter of the late H. Chrysler, K.C., of Ottawa. He remained until 1909 at McGill and left a reputation for enthusiasm and energy which persisted for many years. In 1913 he was appointed professor of zoology in the Imperial College of Science and Technology in succession to Adam Sedgwick, and he remained there until he retired in 1934 and carried with him the well-deserved title of emeritus professor. Here he built up a well-known school of zoology that attracted workers from overseas as well as at home. During this time his eminence was recognized by the bestowal of the honorary doctorates of both McGill and Queen's Universities.

Apart from his strictly academic work, MacBride rendered valuable services to his country and to science by his work as chairman of the Council of the Marine Biological Association of the United Kingdom, the Advisory Committee of the Development Commission on Fishery Research and of the Bermuda Committee of the Royal Society. He also served on the Councils of the Royal Society and the Zoological Society, and the work of all these posts was carried out with the enthusiasm that was so characteristic of him.

His own research ranged over a wide field but his name became particularly associated with the Echinodermata, in the knowledge of which group he became an acknowledged master; and his most noteworthy general contribution to our knowledge of this group was the section on that phylum in the "Cambridge Natural History" volume published in 1906. This was and still remains about the most clear and useful account of the group available to English students. In 1914 he produced vol. 1 (Invertebrata) of the "Text-Book of Embryology" (Macmillan), in which he covered the embryology of the whole of the invertebrates and also the Protochordata in a lucid and comprehensive manner. Here his ability as a teacher is shown better than perhaps anywhere else, for, in spite of his deep knowledge of the Echinoderms, he allots to them no more space than could reasonably be expected, taking into account the relative importance of the phyla in a general scheme and what was then known of their embryology. Apart from the descriptions of the development of selected types of the different organisms, this volume also contains useful and illuminating statements, or discussions of various theoretical points, such, for example, as the biogenetic law, the interpretation of larval forms, etc. It is a definite contribution to the study of invertebrate embryology, not merely a compilation of information, and it needs to be taken into consideration by subsequent workers in this field. MacBride's critical ability also served him well in the selection, from the vast amount of material available, of just those facts that were required to provide a succinct and yet comprehensive review. In 1922 he contributed to the twelfth edition of the "Encyclopædia Britannica" well-known articles on cytology, embryology and eugenics. He also published a series of other works that have been widely read: "Introduction to the Study of Heredity", 1924; "Evolution", 1927; "Embryology", 1929; and "Huxley", 1934.

MacBride's keen mind was not satisfied with the mere accumulation of morphological knowledge, but constantly strove to deduce generalizations from the facts or to see how the current speculations accorded with them. This tendency became more marked in his later works, which, as their titles suggest, are concerned more with the theoretical aspects of biology. In the elaboration of a theory personal opinion plays a greater part than it does, or should do, in the compilation of morphological detail. Some of MacBride's conclusions did not conform with the commonly accepted, one might almost say orthodox, theories; but this did not deter him from putting them forward. He was, for example, generally regarded as the champion in Great Britain of Lamarckism or the heritability of acquired characters, although not in the crude form in which the idea was originally proposed, and there can be little doubt that this was contrary to the main trend of current opinion. This statement requires some qualification. He did not suggest that all characters were acquired or that all acquired characters were transmitted; but, and this is an important distinction, he did suggest that there was evidence, experimental and other, to show that in certain instances changes induced by external forces in the parent could be handed on to the offspring even if in a modified form. As a corollary there is the possibility that the blind acceptance of the opposite point of view will lead to overlooking or misinterpreting evidence. That these opinions were honestly held no one doubted, and when they were put forward without rancour, with his wide knowledge and his cogency, even if they did not always convince, they certainly caused his opponents to pause and take stock of their position. Such jolts to the complacent acceptance of the orthodox are of considerable value. His ideas were by no means all heterodox, and by his clear exposition of both fact and theory he had considerable influence on contemporary zoological thought in Great Britain.

Although not a large man physically, one had only to be in MacBride's presence for a short while to realize that he had a dynamic personality and a well-stored mind. In meetings and in private discussions, no matter how widely the talk might range over the whole field of zoology, he had always a pertinent contribution to make. He has left a memory of untiring energy and remarkable knowledge, and those bodies and institutions that he served will also recall his loyalty and devotion so freely given.

There is another side to his life, although this is not the place to enlarge upon it. He was devoted to his family and in recent years settled down to a well-earned retirement in Alton, Hampshire. Here he had a delightful garden and was much interested in country life, in the affairs of his locality and in the parish church. To his widow we should like to extend our sincere sympathy.

Dr. F. L. Arnot

NEWS has been received from Sydney, Australia, of the sudden death early in October of Dr. Frederick Latham Arnot, for eight years lecturer in natural philosophy in the University of St. Andrews and, since 1939, lecturer in physics in the University of Sydney. He was born on September 29, 1904, at Sydney, of British parents, his father being Scottish and his mother English. He was educated in his home University, and after graduating with first-class honours in 1927, he was awarded an exhibition at Trinity College, Cambridge, and worked as a research student in the Cavendish Laboratory under the supervision of Sir Ernest Rutherford (later Lord Rutherford). Two years later he was awarded an Isaac Newton studentship, and received the degree of Ph.D. in June, 1930, for investigations concerning the collisions of slow electrons with molecules in gases at low pressures. His later results at Cambridge on the scattering of electrons in gases and on the diffraction of electrons in mercury vapour were of great beauty and importance.

In 1931, Arnot was appointed to a lectureship in the United College of the University of St. Andrews, and in association with his fellow-workers in the physical laboratory carried out valuable experimental work on ionization in gases and vapours. In these investigations new processes of ion formation were discovered, in particular Arnot's theory of negative ion formation at metal surfaces being of outstanding importance. The results obtained have important bearings on technical problems, and are of interest in connexion with the formation of negative ions in the outer regions of the earth's atmosphere.

In 1939, he was approved for the degree of Sc.D. by the University of Cambridge at an unusually early age. He was offered and accepted a lectureship in physics in the University of Sydney, and in July Dr. and Mrs. Arnot left St. Andrews for Australia. After his arrival he at once set about the organization of research work with the assistance of advanced students, and commenced investigations on nuclear physics and cosmic ray phenomena. Mention should also be made of the great interest which he took in problems of cosmology, and a preliminary account of his views, admittedly of a somewhat speculative character, was published in NATURE of June 25, 1938. His many friends in all parts of the world deeply regret the untimely close of a promising career.

H. S. ALLEN.

Prof. Julius Wagner-Jauregg

A BRIEF announcement of the death at the age of eighty-three of Prof. Julius Wagner, Ritter von Jauregg, the eminent Viennese medical man who introduced inoculation of malaria as a treatment for general paralysis, appears in the October 5 issue of the *Schweizerische Medizinische Wochenschrift*.

Like his predecessor Kraft-Ebing (see NATURE, August 10, p. 194), he was born at Wels in Upper Austria, on March 7, 1857. He received his medical education at the University of Vienna, where his chief teachers were Stricker, professor of general and experimental pathology, and Leidesdorf, professor of psychiatry. He qualified in 1880 and five years later became lecturer in neurology and psychiatry at his Alma Mater. During 1889–1893 he was extraordinary professor of neurology and psychiatry at Graz, and was then appointed professor in this subject at Vienna, where he remained until his retirement in 1928.

His early work was connected with the treatment of cretinism with thyroid extract, and of goitre with small doses of iodine. His most important achievement, for which he received a Nobel Prize in 1927, was the inoculation of benign tertian malaria for the treatment of general paralysis, which, though not devoid of risk, proved successful in about a third of all cases of this hitherto invariably fatal disease. The same treatment was afterwards applied in tabes. The method had been suggested to him by beneficial effects in various psychoses of pyretogenic substances, such as staphylococcal vaccine or tuberculin. He also was the author of works on heredity, forensic psychiatry and the somatic pathogenesis of various psychoses. A bibliography of his publications up to 1928 was compiled by Prof. A. Pilaz (*Wien. Med. Woch.*, **78**, 842; 1928) and his portraits at different ages appeared earlier (*Wien. Med. Woch.*, **64**, 2239; 1914; *Deut. Med. Woch.*, **53**, 417; 1927).

J. D. Rolleston.

We regret to announce the following deaths:

Dr. J. W. Blagden, a director of Messrs. Howards and Sons, Ltd., formerly head of the research laboratories, aged sixty-seven.

Sir Harley H. Dalrymple-Hay, the well-known underground railway engineer, on December 17, aged seventy-nine.

Prof. Robert Emden, formerly professor of physics in the Technical High School, Munich, aged seventy-four.

Mr. E. H. Hayes, formerly mathematical tutor of New College, Oxford, on December 4, aged eighty-six.

Prof. Karl Hescheler, formerly professor of zoology in the University of Zurich, an authority on the osteology of prehistoric mammals, aged eighty-one.

Dr. A. B. Lewis, curator of Melanesian ethnology in the Field Museum, Chicago, on October 10, aged seventy-three years.

Prof. Alberto Pepere, professor of morbid anatomy in the University of Milan, aged sixty-seven.

Prof. H. J. Spooner, professor of mechanical and civil engineering in the Regent Street Polytechnic during 1882–1922, on December 16, aged eighty-four years.

The Rev. Canon Alfred Young, F.R.S., formerly lecturer in mathematics in Selwyn College, Cambridge, on December 19, aged sixty-seven.

Prof. Rudolf Zeller, formerly professor of geography in the University of Bern, aged seventy-one.

NEWS AND VIEWS

Peace Aims

One result of the proclamation of the Nazi "New Order" in Europe has been a widespread desire for a comparable statement from the British and Allied Governments of their intentions. A noteworthy contribution towards clarifying the situation has been made by a letter which appeared in *The Times* of December 21 over the signature of the Archbishop of Canterbury, Cardinal Hinsley, the Moderator of the Free Church Council and the Archbishop of York. Starting with the statement that no permanent peace in Europe is possible unless the principles of the Christian religion are made the basis of national policy and all social life, they base their letter on the five points put forward by Pope Pius XII a year ago. The first of these requires the "assurance to all nations of their right to life and independence"; violation of this equality of rights demands reparation, based, not upon force, but on the rules of justice and reciprocal equity. The second point refers to the need for "a mutually agreed organic progressive disarmament, spiritual as well as material, and security for the effective implementing of such an agreement"; and the third emphasizes the need for a juridicial institution to guarantee and, when necessary, to revise, such agreement. The fourth and fifth are less specific in that they ask for the adjustment of the needs of nations and populations and for the development of a sense of justice in accordance with the Christian ideal.

To these five points the signatories of the letter add five brief supplementary statements defining their attitude more precisely. They ask for the abolition of extreme inequalities in the distribution of wealth and possessions, for equal educational opportunity for all, and for the safeguarding of the family as the social unit. They also state that "The sense of a Divine vocation must be restored to man's daily work" and that world resources should be regarded as "God's gifts to the whole human race, and used with due consideration for the needs of the present and future generations". These simple and direct statements, coming from the leaders of the Christian Churches in Great Britain, will be received with general approval. Indeed, they crystallize the thoughts of many who have followed the present struggle, not with any doubts as to the righteousness of the British and Allied cause, but with anxious eyes for the future; and they may well form a useful substitute for an official Government pronouncement, hedged about as the latter would be by various provisos and qualifications. The letter will be accepted by all men of good will, whether associated with the Christian Churches or not, as an eloquent statement of war—and peace—aims of the British Commonwealth of Nations and her Allies.

Colonial Policy during and after the War

Lord Lloyd's statement on recent developments in colonial policy in reply to Lord Faringdon in the House of Lords on December 17 is of the greatest moment, not only as being in the nature of an interim report on the steps which have been taken to implement previous declarations of policy in colonial affairs, but also as affording an indication of the line along which it is at present the aim of the allied powers responsible for colonial dependencies to direct future and post-war policy in inter-State relations. The British Government, earlier in the present year, pledged itself to a policy of colonial development so far as conditions might allow during the continuance of hostilities; while, in administration, liaison arrangements with the French Colonial Empire had already been brought into operation before the collapse of France. This co-operation between Colonial Governments, Lord Lloyd stated, has not only begun but is also being deepened every day during the War, and will be continued afterward when all the Colonial Governments will be free from the daily fear of Nazi aggression.

In support of this statement, Lord Lloyd was able to point to the important economic agreements which have been negotiated with the Free French colonies in Africa and with the Belgian Congo. Further, the British Colonial Office has organized within the office to continue the liaison arrangements with the French Colonial Empire. Recent developments in relations with the Dutch colonial authorities are even more striking. The British and Dutch Governments have been so strongly impressed by the results of joint discussion of problems common to Malaya and the Dutch East Indies, which have taken place both in England and between Sir Shenton Thomas and the Netherlands authorities in Batavia, that regular machinery has been set up to ensure that liaison in the form of a joint Anglo-Netherlands Committee on Economic Matters.

While these measures to promote a liaison in the important sphere of economics are a substantial beginning in the promotion of co-operation in administration between Colonial Powers, which will prove of the greatest value in planning post-War development in the Colonies under British administration, Lord Lloyd referred also to measures which, if less spectacular, should nevertheless have the practical result of assisting them in the initial stages of coping with the difficulties of the present situation. For the moment, action is directed in the main towards keeping up essential supplies in so far as is necessary to avoid war-time distress and to maintain the standard of living. Apart from special forms of assistance, financial and other, this has entailed urging upon the Colonies to grow more and better kinds of food, and in the relation of exports and imports to ensure that cash provided should be turned into essential supplies from outside. In this connexion Lord Lloyd pointed out that, in the past, the Colonies have concentrated too much on the production of some profitable export crop and have relied upon imports for their necessary foodstuffs. His predecessors, he added, for some years past had urged upon Colonial Governments the importance of mixed farming, by which the soil would be enriched and a better balance secured in agriculture. It is to be presumed that no opportunity in the future will be lost to stress the advantages of a policy for which the argument is now so greatly reinforced by the urge of necessity.

Dr. F. B. Jewett

THE resignation of Dr. Frank B. Jewett, president of the National Academy of Sciences, from his post as president of the Bell Telephone Laboratories, Inc., in New York City, has recently been announced. He now becomes chairman of the Board of Directors, and will thus have more time to aid the U.S. Government as a member of the National Defence Research Committee. He will be succeeded as president of the Laboratories by Dr. O. E. Buckley, who has been executive vice-president. For the past twenty-four years, Dr. Jewett has been the operating head of the Bell System's research programme, and since 1930 has been responsible both for the programme and its execution. He will now continue as vice-president of the American Telephone and Telegraph Company, in charge of research, as such retaining his jurisdiction over these activities. Dr. Buckley, new president of the Laboratories, has been associated with telephone research since he entered the Bell System in 1914. He became director of research in 1933 and executive vice-president in 1936 (see also p. 824 of this issue).

Jacob Petersen

DR. JACOB JULIUS PETERSEN, a well-known Danish medical historian, was born at Rönne in the island of Bornholm on December 29, 1840. He studied medicine at Copenhagen, where he qualified in 1865. After a visit to Germany, where he worked under Virchow and Traube in Berlin, he settled in Copenhagen. Besides his activities as a communal doctor he delivered lectures on the history of medicine from 1874 onwards, but it was not until 1887 that he received official recognition as a lecturer, and in 1890 was appointed extraordinary professor of medical history in the University of Copenhagen. His chief publications were on the contagion of tuberculosis (1869), chief factors in the historical development of medical treatment (1876), the older history of clinical medicine (1889), cholera epidemics with special reference to Denmark (1892), Danish medicine in the years 1700–1750 (1893), and small-pox and vaccination (1896). He died on May 28, 1912.

Museums and the Public

THERE is an aspect of museum work and museum service to the community of which little is heard and which nevertheless occupies a considerable part of the duties of the staff and is of some national importance. It concerns minor inquiries of many sorts which can be answered only by a specialist, and the answers to which may be of some value to the inquirers. Some of the miscellaneous economic problems placed before the Department of Botany in the Free Public Museums of Liverpool are instanced by H. Stansfield in an article in the *Museums Journal* (**40**, 215; 1940). A young woman was given a cigarette, collapsed on smoking half of it and remained unconscious for two days. The cigarette had been home-made by a man who used the leaves of a plant growing accidentally in his garden; the botanist identified the plant as Indian hemp, the source of "hashish" ; and the plant had grown from the refuse of a parrot's cage containing remains of a mixture from a chance packet of bird-seed. A point of insurance was decided by the relative inflammability of teff grass and ordinary hay. Questions of adulteration in manufactured chicory, inquiries about possible new sources of iodine, about diseases of bulbs, the qualities of timber for various specific purposes, the control of weeds, the identification of consignments of unrecognized materials, indicate the variety of information which is expected of a museum botanist.

Textile Studies at Leeds

REPORTS on the work of the session 1939–40 in the Departments of Textile Industries and of Colour Chemistry and Dyeing at the University of Leeds show that, although the number of students, particularly of those from overseas, has suffered to some extent and the time-table has had to undergo considerable alteration to meet the special conditions arising out of the War, the work of both Departments has been actively carried on and an impressive list of successes in the examinations of the University and of the City and Guilds of London Institute has been achieved. The degree of Ph.D. was conferred upon three students, one gained the M.Sc. degree and sixteen others graduated with honours. Twelve diplomas were awarded, while no fewer than forty-seven students obtained first class passes in the examinations of the City and Guilds of London Institute, several of them gaining prizes and silver medals. Facilities for work by the students in factories during the vacation, which forms a valuable and highly appreciated part of the training, have of necessity been somewhat restricted though not altogether suspended. In addition to the normal work of the research laboratories, much of which is carried out in co-operation with various firms in different parts of Great Britain, much attention is being devoted to problems of immediate national importance. Research activity has increased in intensity, not merely on account of the War, but also because of the appreciation shown by the industry in their results. A long list of recent publications in scientific journals is appended.

Forest Research Programme at Dehra Dun

THE triennial programme of work, 1940–42, of the Forest Research Institute, Dehra Dun, India (New Delhi: Government of India Press, 1940) gives evidence of the great progress made in this respect in India during the last three decades. When the Institute was inaugurated in 1906–7, the five branches still in force were decided upon, namely: sylvicultural, botanical, entomological, utilization and chemical. Some progressed more rapidly than others, notably utilization, as a result of the War of 1914–18 and the demands then made upon it. The present triennial programme shows, however, that advances in sound forest research have since made uniform progress in all the branches. The brochure is inevitably somewhat technical in many of the inquiries and research being undertaken, but in the sylvicultural branch investigations in various provinces are being carried on into that important subject in tropical forestry 'grazing combined with forestry' ; also into erosion and soil-covering and its effects. The utilization branch has been for long subdivided into wood technology, timber testing, seasoning, wood preservation, paper pulp and wood workshop. Perhaps one of the surprising things about the Institute is that the minor forest products section, which is once again in 'cold storage', as it is expressed, owing to want of staff, has never received the serious attention which it so obviously seemed to demand. It would have been thought that from very early years in the functioning of the Institute, the Department and Government would have realized the enormous possibilities of research into the very large number of minor products of the Indian forests ; lac and resin have already proved the value of experimental research work. It is difficult to understand this neglect.

Riveted Joints and Welded Joints

THE quarterly journal *Electric Welding*, issued by the Quasi-Arc Company, Ltd., Bilston, Staffs., is being discontinued. Advances which may occur in welded construction or technique will be published by distribution of technical circulars or by articles in technical or trade journals. The last issue of the journal (October) contains a paper by Prof. B. P. Haigh entitled "Riveted Joints and Welded Joints", who points out that riveted joints can be relied on to meet all ordinary requirements, provided that the working drawings of the structure provide the necessary scantlings. So firmly established is this faith in riveted joints that almost any failure in a riveted structure is attributed, if not to accident, then to faulty design of the structure as a whole. A riveted structure, if neglected, may be expected eventually to deteriorate by rusting. Water percolates between the plates and forms rust, forcing the plates apart between the rivets. The rivets become tighter for a time but eventually loosen or crack, and the structure falls asunder.

Welded structures may be expected to last longer in such circumstances because overlapping plates or rolled sections can be and commonly are very efficient from the mechanical point of view ; thus channel sections welded back to back and welded all round the overlap, are so strongly joined that the rolled sections yield before the joints. The use of galvanized plates is not recommended either for riveting or welding, where full strength is required, particularly in vibration. At the high temperatures required for either riveting or welding, zinc is liable to penetrate between the grains in the steel, particularly when the metal is under tension, with the result that rivets and welds are then liable to crack in a brittle manner. When welds are made between galvanized plates of fair thickness, it is expedient to grind off the layer of zinc from the surfaces that will carry the fillets ; but grinding is more difficult for riveted joints and is probably impracticable.

Electric Supply in East Africa

THE report of the annual meeting of the East African Power and Lighting Co. in Nairobi, at which Major Ward presided, is now available. Major Ward pointed out that in present circumstances it is not possible to give so much detail as in the past; but as the period since the outbreak of the War has passed with remarkably little change in the conditions in which the Company has been working, it has been able to maintain progress. Results in the East African Territories are largely affected by commodity prices, which were well maintained. The past year had shown considerable increase in the development of secondary industries. In 1939 the rainfall in the Nairobi area was the lowest on record, and the Company found much difficulty in meeting the demand of its consumers, but a supply was maintained until the rains broke. Actually there was a new 1,400 b.h.p. Diesel generator, due for delivery, but the War delayed shipment of the plant, which is the largest generator of this type in East Africa. It arrived in April last. Units sold in Kenya increased from nearly 14 million in 1938 to more than 16 million in 1939. In Tanganyika Territory, the Dar-es-Salaam and District Electric Supply Co. had an increased demand, requiring an additional plant capacity, and a further Diesel set was installed.

Health Conditions in Venezuela

IN a recent paper (*Bot. Ofic. San. Panamer.*, , 962; 1940) Dr. Julio García Alvarez, the Venezuelan Minister of Health and Social Assistance, remarks that the advance in public health in his country in 1939 includes the establishment of milk stations in 11 towns, of maternity hospitals in 10, the founding of a venereal disease dispensary-school, the completion of the Simon Bolivar tuberculosis sanatorium, the establishment of 40 centres by the Yellow Fever Service, and improvements in the national leprosariums and in the system of registering leprosy patients. In the campaign against malaria, 3,500 kgm. of quinine were distributed among 934 towns, and 312,985 treatments were given—two and a half times the number for the previous year. In 1939 the Ministry maintained 37 health units, a health commission, six health bureaux, 64 rural health officers and two port health officers, and its staff included 293 physicians, 14 sanitary engineers, 49 dentists, 43 laboratory workers, 244 inspectors, 294 nurses, 5 veterinarians and 1,237 unclassified employees as compared with 93, 2, 3, 26, 22, 54, 3 and 565 respectively in 1936.

The Night Sky in January

THE moon is full on January 13 at 11h. and new on January 27 at 11h. U.T. No star as bright as mag. 5·0 is occulted during the month. Jupiter and Saturn are in conjunction with the moon on January 7 at 7h. and 12h. respectively; Mars is in conjunction on January 23 and Venus on January 25. Jupiter and Saturn are near the southern meridian in the early evening. Saturn is stationary in its movement among the stars on January 10, after which the planet increases its right ascension very slowly. Jupiter's right ascension is increasing appreciably, thus bringing the two planets more closely together in the sky until the middle of February (conjunction on February 20 at 19h.). Jupiter's four inner satellites may be seen grouped most closely together at 20½h. on January 1, 4 (all eastwards), 11, 17 (all westwards), 19, 25 and 28. They will be seen widely grouped on January 8, 9, 13 and 31 (all westwards). Saturn's ring system is well presented for observation. Mars and Venus are both morning stars, the former predominantly bright in the morning skies before dawn. Clear evenings in January and February are associated with the brilliant assembly of stars attendant upon Orion. The Milky Way in this part of the sky is much fainter and less interesting than along its stretch visible during autumn evenings. During January, the night—sunset to sunrise—shortens by 1·2 hours in the latitude of London.

Announcements

DR. JEAN RAYNAL, director of the Pasteur Institute of Shanghai, has been awarded the French Commission Gold Medal in recognition of his work.

A CENTRAL institute for the investigation of foodstuffs is being erected at Utrecht to be in close association with the Institute of Hygiene.

THE second Pan-American Congress of Endocrinology will be held at Montevideo during March 5–8. 1941. Further information can be obtained from Dr. Pedro A. Barcia, Casilla de Correo 255, Montevideo,

COMPULSORY examination of students at the University of Budapest has shown that about 50 per cent are suffering from diseases such as nephritis, heart disease, tuberculosis, syphilis, etc., without knowing it.

IN 1934 the United States had only a little more than 5,000 cases of smallpox. Since then there has been a rapid increase. In 1937 there were 11,673 cases and in 1938 about 15,000. These figures indicate that, with the exception of India, smallpox is more prevalent in the United States than in any other country in the world.

THE Lac Research Laboratory of the London Shellac Research Bureau is removing from the Ramsay Laboratories, Chemical Engineering Department, University College, London. Inquiries should be sent to Mr. A. J. Gibson, India House, Aldwych, London, W.C. 2.

University of Birmingham: Air Raid Damage

INCENDIARY bombs have fallen on the buildings and in the grounds but the damage done was negligible. A part of the old building in the city which used to be the Department of Anatomy has been demolished.

The rooms of the Birmingham Natural History and Philosophical Society, which contained historic apparatus and a library of 8,500 volumes, have been totally destroyed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

An Enzyme from Bacteria able to Destroy Penicillin

FLEMING[1] noted that the growth of *B. coli* and a number of other bacteria belonging to the coli-typhoid group was not inhibited by penicillin. This observation has been confirmed. Further work has been done to find the cause of the resistance of these organisms to the action of penicillin.

An extract of *B. coli* was made by crushing a suspension of the organisms in the bacterial crushing mill of Booth and Green[2]. This extract was found to contain a substance destroying the growth-inhibiting property of penicillin. The destruction took place on incubating the penicillin preparation with the bacterial extract at 37°, or at room temperature for a longer time. The following is a typical experiment showing the penicillin-destroying effect of *B. coli* extracts. A solution of 1 mgm. penicillin in 0·8 c.c. of water was incubated with 0·2 c.c. of centrifuged and dialysed bacterial extract at 37° for 3 hours, in the presence of ether, and a control solution of penicillin of equal concentration was incubated without enzyme for the same time. (The penicillin used was extracted from cultures of *Penicillium notatum* by a method to be described in detail later. It possessed a degree of purity similar to that of the samples used in the chemotherapeutic experiments recorded in a preliminary report[3].) The growth-inhibiting activity of the solutions was then tested quantitatively on agar plates against *Staphylococcus aureus*. The penicillin solution incubated with the enzyme had entirely lost its growth-inhibiting activity, whereas the control solution had retained its full strength.

The conclusion that the active substance is an enzyme is drawn from the fact that it is destroyed by heating at 90° for 5 minutes and by incubation with papaïn activated with potassium cyanide at *p*H 6, and that it is non-dialysable through 'Cellophane' membranes. It can be precipitated by 2 volumes of alcohol, but much of its activity is lost during this operation. The activity of the enzyme, which we term penicillinase, is slight at *p*H 5, but increases considerably towards the alkaline range of *p*H. It is very active at *p*H 8 and 9. Higher *p*H's could not be tested as penicillin is unstable above *p*H 9.

The mechanism of the enzymatic inactivation of penicillin is being studied. No oxygen uptake occurs during the reaction, and the inactivation proceeds with equal facility under aerobic and anaerobic conditions. No appearance of acid groups could be detected by *p*H measurement with the hydrogen electrode. Extracts of a number of other micro-organisms, made by crushing the bacteria in the bacterial grinding mill, were tested for penicillinase. The enzyme was absent from extracts of the penicillin-sensitive *Staphylococcus aureus*, of yeast and of *Penicillium notatum*. It was present in a Gram-negative rod, insensitive to penicillin, found as a contaminant of some Penicillium cultures. Unlike *B. coli*, it was not necessary to crush the organism in the bacterial mill in order to obtain the enzyme from it; the latter appeared in the culture fluid. The enzyme was also found in *M. lysodeikticus*, an organism sensitive to the action of penicillin, though less so than *Staphylococcus aureus*. Thus, the presence or absence of the enzyme in a bacterium may not be the sole factor determining its insensitivity or sensitivity to penicillin.

The tissue extracts and tissue autolysates that have been tested were found to be without action on the growth-inhibiting power of penicillin. Prof. A. D. Gardner has found staphylococcal pus to be devoid of inhibiting action, but has demonstrated a slight inhibition by the pus from a case of *B. coli* cystitis. The bacteriostatic action of the sulphonamide drugs is known to be inhibited in the presence of tissue constituents and pus.[4] That the anti-bacterial activity of penicillin is not affected under these conditions gives this substance a definite advantage over the sulphonamide drugs from the chemotherapeutic point of view. The fact that a number of bacteria contain an enzyme acting on penicillin points to the possibility that this substance may have a function in their metabolism.

E. P. ABRAHAM.
E. CHAIN.

Sir William Dunn School of Pathology,
Oxford.
Dec. 5.

[1] Fleming, A., *Brit. J. Exp. Path.*, **10**, 226 (1929).
[2] Booth, V. H., and Green, D. E., *Biochem. J.*, **32**, 855 (1938).
[3] Chain, E., Florey, H. W., Gardner, A. D., Heatley, N. G., Jennings, M. A., Orr-Ewing, J., and Sanders, A. G., *Lancet*, 226 (1940).
[4] MacLeod, C., *J. Exp. Med.*, **72**, 217 (1940).

Morphological Effects of Penicillin on Bacteria

WHILE working with Chain, Florey and others on the inhibition of bacterial growth by penicillin[1], I noticed that concentrations of less than full inhibiting power caused a change in the appearance of the growth of *Cl. welchii* in fluid media. The normal uniform turbidity was replaced by a flocculent growth with a heavy deposit. Microscopical examination showed an extreme elongation of the majority of the cells, which took the form of unsegmented filaments ten or more times longer than the average normal cell.

I have now examined a number of bacteria grown in broth or serum broth with penicillin, and I have found similar microscopical changes in all the rod-shaped organisms that have shown any inhibition. These changes may be traceable, in the form of a distinct average lengthening of the cells, to a dilution eight or ten times, and even sometimes thirty times, higher than that which completely inhibits growth.

The Gram-negative rods, which are relatively resistant to penicillin, show the effect very well. Thus in *S. typhi*, which was completely inhibited by a 1 in 1,000 concentration, almost completely by 1 in 2,000, and partially by 1 in 4,000, an elongation of the cells, which was enormous at these two latter dilutions, could still be detected at 1 in 32,000. *Vib. choleræ*, which was inhibited only slightly at 1 in 1,000, growing as immense swollen filaments, showed appreciable lengthening up to 1 in 8,000. Similarly with the Salmonella group, *Bact. coli* and other Gram-negative rods, which often showed grotesque giant-forms due to the autolytic swelling and frequent bursting of elongated cells.

The changes are similar to and at least as great as those figured by Ainley Walker and Murray[2] in their experiments on the effect of methyl-violet and other dyes on the typhoid-coli group of bacteria.

The growth of *Brucella melitensis* and *abortus* is not inhibited by penicillin at 1 in 1,000, the strongest solution tested ; nor is there any enlargement of the cells. But a vacuolation of the majority of them was seen in both species at 1 in a few thousands, and in *Br. abortus* this effect could be decreasingly traced right down to 1 in 300,000. It does not, however, seem likely that such a minor disturbance can be of great importance.

Gram-positive organisms, which are in general a good deal more sensitive to penicillin than the Gram-negative rods, show similar phenomena. For example, *Cl. welchii*, which was completely inhibited at 1 in 60,000, showed considerable filament-formation right up to 1 in a million and a half. In *Bac. anthracis* the corresponding figures were about 30,000 for total inhibition and 300,000 for lengthening.

With the Staphylococci the morphological change takes the form of spherical enlargement of the cell and imperfect fission, easily detectable at dilutions four to eight times higher than the completely inhibitory dilution, which, with a very small inoculum, may be as high as 1/800,000.

Streptococcus pyogenes, an extremely sensitive species, showed great swelling of the cells, incomplete fission with formation of large spinoles, and increased length of chains. This occurred at dilutions at least four times higher than the completely inhibiting dilution, which was 400,000. The growth was deposited, leaving a clear supernatant fluid. Several appearances were seen in *Str. viridans* at 1 in 50,000, though growth was completely inhibited at only 1 in 4,000.

I have not been able to see any morphological effect on the Meningococcus, though it is inhibited by penicillin at 1 in 50,000.

An observation by R. Tunnicliff[3] on the action of sulphanilamide on *Streptococcus viridans* probably points to a similar phenomenon. She found that the drug causes the coccus to form more and longer chains and to grow in granular form in fluid media. This change she considers to be in the direction of roughness, and adds that it "appears to make the Streptococci more phagocytable".

Thus it seems that toxic dyes, the atoxic penicillin and probably sulphanilamide cause similar morphological changes at incompletely inhibitory concentrations, and that the changes are mainly due to a failure of fission. Growth proceeds, but division and separation do not follow in due course. Many cells then fall victim to autolysis.

If the bacteria, as Tunnicliff suggests in the case of sulphanilamide, are thereby reduced in virulence, the chemotherapeutic agent can be expected to exert some action *in vivo* at concentrations much lower than those needed for complete inhibition of growth.

It should be noted that penicillin is not yet a pure substance, so that the figures given must be taken with considerable reserve.

A. D. GARDNER.
Sir William Dunn School of Pathology,
University of Oxford.
Dec. 10.

[1] *Lancet*, 226 (1940).
[2] *Brit. Med. J.*, 2, 16 (1904).
[3] *J. Inf. Dis.*, 64, 59 (1939).

Para-Amino Benzoic Acid as a Bacterial Growth Factor

THE mode of action of sulphanilamide has been the subject of much recent work. Possibly the most precise contribution has been Woods's discovery of the anti-sulphanilamide effect of *p*-amino benzoic acid ('p.a.b.'). In a discussion of this work, Fildes[1] has suggested that 'p.a.b.' might be considered an essential metabolite for bacteria. It is now inferred that sulphanilamide inactivates an essential co-enzymic grouping of the susceptible organism[1,2], and in view of Woods's work, this grouping is most probably 'p.a.b.'. Before this hypothesis of sulphanilamide action can be widely accepted it remains to be proved that 'p.a.b.' is essential for the growth of organisms inhibited by the drug.

Previous work by Brown *et al.*[4] on the growth requirements of the butyl alcohol - acetone organism, *Clostridium acetobutylicum*, has shown that thiamin, riboflavin, tryptophane, nicotinic acid, pimelic acid, pantothenic acid, alanine and uracil, are unable to stimulate growth in synthetic media. More recently Weizmann[5] (1939) has stated that biotin was essential for the growth of this organism.

In our earlier work on the isolation of the growth factor for *Cl. acetobutylicum* a yeast concentrate was prepared which supported growth of the organisms in a concentration of 2×10^3 μgm. per ml. of a basal medium of the following composition : asparagine 0·1 per cent, glucose 2·0 per cent, KH_2PO_4 0·5 per cent, K_2HPO_4 0·5 per cent, $MgSO_4$ 0·2 per cent, NaCl 0·1 per cent, $FeSO_4 . 7H_2O$ 0·01 per cent, $MnSO_4 . 4H_2O$ 0·01 per cent, in distilled water.

Thirty kgm. of brewer's yeast (wet) yielded 750 mgm. of yeast concentrate by a procedure too lengthy to describe in this communication. An ether extract of this concentrate was evaporated, benzoylated, and the product (recrystallized five times from alcohol), was identified as *p*-benzoyl-amino benzoic acid, m.p. 277° C., yield 2 mgm. In Table 1 are recorded the results of experiments condensed from the study of nine species of *Cl. acetobutylicum*, of which seven were isolated in this laboratory and two were obtained from the American Type Cultures Collection Nos. 862 and 4259. Growth has only been recorded as positive when the test medium gave growth in five successive subcultures.

From Table 1 the following conclusions may be drawn :

(1) *p*-amino benzoic acid and its derivatives act as growth factors for *Cl. acetobutylicum*.

(2) *p*-amino benzoic acid can be recovered from a yeast concentrate factor as the benzoyl derivative.

(3) Removal of *p*-amino benzoic acid from the yeast concentrate removes its growth factor activity.

Table 1.

Growth Factors for *Cl. acetobutylicum* and related substances.

Substance	Amount of substance per ml. of basal synthetic medium					
	2×10^{-5} μ gm.	2×10^{-4} μ gm.	2×10^{-3} μ gm.	2×10^{-2} μ gm.	2×10^{-1} μ gm.	2 μ gm.
1. Yeast concentrate	−	−	+	+	+	+
2. Yeast concentrate (after ether extraction)	−	−	−	−	−	−
3. *p*-benzoyl amino benzoic acid (from yeast concentrate)	−	+	+	+	+	−
4. *p*-amino benzoic acid	+	+	+	+	+	−
5. *m*-amino benzoic acid	−	−	−	−	−	+
6. *o*-amino benzoic acid	−	−	−	−	−	+
7. Novocaine	−	+	+	+	+	−
8. Sulphanilamide	−	−	−	−	−	−

Growth +, no growth −

A comparison of these results with the anti-sulphanilamide tests of Woods reveals a remarkable correlation. In this work the growth factor activity is: *p*-amino benzoic acid $6\cdot8 \times 10^{-8}$ *M*., novocaine $1\cdot2 \times 10^{-8}$ *M*., *ortho* and *meta* amino benzoic acid probably inactive. In regard to Weizmann's statement, it is presumed that his biotin, which stimulated growth, contained *p*-amino benzoic acid.

The bacteriostatic action of sulphanilamide on growth was determined by subculturing the organisms in the basal medium containing varying quantities of 'p.a.b.' and constant amounts of sulphanilamide. The results recorded in Table 2 confirm Woods's findings[6] on the anti-sulphanilamide action of 'p.a.b.' They also illustrate how it is possible to titrate the two antagonists using growth as the end point.

Table 2.

Titration of *p*-amino benzoic acid against sulphanilamide.

Concentration of sulphanilamide	Amount of *p*-amino benzoic acid per ml. of basal medium					Molecular ratio 'p.a.b.' : sulphanilamide
	5×10^{-3} μ gm.	1×10^{-3} μ gm.	2×10^{-3} μ gm.	3×10^{-3} μ gm.	4×10^{-3} μ gm.	
$\frac{M}{1,650}$	−	−	−	−	−	23,000
$\frac{M}{3,300}$	−	−	+	+	+	23,000
$\frac{M}{6,600}$	−	+	+	+	+	23,000

Growth +, no growth −.

On the basis of the above figures one molecule of 'p.a.b.' antagonizes 23,000 molecules of sulphanilamide. This tremendous disproportion between these two antagonistic reagents makes it difficult to conceive how the growth activator 'p.a.b.' can overcome the effect of the growth inhibitor (sulphanilamide) if the two molecules are destined towards the same receptor site on the organism. The chances of the activator making first contact seem fairly remote when considered from a physico-chemical point of view.

Sydney D. Rubbo.
J. M. Gillespie.
University of Melbourne.
Oct. 22.

[1] Fildes, *Lancet*, 1, 955 (1940).
[2] Stamp, *Lancet*, 11, 10 (1939).
[3] Green, *Brit. J. Exp. Path.*, 21, 38 (1940).
[4] Brown, Wood and Werkman, *J. Bact.*, 38, 631 (1939).
[5] Weizmann, *Biochem. J.*, 33, 1376 (1939).
[6] Woods, *Brit. J. Exp. Path.*, 21, 74 (1940).

Chromosome Diminution in a Plant

The genus Sorghum consists of two groups. Eu-Sorghum includes the tetraploid millet species and an octoploid fodder species[1]. Para-Sorghum includes only diploid species ($n = 5$) which are not cultivated. One of these is *S. purpureo-sericeum*, from the Sudan, in which I have described plants with varying numbers of extra chromosomes. These chromosomes I supposed to be inert[2].

I now find from meiosis in the pollen mother cell that, amongst a wild 1931 collection of seeds given me by Mr. C. E. Hubbard of Kew, 40 out of 100 had these extra chromosomes (Table 1).

Table 1.

Plants with *B* chromosomes in *Sorghum purpureo-sericeum*.

No. of *B*'s	0	1	2	3	4	5	6	Total
Total plants	60	12	20	5	1	1	1	100
Tested in roots	—	8	7	2	1	1	1	20

Thus there appears to be the same kind of distribution of extra *B* chromosomes in the natural population of this species as occurs in certain cultivated varieties of maize[3]. Again as in maize, these *B* chromosomes do not pair at meiosis with the five ordinary members of the complement. They have, therefore, lost all effective relationship with the active chromosomes, alongside which they must have maintained a separate existence for a great time.

That these chromosomes are in some respects active, and disadvantageously active, is shown by the proportion of healthy pollen (from 500 grains each) in plants having different numbers of *B*'s (Table 2). Their long maintenance in the species therefore demands that they have certain compensating advantages for the plant.

Table 2.

Effect of *B*'s on Average Pollen Fertility.

No. of *B*'s	0	1	2	3
No. of Plants	6	3	5	2
Good pollen	93·6%	83·6%	63%	11·5%

From mitosis in the root-tips, however, a new and remarkable property of these *B* chromosomes appears. Twenty plants having *B*'s in the pollen mother cells were examined. None had *B*'s in the roots. All had the ordinary chromosome complement of 10 (second line, Table 1).

Re-examination of the flower-tissues of these plants showed the presence of *B*'s at metaphase of mitosis. The resting cells also frequently contained small extra nuclei, which had doubtless arisen from lagging *B*'s. Since these chromosomes are maintained in the tissue, it seems that the extra nuclei must rejoin their companions during mitosis in the flower parts. In the early growth of the roots, on the other hand, they must be lost.

Now irregularities (attributed to a deficient centromere) have often been found in the mitotic movements of extra chromosomes, but never before has a regular loss of such chromosomes been recorded in a particular tissue of a plant. The case at once recalls the well-known *diminution* of chromosomes in Ascaris and, still more forcibly, the exclusion of certain 'sex-limited' chromosomes from the somatic line in Sciara[4].

The further study of these highly controlled chromosomes is therefore likely to throw light on the physiology and mechanics of the more elaborate and more abstruse systems of chromosome diminution found in animals.

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John Innes Horticultural Institution,
Merton Park, London, S.W.19.
Nov. 26.

[1] Hunter, A. W. S., *Canad. J. Res.*, **11**, 213–241 (1934).
[2] Janaki-Ammal, E. K., *Curr. Sci.*, (1939).
[3] Darlington, C. D., and Upcott, M.B. (1940). *J. Genet.* (in the Press).
[4] Metz, C. W., *Amer. Nat.*, **72**, 485–520 (1938).

Compression of Cylinders of Soft Materials

SOME time ago, we proposed an equation[1] to describe the behaviour of soft bodies under compression, with special reference to the compression of cylinders. Whereas for a true fluid we have $\eta = s\sigma^{-1} t^1$, and for an elastic solid $n = s\sigma^{-1} t^0$; we proposed for 'intermediate' materials

$$\psi = s\sigma^{-1} t^k$$

where s is shearing stress, σ is shearing strain calculated by the logarithmic formula, t is time of compression, η is viscosity, n is shear modulus, and ψ was described as the "firmness" and k as "a measure of elasticity", though we should no longer care to use the latter expression, since such properties as work-hardening and dilatancy would reduce k without increasing the elastic recovery.

This equation obviates the difficulties, both practical and theoretical, involved in attempting to divide σ into two parts, recoverable and non-recoverable, in order to calculate η and n for such materials.

In a later paper[2], psychological experiments were described which we believe to justify the use of ψ as a criterion of firmness, in spite of, or rather because of, its peculiar physical dimensions. In neither paper was it possible to give any data to test the equation, nor was it claimed that ψ and k would be expected to be constants for all materials independent of stress and strain conditions. It was, however, hoped that the new treatment would prove simpler than the classical analysis, in which very complex variations in η and n with varying stress and strain conditions and histories are to be found[3].

A direct test of the equation has now been made possible as a result of the design and construction by Dr. P. White and Mr. J. Cotton of an apparatus, to be described shortly, in which cylinders can be loaded in such a way that the load increases proportionally to the change in cross-section of the cylinder, the value of s thus remaining constant throughout the compression.

Under these conditions, the equation may be written :

$$\log \psi = k \log t - \log \sigma + \text{const.} ;$$

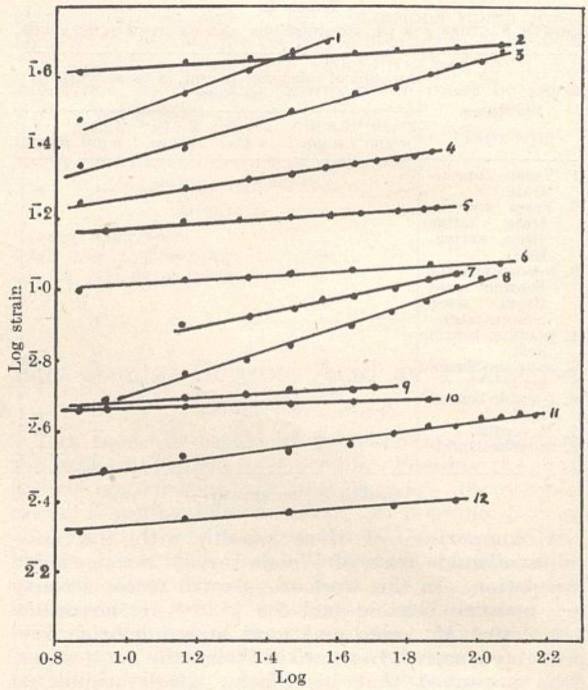
or, in the case where the log σ/log t curves are linear :

$$\log \psi = k - \log \sigma_{10} + \text{const.},$$

where σ_{10} is the strain produced in 10 sec.

In view of the principle underlying Fechner's law, it seems not unlikely that 'firmness' as judged subjectively may be related directly to log ψ, and for this reason as well as because the logarithmic values are easier to handle, we prefer to keep the data in the logarithmic form.

The new instrument was designed for experiments with cheese and butter, so that the stress range available is somewhat limited, but it has been possible to test, at a constant temperature of 60° F., a number of very varied materials, curves for some of which are shown in the accompanying graph. The log σ/log t curves are remarkably linear, except perhaps at very small strains, where measurements are, in any event, decidedly inaccurate.



No.	Material	Radius	Shearing stress	Log ψ	k
1.	Worked butter	1·5 cm.	58,260 dyne cm.$^{-2}$	5·61	0·35
2.	Wet clay soil	1·0	131,100	5·53	0·035
3.	Rested butter	1·5	58,260	5·67	0·28
4.	Cake	1·0	102,500	5·89	0·14
5.	Acrylic acid polymer	1·0	192,600	6·18	0·06
6.	Mod. wet clay soil	1·0	131,100	6·17	0·055
7.	Cheddar cheese	1·0	131,100	6·47	0·20
8.	Stale bread	1·5	58,260	6·40	0·325
9.	Apple (flesh)	1·0	192,600	6·66	0·055
10.	Potato	1·0	192,600	6·66	0·035
11.	Plasticine-rubber Vaseline mixture	1·0	192,600	6·93	0·14
12.	Dry clay soil	1·0	131,100	6·86	0·07

Experiments with cylinders of Californian bitumen, which approximates very closely to truly fluid behaviour, indicate that the instrument is compensating correctly for the change in cross-section, unless exceptionally small loads are used. The only case where this error is likely to be just significant is for No. 4, but the curve is shown because of its intrinsic interest.

Our views as to the significance of k have altered in the light of experience with the apparatus. This will be discussed when the experiments are described more fully elsewhere.

G. W. SCOTT BLAIR
F. M. VALDA COPPEN.
National Institute for Research in Dairying,
University of Reading. Nov. 25.

[1] Scott Blair, G. W., and Coppen, F. M. V., *Proc. Roy. Soc.*, B, **128**, 109 (1939).
[2] Scott Blair, G. W., and Coppen, F. M. V., *Brit. J. Psychol.*, **31**, 61 (1940).
[3] Schofield, R. K., and Scott Blair, G. W., *Proc. Roy. Soc.*, A, **138** 707, (1932); **139**, 557 (1933); **141**, 72 (1933); **160**, 87 (1937.)

AN IRON AGE SETTLEMENT IN SOUTHERN BRITAIN*

THE aim of the excavation of the site of Little Woodbury, Wilts, was to uncover the settlement systematically and discover as much about it as possible as a social and economic organism. Little Woodbury being typical, its excavation throws light upon a number of similar sites. Excavations were carried out in the periods June 12–September 18, 1938, and June 12–July 19, 1939. Examination of the site has not yet been completed, but further work has been interrupted by the War.

The settlement lies 1¼ miles west-south-west of Salisbury Cathedral, on low hills between the Avon and Ebble at about 270 ft. above sea-level. It is situated in a kind of plain of which the highest point is the middle of the site. Four hundred metres to the west is the larger settlement, to which the name of Woodbury has been given. In 1938, 4,500 sq. metres of the site were uncovered, and in 1939 a further 2,500 sq. metres. The traces of prehistoric occupation all belong to Iron Age *A2–AB*, which is regarded as extending over the period from the beginning of the third century B.C. into the first century B.C. The traces of occupation consist of ditches, pits, hollows, and post holes. Finds are few in number, suggesting that the settlers were not numerous, but the nature of the finds shows that the settlement was thoroughly agricultural in character, although the animals' bones indicate that the settlers carried on cattle rearing. There is no sign of industrial activity beyond what was necessary to supply the individual need of each, as for example in weaving. Slag points to the visits of wandering smiths. There is no evidence of any wealth of imported goods.

From the traces of occupation in the form of ditches, pits, hollows, and post holes, of which the examination is described in detail, certain inferences can be drawn. In the area enclosed by the ditches, about a hundred pits have been uncovered up to the present. They vary very much from one to another in form, and some clearly being later than others, obviously were not all in use at one time. In depth they range from 0·49 metres to 2·98 metres. After they had been in use for a time, the pits were filled in, the filling including fragments of chalk, burnt and unburnt flint, ash, potsherds, bones, food refuse, saddle querns and sandstone grinders, iron-slag, smaller objects of everyday use, and cob fragments which had been parts of ovens. From the uses of analogous subterranean receptacles elsewhere and at other times, it is inferred that these pits were used as granaries for the storage of corn, probably roasted previously. The shallower pits may have served to receive receptacles in which water had been stored.

Eleven isolated hollows, in form an irregular quadrangle, with steep or sloping edges and a level floor, were found within the enclosure. In depth they never exceeded a metre, while in size they varied from 10 m. to 24 m. They are dug out on a uniform principle. They were not used for dwelling places, and probably served some purpose in connexion with the harvest, just as in Upper Egypt to-day the women of the villages sit in similar pits to prepare the fruits of the harvest for storage.

The post holes indicate the ground plan of two houses, of which one, the farmstead, shows evidence of reconstruction, and probably represents an advanced stage of development of a primitive prototype in which a circle of huts with lean-to roofs served individual functions belonging to the farmstead. Other post holes, it is inferred, served as drying frames or racks, square granaries, and storehouses.

Each of these elements of the settlement existed over a long period (200–300 years); but while some such pits and work places were short-lived, others, like the houses, were long-lived. No large number of houses existed at the same time. Consequently, the settlement was not a village. Probably there was no more than one dwelling-house at any one time. It follows that this was a farm, with auxiliary buildings necessary for farm work, in which habitation was continuous. No water supply was near, and dependance on water collected from the roof makes it probable that no more than one family occupied the house.

The water deficiency also points to husbandry, rather than cattle farming, as the staple occupation. The open situation of the farm points to peaceful conditions at the time of its erection. The narrow entrance to the palisade precludes the use of carts or the quick driving in of large stocks of cattle, while the decorative gate-building has no military value. Later, however, there was sudden interruption to this state of peace, and it was necessary to provide powerful defences for the farm. The work was never completed, and the palisade again became adequate.

The excavation at Little Woodbury has thrown a flood of light on a large number of other settlements of the same age previously excavated. It is one of a series of farm settlements, not previously recognized as such, which all suffered the same fate and generally enjoyed a uniform civilization. It is calculated that round about twenty acres would represent the land requirements of such a farm, and it is no matter for wonder that these farms should be found lying comparatively close together.

In Woodbury one type only of Iron Age settlement has been established; but its existence presupposes other types. The settlements of the builders of the hill-forts have not yet been determined. Yet the erection of the hill-forts implies a strongly organized and relatively numerous community. Manifestly the people of the farms were too few to have been responsible for them. Their settlements must be sought on the lower slopes in proximity to water to serve both themselves and the relatively large stocks of cattle for which presumably such spacious hill-forts were erected.

All Cannings Cross, Wilts, seems to have been a village on a slope, a situation unusual for this part of the country. Though little of the settlement has been excavated, it is evidently considerably more extensive than the farm. Its inhabitants lived primarily by husbandry.

* *Proc. Prehist. Soc.*, N.S. **6**, 1 (1940). Excavation at Little Woodbury, Wilts.: The Settlement as Revealed by Excavation. By Gerhard Bersu.

The Iron Age *A*2–*AB* hill forts which were completed when excavated reveal the same civilization as the folk who inhabited other settlements marked by pits. The pits, however, are far too few to suggest that such hill-forts were either constantly inhabited *oppida* or concerned with urban civilization and industry. They were only built and inhabited for a short time during periods of unrest. On the other hand, both boundary ditches and hill-forts lead us to presuppose a substantial agricultural population living outside the farms in open settlements on low ground and on slopes close to water. In such settlements lived the greater part of the agricultural Iron Age *A*2–*AB* population.

ELECTRIC TUNNEL KILNS FOR FIRING PORCELAIN

IN *Electrotechnics,* the journal of the Electrical Engineering Society of the Indian Institute of Science, Bangalore (S. India), of September, there is published an instructive paper by H. N. Ramachandra Rao, of the Government Porcelain Factory, Bangalore, discussing the use of an electric tunnel kiln for firing porcelain.

Until recently, the discontinuous coal-fired kiln, known as the round kiln, was generally used for firing hard porcelain. This type of kiln has certain inherent defects and demands great skill in handling. The coal used for such a kiln should have a high calorific value and must be free from impurities.

In using these round kilns, the ware is kept in saggars (refractory containers) which prevent the ware from direct contact with the flames, provide for economic filling and keep the ware free from strain. To obtain the maximum temperature of 1,350° C. takes about 36 hours and the kiln has to cool for an additional 48–60 hours before being unloaded.

An important factor that enters into the correct firing of porcelain is the composition of the flue gases. In the round kiln it is very difficult to control the composition of the gases within desired limits on account of the unavoidable contamination or oxidation which takes place owing to the leakage of air into the kiln through combustion devices and holes or cracks that develop in a structure made of brick and fireclay when subjected to repeated heating and cooling. Besides, it is practically impossible to get a uniform distribution of heat inside this type of kiln.

The thermal efficiency of the kiln is very low, about 5–10 per cent, chiefly due to the wastage of heat from the hot gases, which are allowed to escape to the atmosphere at a high temperature. The working cost of such a kiln is again influenced by high labour charges, total holding capacity of the building and high cost of saggars.

These difficulties were to a great extent overcome by the introduction of fuel-fired tunnel kilns which are in more general use at present. There are two types of tunnel-kilns which are suitable for firing hard porcelain. In one type the products of combustion mingle with the ware; the most modern example is the Harrop kiln. The other is of muffled type, and is known as the Dressler kiln. The fuels in general use are natural gas or oil, and they are introduced with a small amount of air through highly refractory burner tubes. The tunnel is provided with a series of fire-places or gas burners on both sides and the goods to be fired are made to enter it on a chain of cars. The hot gases pass along the tunnel towards the end at which the goods enter, so that the ware is gradually heated as it passes towards the hottest part of the kiln. After having attained the maximum temperature required the ware travels on through the remainder of the tunnel, meeting in the journey a current of air travelling in the opposite direction. This air is heated by the cooling goods and gradually attains the maximum temperature of the kiln, thus ensuring the greatest efficiency of combustion. The goods on leaving the tunnel are almost cold.

The tunnel is built almost entirely of brick; low-grade fire bricks are used in the zones of low temperature, and silica or carborundum bricks in the high temperature zone. Suitable expansion joints are provided in the structure. The draught which supports combustion is provided by an exhaust fan.

Although the fuel-fired tunnel kiln is an improvement on the round kiln, it has certain drawbacks which can be eliminated by using the electric tunnel kiln. When the tunnel kiln is fuel-fired, the incoming ware is dependent for its preheating upon the outgoing combustion gases, which heat the upper portions of the ware more than the lower. This not only makes an even rate of preheating over a given cross-section practically impossible, but also limits the rate of preheating to the speed at which the coldest portion becomes sufficiently hot to advance into the high-temperature zone. In the case of an electric tunnel kiln, on the other hand, the absence of moving atmosphere makes an easier recuperation possible in a continuous operation by having two lines of the ware in the same or adjacent tunnels moving in opposite directions. Owing to the greater ease of control in temperature and atmosphere the electric kiln yields first-class ware of a uniformity which cannot be obtained in a fuel-fired kiln. In spite of these advantages the progress made in the use of electricity has been very slow on account of the high cost of electric power. In America especially the general opinion is that electricity cannot compete with such low-priced fuels as oil or natural gas. The use of electricity for heating at low temperature (up to 1,000° C.), for example, in decorating or enamelling kilns was introduced into Switzerland and Germany fifteen years ago.

After extensive research work and experimentation a number of electric tunnel kilns have been installed in Switzerland (since 1933) for the glazing of wall tiles, and for firing fireclay, soft porcelain and other goods requiring temperatures up to 1,300° C. The first kiln for firing hard porcelain was put into operation at the Langenthal Factory in Switzerland in August 1937 and was constructed by Messrs. Brown, Boveri. The main novelty of this kiln, apart from the high temperature of 1,400° C., is that part of the firing is conducted under a reducing oven atmosphere. Above 1,000° C. the heating must be done under reducing conditions, as otherwise the small amounts of iron always present in the raw materials cause a yellowish-brown discoloration with a lowering of the transparency of the body mixture.

The Langenthal kiln is about 100 metres long with two tunnels, one for biscuit firing at 900° C. and the other for sharp firing at 1,400° C. The working experience of this kiln shows that apart from the smaller maintenance charges and high percentage of first-class ware obtainable, the savings in saggars is much more than the replacement charges on the elements. The writer concludes by saying that the success of the electric kilns can only be based on a proper combination of electrical engineering and ceramic knowledge.

VIBRATION OF PROPELLER BLADES

EARLY in 1936, at the instigation of the National Physical Laboratory, the Singing Propeller Committee of the Institution of Naval Architects included among other recommendations in its report a proposed research on "the manner in which typical blades vibrate and the effect on vibration characteristics of changes in shape, thickness, etc." Some two years later the research was approved by the Advisory Committee of the William Froude Laboratory.

One of the difficulties involved in the discussion of vibrating propellers has been the absence of any experimental knowledge of the modes of vibration of propeller blades. A few experiments were made by Mr. Harry Hunter, using a shaped flat plate of uniform thickness which was set in motion by 'bowing' it. This gave some patterns, but not frequencies. Tests with a single propeller blade having a flat driving surface have recently been published by Kerr, Shannon and Arnold. As before, the blade was held in a vice and vibrated by bowing the edge. Frequencies measured by tuning fork and mono-chord are given with their diagrams.

The method adopted to vibrate the blades in the present experiments was devised in conjunction with the Physics Department of the National Physical Laboratory, the apparatus being made and the experiments being carried out by E. J. Evans of that Department.

The model propellers were one foot in diameter, made with two blades on a heavy boss 2·25 in. in diameter and 3·2 in. in length. The blades were made flat on the driving face, which was in a horizontal plane when secured to the base plate by a 1·25 in. diameter bolt and nut. The propeller plates were made flat on the driving face, which was in a horizontal plane when secured to the base plate. The method of exciting vibration of the blades was by an electromagnet with its pole tips just above the blade surface. The pole tips were about $\frac{1}{8}$ in. square and $\frac{1}{8}$ in. apart, so that the exciting force was applied over a small area of the blade. The magnet could be moved horizontally over the whole surface of one blade. It was supplied with alternating current from a beat-tone oscillator and amplifier. The frequency could be varied continuously over a range of about 50–11,000 cycles per second. In addition to the alternating current, the magnet was supplied with direct current through a separate pair of coils. In this way the magnet produced an alternating field of known frequency superimposed on a direct field.

To find the resonant frequencies of the propeller, fine sand was sprinkled on the upper surface of the blades, and the exciting current was slowly varied through a given and known range of frequency. The resonance frequencies were detected by the loudness of the note emitted by the propeller, and by the sand on the blades taking a definite pattern, the sand usually moving towards the nodal regions. The magnet was moved about the blade in the tip region until the clearest diagram had been obtained on the blade under the magnet and the most intense note had been found. The frequency was then noted, the magnet removed, its position marked by a black dot, and a photograph of the sand pattern taken. A wide selection of these photographs are used to illustrate the paper.

Since the work was undertaken with a general idea of the results being applied to the problem of the singing propeller, it was desirable to know the range of frequencies which need to be studied for this purpose. The noise (if any) made by a bronze propeller about 18 ft. in diameter, propelling a ship in smooth water, is either a low-pitched hum with beats in it proportional to the number of blades and a frequency varying from 200 cycles per second to a somewhat higher figure ; or a grinding noise or grunt with a maximum once per revolution of propeller, the major tone of which may vary from 200 to 300 c.p.s. Either or both of these may be present.

There are two principal modes of vibration which need to be considered, namely, (1) that in which the blade tip as a whole moves perpendicularly to the blade surface, which is referred to as flexural, and (2) that in which the blade twists from the boss about a more or less central line lying on its surface, referred to as torsional. Formulæ for a blade of parabolic outline, obtained by Conn, are given for these two kinds of vibration.

Although the two blades of any propeller were made alike within the normal limits of error for model work, it was found that actually they had slightly different resonant periods. The extreme figures obtained for the two blades for any mode of vibration are given. It is concluded that some of the variations must arise from variations in the metal of the two blades. Torsional and mixed resonance are also discussed and tables of extreme values of cycles per second are given.

A broad comparison of the results obtained with those given by others indicates that most of the patterns obtained by H. Hunter are at too high a frequency to have much bearing on the singing propeller problem. The patterns shown in the paper by Kerr, Shannon and Arnold present some difficulties when compared with those in this paper. Possibly the difference arises from the fact that in these tests the exciting force was continuous and not a single strong burst of vibration. Twenty-five vibration patterns of propeller blades are shown.

HEAT INSULATION IN ELECTRIC POWER STATIONS

HEAT insulation of pipes, boilers and generating sets, which used to be indicated by the general term 'lagging', has now become an art in itself and, to obtain the best results, the material must be graded and applied in a totally different manner for high-, medium- and low-temperature pipe lines and surfaces. In a paper presented at a semi-annual meeting in Milwaukee to the American Society of Mechanical Engineers by Messrs. E. T. Cope and W. F. Kinney, engineers to the Detroit Edison Co., the authors point out that in water-cooled boiler furnaces used in steam generating plants, it is common experience to find that cracks develop in the insulation on water-cooled furnace walls as the result of: (*a*) expansion and contraction of the setting, (*b*) shrinkage of the material, (*c*) settling of the material or (*d*) loosening of the material due to faulty attachment. Because of the likelihood of air infiltration as a result of this situation and to provide a pleasing external appearance, it is frequently considered necessary to encase waterwall furnaces in airtight steel shells, which in turn may require insulation.

Experience has shown that it is virtually impossible to maintain airtight any of the assemblies used in practice unless all-welded steel casings are used, but this is an elaborate and expensive construction and no satisfactory economical method has yet been found. Large areas comprising air-ducts, breechings, fan-housings, tanks and similar equipment are subject to vibration and considerable expansion and contraction. The presence of hot gases varying from perhaps 100° to 600° F. on the inside of the wall with insulation on the exterior is conducive to a great deal of warping and irregular movement, which in turn affects the tightness of the insulation. To provide for this movement, expansion joints are usually installed in various locations on the equipment. It is difficult to retain blocks, blankets, or insulating cement on a surface where so much relative movement and vibration takes place. Unless extreme precautions are taken during the installation, loosening of the insulation will be a recurring problem.

Large pipe-bends are still covered with double-layer block insulation, leaving an expansion joint covered with curly glass wool at both ends of each bend.

The selection of thermal insulation for steam turbines is a problem that presented few difficulties in the past, when the operating steam temperatures were well within the temperature limit for asbestos and magnesia products. In recent years the design of steam-generating equipment and turbines has advanced so rapidly in the direction of higher steam temperatures that severe operating conditions are imposed on insulating materials.

Plastic insulating cement has grown in favour because it permits easy application over the irregularities in the turbine shell, but it must be applied in layers, preferably less than 2 in. thick, covered with reinforcing netting secured to lugs on the casing, and trowelled with a finishing cement—a procedure which requires several days to permit adequate drying of each layer on a cold surface. It is questionable whether admitting steam to the turbine to expedite drying of the plastic insulation is an acceptable operating practice, due to the possibility of inducing unequal stresses in the bolts, flanges and appendages.

The advantages of flexibility and low thermal conductivity of reinforced open-face flexible insulating blankets are offset by the widespread objection to having around the turbine a loose wool that may become detached from its backing, and to the difficulty of cutting the metal mesh reinforcement to fit.

Finally the following conclusions, among others, are reached: (*a*) Insulating pads, composed of a textile jacket enclosing a loose filler, appear to be the most desirable form of insulation for turbines. (*b*) As determined by extensive field tests, there is one brand of glass fabric pad with glass-wool filler that is preferred for temperatures up to 1,050° F., and two brands of reinforced white asbestos pads with either mineral-wood or amosite asbestos fibre filler are considered reasonably acceptable. (*c*) From actual installations on various sized turbines operating at different steam temperatures from 700° to 910° F., it was concluded that 50° F. appears to be a reasonable temperature difference between the outside surface of the insulation and the ambient air.

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Freshwater Biological Association of the British Empire. Scientific Publication No. 3: The Food of Coarse Fish; being the Interim Report on the Coarse Fish Investigation. By P. H. T. Hartley. Pp. 33. (Ambleside: Freshwater Biological Association.) 1*s*. 6*d*. [2611

The British Academy. Presidential Address, 10 July 1940. By Sir David Ross. (From the *Proceedings* of the British Academy, Vol. 26). Pp. 8. (London: Oxford University Press.) 6*d*. net. [212

Other Countries

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Annual Report on the Forest Administration of Nigeria for the Year 1939. Pp. 37. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 1*s*. 6*d*. [2711

The Cooper Union for the Advancement of Science and Art. Eighty-first Annual Report, July 1, 1940. Pp. iii+141. (New York: The Cooper Union for the Advancement of Science and Art.) [212

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 204 (Occupational Information and Guidance Series No. 1): Occupational Information and Guidance; Organization and Administration. With a Brief Survey of the Development of Guidance and Reports on Present Practices. By Layton S. Hawkins, Harry A. Jager and Giles M. Ruch. Pp. vii+181. (Washington, D.C.: Government Printing Office.) 25 cents. [212

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 19, 1937. vii. Meteorologiska iakttagelser i Riksgränsen. Pp. 44. 4.00 kr. Årsbok, 21, 1939. ii. Nederbörden i Sverige. Pp. 15+1 plate. 2.50 kr. Meddelanden, No. 32: The Lag-Coefficient of Aerological Instruments and the Function of Hair Hygrometers at Low Temperatures. By Alf Nyberg. Pp. 20. Meddelanden, Band 7, No. 7: Vårflödet i Norrländska vattendrag samt i Dalälven och Klarälven. Av Folke Bergsten. Pp. 14. 1.50 kr. (Stockholm: P. A. Norstedt and Söner.) [212

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