

## SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS \*

## Logic and Probability in Physics

**A**FTER paying a short tribute to the memory of Lord Rutherford, the president of Section A (Mathematical and Physical Sciences), Prof. C. G. Darwin, comes to his main subject, which is the inadequacy of the reasoning processes which have in the past been regarded as the proper machinery of scientific thought. We have set up as the ideal form of reasoning the formal logic of Aristotle; we rarely conform to this ideal, but instead we make use of arguments having no accurate axiomatic basis, which compel belief because of some large accumulation of favourable evidence. The old logic was devised for a world that was thought to have hard outlines, and now that we know that the outlines are not hard the method of reasoning must be changed. The key to the modification lies in probability, but whereas in the past it was expected that probability could somehow be fitted into the old logic, the attempt has always failed, and we must recognize it as an independent principle. Our instincts only accept this with difficulty, but a similar unsatisfying state of affairs used to exist in mechanics, which has been overcome by the quantum theory, and an analogy may be developed between the two cases.

There follows a review of the history of the quantum theory, touching on a number of points of interest, but having special reference to the way in which it has dealt with causality. The old mechanics seemed to point with all the compulsive force of a logical syllogism to absolute determinism. We are still scarcely free from the feeling of this compulsion, but we know it is wrong, and we know where the fault lay. An analogy may be made between this state of affairs and our feeling about the place of probability in logic. We used to feel that classical mechanics provided no room for anything outside itself, and we feel that the old logic is the only really admissible form of reasoning. Certain things refused to fit into the classical scheme and led to the old quantum theory, and we have found that the old logic is inadequate without the supplementary principle of probability. In mechanics the union is completed by the new quantum theory, but we have not yet satisfactorily blended our reasoning principles.

The sort of way the union may come about is suggested by another branch of physical theory,

\* Lord Rayleigh's presidential address, and the addresses of the sectional presidents, are being published as "The Advancement of Science, 1938". (Cambridge: B.A. Reception Room. London: Burlington House.) 3s. 6d.

the kinetic theory of gases. One of the most important ideas in the statistical theory of matter has been Gibbs's ensemble. With the old mechanics the ensemble was a rather strange idea, and it was hard to see where it came from, but now it fits beautifully into the new mechanics, for any actual piece of gas is not merely a single member from among the countless representatives in the ensemble, but is itself the whole ensemble. This example suggests a real synthesis of probability with our other reasoning processes, and gives the hope of a true reasoning adapted not to the artificially simplified world of hard outlines of the classical mechanics, but to the real world with its slightly indefinite outlines.

The address concludes with a plea for a reform of our education at both school and university, so that probability and statistics should be given a proper share in our mathematical courses. At present all the attention is given to things susceptible of exact proof, and none to the things of much more frequent occurrence where inaccuracies, tolerances or fluctuations are also of interest. It is not so much that new special courses are needed as that the emphasis should be altered in the ordinary courses of mechanics and kindred subjects. The mathematics would not be any more difficult than in the customary courses, but the train of thought is at present unfamiliar, and it would not be hard to remove this unfamiliarity. In this way the student would acquire a much juster appreciation of the physical world than can ever be acquired by an exclusive attention to those things which are capable of exact proof.

## Recent Investigations in the Chemistry of Gold

**T**HE recent advances in our knowledge of the chemistry of gold have for the most part been due to investigations carried out by workers in Great Britain; amongst others, H. Bassett, E. G. Cox, F. G. Mann, Sir Gilbert Morgan, Sir William Pope, W. Wardlaw, and their respective co-workers. This work, together with that of the president of Section B (Chemistry), Prof. C. S. Gibson, and his collaborators, which forms the topic of Prof. Gibson's presidential address, has emphasized the similarities and also the striking anomalies existing among the currency metals, copper, silver and gold, the metals of Sub-group 1B of the Periodic