lem of formulation if various systems and theories of psychology have been reviewed. The psychologist's relative lack of concern with the problem of more adequately formulating emerging problems is often reflected in what seems to be his extreme self-consciousness in respect to the short history of his discipline.

We are not in the least denying, of course, that rigorous methodological standards must be insisted upon or that the history of the subject should be reviewed. But we do feel that progress in psychology can be brought about more rapidly only if methodological procedures are considered in relation to concrete problems and if the history of psychological investigations can be viewed from the perspective of problems that now seem significant, rather than vice versa. Whitehead has nicely stated both points in his dicta that "the main evidence a methodology is worn out comes when progress within it no longer deals with main issues" (*13*, 13) and that "a science which hesitates to forget its own history is lost" (*12*, 162).

(*This is the third of a series of three articles.*)

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The 112th Annual Meeting of the British Association for the Advancement of Science

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THE 112TH ANNUAL MEETING of the British Association for the Advancement of Science was held in the heavily industrialized northern England town of Newcastle-upon-Tyne, in the first week in September. Some 3,500 persons—scientists and science-minded citizens—were present.

This area has a great technological tradition, for—as Pierre Auger, head of Unesco's Natural Sciences Department, pointed out in an official address—"It was in this ancient city of Newcastle that the world-famous engineer George Stephenson, a century and a quarter ago, established the iron works where were built the first steam engines that went puffing into history between Stockton and Darlington, and Manchester and Liverpool—and began a new and splendid phase in industrial development."

The theme for this meeting was set by Sir John Russell, who devoted his presidential address to a review of the world's food and population problems. He pointed out that the present population of the world—2,300,000,000—was increasing by 20 millions a year. That meant an average addition of two every three seconds, day and night, year after year, and these two might become more as science advanced, social services improved, and international organizations became fully operative.

About 11 billion acres of the world are climatically suited to crop growth, he said: but of this area, only 3 to 4 billion acres are used—7 to 10 percent of the world's land surface—for both food and industrial crops. There is no need, however, for gloom. Science is continuously opening up new possibilities. For example, thyroxin, or iodated protein, fed to cows by mouth, can increase the fat content of milk and augment the yield by another 20 percent. Even more dramatic is the use of a synthetic estrogen (the female sex hormone) introduced under the skin, for inducing lactation in virgin heifers or barren cows. This is the first stage in making the male redundant.

Experiments with rabbits, Sir John pointed out, have shown that at some time in the near future a single pedigreed cow might produce 75,000 calves without undergoing the pangs of birth. The calves would come from "living incubators"—inferior cows in which an ovum had been transplanted from the pedigreed animal and then fertilized by artificial insemination. In this process, again, a bull might become all but obsolete.

Among other research results which have an immediate practical application, Sir John Russell mentioned:

The use of auxins. A spray of β-naphthoxyacetic acid, 40 parts per million of water, has been used by commercial growers of tomatoes and cucumbers to produce fruits normal in appearance but not yet in quality. They are seedless.

The work of R. Brown, of Leeds, and A. R. Todd, of Cambridge, on chemical stimulants and pests. They have found that the seeds of witchweed (*Striga*), a flowering plant that parasitizes sorghums and millets and is the cause of much loss in Africa and India, germinates only when stimulated by substances excreted from their roots. This substance is apparently a sugar. If the different varieties of sorghum should differ in their ability to prepare and excrete this stimulant, a chemical test might be devised that would greatly assist plant breeders searching for resistant strains. It is possible that other parasitic fungi could live only on varieties of plants capable of producing the necessary stimulant.

The fact that various soil organisms are known to produce antibiotic substances analogous to penicillin. For example, Thaysen and others have found in tropical soils bacteria with high powers of inhibiting the growth of fungi. In the absence of a good soil fungicide it is possible that soil-borne fungal diseases may be successfully controlled by introducing or encouraging organisms producing the appropriate antibiotic.

The subject of "Food and People" was discussed at a public meeting held under the chairmanship of Sir John Russell. Pierre Auger contrasted the eagerness with which Great Britain accepted the railway as a means of increasing the wealth and resources of mankind with the current doubt as to whether science should be regarded as a friend or the enemy of mankind. If man wishes, he can use science and technology to rid himself of illness and disease, and to remove the burden of unproductive and uneconomic toil. He gave details of the major experiment in mass enlightenment begun by Unesco, in an attempt to organize in many countries active discussion of this topic, with the object of focusing the attentions of the peoples of the world on this urgent problem. Unesco hopes to show not only the necessity for international cooperation in solving the problem, but also that such collaboration is already taking place at all levels among the existing international organizations.

Lord Horder said that he believed man could achieve such physical, chemical, and biological control of the earth as to enable him not only to adjust population to food, but also food to population. He warned, however, that food would not be produced, even with the full utilization of science, without hard work. The ultimate consideration, he said, is moral control, of which the simplest expression is live and let live. He wondered whether it came within the province of science to obtain that indispensable moral control.

Other speakers described developments in the British Commonwealth in the attempt to supply the world with more food.

Sir David Rivett said that Australia would need more first-class scientists. Geneticists are needed to develop from British cattle breeds that are already established in Australia, strains adapted to local conditions. The fertility of rams is affected by high temperatures, and knowledge of climatic influences on the fertility of rams and ewes is needed to raise the present low lambing percentage. Speaking of the possibility of more efficient use of present resources, he told of how, in Australia, skimmed milk is used mainly as pig food. But research has revealed that in that waste there are more first-class animal proteins than in the whole of the beef and mutton production of the Commonwealth.

A. C. Hardy rather startled many scientists when, in his section presidential address "Zoology Outside The Laboratory," he expressed a belief in telepathy. He said:

It is perhaps unorthodox for a zoologist to introduce such a topic, but I do so for a reason. If telepathy has been established, as I believe it has, then such a revolutionary discovery should make us keep our minds open to the possibility that there may be so much more in living things and their evolution than our science has hitherto led us to expect.

Such an idea as I am about to suggest is no doubt highly improbable and would perhaps be better kept locked in a bottom drawer; I mention it, however, merely as a reminder that perhaps our ideas of evolution may be altered if something akin to telepathy—unconscious, no doubt—was found to be a factor molding the pattern of behavior among members of a species. If there was such a nonconscious group behavior plan, distributed between, and linking, the individuals of the race, we might find ourselves coming back to something like those ideas of subconscious racial memory of Samuel Butler, but on a group rather than on an individual basis.

It would remove many of the fatal difficulties of his hypothesis. Samuel Butler's ideas were, of course, the logical development of Lamarck's, but thought of independently.

If there was such a group habit and behavior pattern it might operate through organic selection to modify the course of evolution; working through selection acting on the gene-complex. If this flight of fancy ever proved to be a fact, it would be a wedding of the ideas of Darwin and Mendel on the one hand, and Samuel Butler and Lamarck on the other.

Professor Hardy made a plea for more ecological research. He defined ecology as "the conversion of natural history into science," which involved more than the expressing of the interrelationship of organisms with their environment, living and inanimate, in numerical terms. The aim of ecology is to discover more of the laws operating in the world of living things. He remarked on the fact that ecological knowledge of marine life is much more advanced than that of man's ordinary terrestrial surroundings.

Sir Alexander Gray, in his presidential address "Economics: Yesterday and Tomorrow," said that the problem of government is essentially one of expediency; above all, it is concerned with the urgent question of how to keep going for the next six months. The enunciation of a flawless theory of wages, if such could be formulated, would never still the passions which had given rise to a strike. Accordingly, he believes the economic adviser should at times be able to forget that he is an economist, and indeed to realize that there might be occasions when he ought to forget his economics. He is certain that a structure of economic theory that is not based on sound psychology is a house without foundation, therefore the economist must be a psychologist, of a sort.

There is no room here to do more than mention some of the other interesting papers that were read.

Kenneth Oakley, of the Natural History Museum in London, read a paper to the anthropological section on his fluorine test. Fluorine is a gas which, in the form of fluorides, occurs as a trace in most ground water. When fluorine ions reach bone material, they are locked into the ultramicroscopic mesh of the calcium phosphate crystals. Once they thus enter they are not released, and the fluorine content of the bone increases with time. This fact provides rather a neat means of distinguishing fossilized bones of different ages occurring at a particular place, though it does not make it possible to date an individual bone in isolation.

In the physics section, some papers were read on recent techniques applied to astronomical problems.

J. S. Hey, of the Army Operational Research Group, dealt with investigations of solar radio noise. This is emitted in two forms. First there are fairly sharply beamed emissions from sunspots, a maximum being obtained when the sunspot is near the central meridian on the sun's disk. Next there are very sudden bursts of emission from solar flares, which are tongues of very hot gas moving at immense speed from the solar surface near the sunspots. This type of emission is characterized by its suddenness, and it does not appear to be beamed. There seems to be a greater chance of radio emission with flares occurring on the east side of the sun's disk than with flares in any other position. Intense ionization of the lower part of the ionosphere is simultaneous with the flare and the radio emission. It seems that this intense ionization is caused by ultraviolet light from the flare, and the result is a complete black-out of long distance radio communication on the earth.

F. G. Smith, of Cambridge, described work on radio techniques applied to the analysis of radio noise coming from the rest of the galaxy. The first problem is to determine whether the noise comes from a diffuse interstellar gas or from point sources such as the known stars. From experimental evidence at Cambridge it appears that there are two major sources and 23 smaller ones, and with certain assumptions the diameter of the source seemed to be less than ten light seconds, i.e., of the order of size of an average visual star. It appears that the noise is due to electrons having a random motion of at least 10^{10} electron volts. The great energy suggests that the origin of cosmic rays is the same as that of the radio noise investigated.

A. C. B. Lovell, of Manchester, described new developments in meteor astronomy. He said electron trails formed by the burning away of a meteor make excellent radar targets and can thus be detected on a cathode-ray screen. Difficulties occur because of the immense speed of the meteors, in the neighborhood of 100,000 miles an hour, thus producing radar echoes of extremely minute duration. As the central problem of meteor astronomy is to discover where the meteors come from, it is very important to determine the meteor speed very accurately, for a difference of less than 1 percent in the velocity means the difference between a meteor belonging to the solar system, i.e., moving in an orbit around the sun, and one from interstellar space.

W. C. Hodgson and K. M. Rae described two types of apparatus for submarine investigation. The continuously recording echo-sounder gives the depths at which fish are swimming and allows the nets to be adjusted accordingly. It also allows the extent of a shoal to be calculated and therefore the likely catch. Herrings, sprats, cod, and mackerel can all be identified by the characteristic trace they give on the paper record. The other apparatus is a recorder which, towed behind a ship, gives a continuous record of plankton (the small animal life on which fish feed). Much time, money, and effort could be saved by this technique when fishing research comes to be conducted in such large areas as the Pacific. It would give a broad basis on which to plan more detailed research cruises.

The impact of science on society was implicit in all papers read, and Sir John Russell, in his presidential address, raised some controversial points about the powers of science. He said:

> It can do much to overcome material difficulties and, better still, to satisfy man's thirst for knowledge of the universe in which he lives, and it can insist continuously on our high duty to seek out the truth fearlessly and honestly, and having found what we believe to be the truth, to proclaim it—but in all humility and recognizing that we may be wrong. Apart from that, science can give little guidance in those great moral and spiritual problems which lie at the root of our most serious troubles today. It opens up many possible ways of life but gives no help in choosing which to follow, it deals with the facts of existence but not with the values of existence. It offers us great possessions but, as the old aristocracy knew, great possessions imply great personal responsibilities. Democracies still have this to learn. That is one of our greatest problems today.
>
> Science can help us best if we have a sustaining faith, a high purpose in life and unflinching courage to pursue it.

Sir Alfred Egerton summed up the general feeling when he said:

> Looking back to the turn of the century and remembering the stage of chemical science at that time, then seeing in my mind's eye the integrated achievements of chemists since those days, I cannot but believe in a bright future: "That which they have done is but an earnest of the things they shall do."

Next year's meeting is to be held in Birmingham, and the new president of the British Association for the Advancement of Science is Sir Harold Hartley. The 1951 meeting is to be held in Edinburgh, under the patronage of the Duke of Edinburgh.

TECHNICAL PAPERS

A Reversible Photochemical Alteration of Uracil and Uridine[1]

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Various lines of evidence (*1, 3, 4*) have suggested that the primary effect of lethal and mutagenic doses of ultraviolet radiations upon living cells may be partially reversible, or at least compensated within the cell. In connection with a general study of the photochemistry of nucleic acid derivatives, we have discovered that, under certain conditions, the initial photodecomposition product of the pyrimidine, uracil, and the corresponding product of the ribose nucleotide, uridine, may spontaneously revert to the initial substances, uracil and uridine, respectively.

A distinction must be made between the effects of radiation in the longer wave pyrimidine absorption region, 2300–2800 A, and the effects of short wave radiations of wavelength less than 2300 A. The former radiation gives rise to the partially reversible effect, whereas the latter produces—with a much higher quantum efficiency—an irreversible decomposition.

In our experiments we have employed as a radiation source a low pressure mercury discharge tube, wound in the form of a spiral, obtained from the Hanovia Chemical and Manufacturing Company. The principal radiation from this tube is the 2537-A mercury line, but photochemically significant quantities of 1849-A, 1942-A, and 2224-A radiation are emitted. We have filtered these latter out with a 1-cm path of absolute ethyl alcohol.

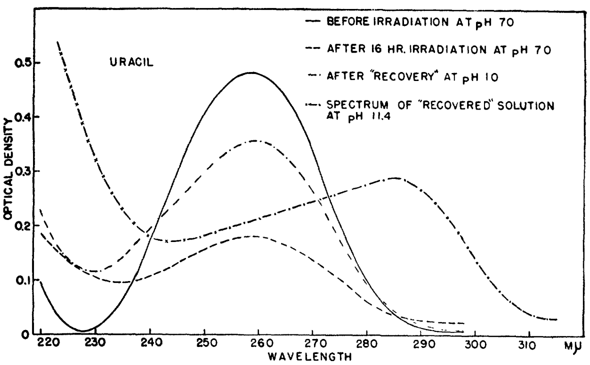

FIG. 1.

The solutions have been irradiated directly in the silica cells of the Beckman DU Spectrophotometer. Under these conditions, it is possible to destroy 63% of the absorption of a uracil solution (6.2 μg/ml in M/100 PO_4 buffer, pH 7.0) at the uracil maximum, 2590 A, in 16 hr of irradiation (Fig. 1). If now the pH of the irradiated uracil solution is changed to 1.0 (by addition of 1 ml 1 M HCl to 3 ml of irradiated solution), the absorption at 2590 A is then found to rise exponentially, following first-order kinetics, with a rate constant of 14 min at room temperature. As shown in Fig. 1, 74% of the

[1] This study was supported by the American Cancer Society, acting through the Committee on Growth of the National Research Council.

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