Finally, some papers discuss possible ways of synthesizing "systems that are optimal, both from the viewpoint of performance and the viewpoint of sensitivity. This can be considered as one of the future and more ambitious objectives of sensitivity theory which may depart from the now classical methods of parametric imbedding and rely on some new concepts such as game theory".

The book by Fel'dbaum is superficially quite different from the Dubrovnik volume. Instead of a loose collection of papers, it presents a highly systematic account of optimal control processes. However, it issues ultimately into a different approach to the same problem: the variation of mathematical models. Chapters 5 and 6 are entitled "Optimal Systems with Independent (Passive) Storage and Information about the Object" and "Optimal Systems with Active Information Storage" respectively. They are concerned with optimal control sequences for systems about which information is gathered in the process of control itself, so that the model is progressively better identified.

By means of Bayesian prior distributions of the fixed, but unknown, parameters, Fel'dbaum describes what he calls "dual control". In computing an optimal control strategy, the consequences of the values of the control variables include the possible effects on future values of information gained. Although this concept was developed some years ago, it appears to have been little known outside Russia. Its lack of impact on control theory generally is no doubt related to the extreme difficulty of actually solving analytically any of the problems so formulated.

Sworder's book is devoted mainly to an exposition of Fel'dbaum's theory of dual control. It discusses several examples in detail and considers alternative policies to the optimal one, which may be more readily computed.

In my opinion, the lines opened up in these books are not only important for engineering control problems. Because they attempt to take account of the inherent limitations of mathematical models they make it possible to consider decision-making for processes whose definitions are imprecise. In the long run, socio-economic systems may well form a major field of application for the more sophisticated developments of control theory.

CYRIL SMITH

# NEO-CLASSICAL IONS

## Nonclassical Ions

Reprints and Commentary. By Paul D. Bartlett. Pp. xiv + 559. (New York and Amsterdam: W. A. Benjamin, Inc., 1965.) $12.

THIS collection of reprints (it has no pretensions—it is not a book) is produced in order to familiarize students with a current research problem in organic chemistry. Thus it saves them from searching the literature. There is a danger in such a procedure if the selection of papers is biased. I have every confidence that here such bias has been avoided. Apart from the collection of papers, there are inserted a few pages of comment by Prof. Bartlett. He treats his subject and arranges his chosen reprints so as to give the history of an idea starting back in 1939 and finishing in 1964. Thus there is bound to be a gap of two years research work between this set of reprints and the present day student—an unavoidable disadvantage of such hard-backed publications compared with a rapid photo-copying of research papers. (It is to be weighed against only one clear advantage—financial profit to publishers.) A reviewer faced with this mixture of old major papers and new minor comment is forced to discuss not a book as such, but the general state of research on "nonclassical ions" seen in historical perspective. Moreover, he must do this from the viewpoint of a semi-literate student, because the collection sets itself an educational purpose. As I am interested in the subject matter, but am not by any means an expert, I have taken the liberty of acting as a "trial" student.

The first fifty to sixty papers make the following point with many examples. A classical carbon cation is a single positive charge centred on one carbon atom. A non-classical cation is a notional cation in which the charge distributes itself over neighbouring carbon atoms, for example, in a group $CH_2=CH—CH_2—CH^{\pm}$. It is notional because its existence is based largely on enhanced kinetic effects, and its lifetime is associated with the lifetime of an intermediate, making it difficult to study. (Discussion is largely limited to delocalization in σ-bond systems, and analogies are drawn with the boron hydrides. There are clearly other systems of this kind involving metal cations, hydrogen and carbon compounds, but these are not discussed.) It is postulated that there is a resonance stabilization of the non-classical electron-deficient cation which gives rise to the enhanced substitution rates and certain abnormalities in the type of product. Most of the papers set out to prove this point by circuitous chemical methods in different systems. (Many pages are wasted on trivial and repeated experimental procedures—who wants to pay for this?) All in all, from 1939 to 1962 the whole concept is something of an inspired guess. The real test comes at the end (1963) when the cations were studied by physical methods at low temperature in special solvents. I was not told that for 524 pages—and it looks as if non-classical ions do not exist. (What special interaction do they contain?) Worse is to follow, for on page 531 there are 25 extra references, 1963–65, and I also found a short review in *Chemistry in Britain* (199, 1966) which denies the whole concept. I do not advise my fellow students to use this book unless they want a non-classical outlook on neo-classical ions.

R. J. P. WILLIAMS

# MAKE MORE COMPOUNDS

## Preparative Inorganic Reactions

Vol. 2. Edited by William L. Jolly. Pp. ix + 378. (New York and London: Interscience Publishers, a Division of John Wiley and Sons, 1965.) 110*s*.

THE principal aim of the series of which this book is part is to describe the rationale and theory behind the preparation of various important classes of inorganic compounds. A secondary aim is to provide a critical evaluation and comparison of methods. These aims are particularly difficult to fulfil completely in inorganic chemistry, where excessive generalizations are notoriously unreliable. Each of the authors has in some measure, however, attempted this, and a number of outstanding contributions have resulted which, coming as they do at a time of great interest in exploring the preparative possibilities of inorganic chemistry, will stimulate and help workers in many fields.

The subjects covered include phosphazenes (R. A. Shaw, R. Keat and C. Hewlett), silicon-nitrogen compounds (B. J. Aylett), orthophosphoric acids and orthophosphates (C. Y. Shen and C. F. Callis), metal alkoxides (D. C. Bradley), *cyclo*pentadienyl and arene metal carbonyls (R. L. Pruett), sulphur and phosphorus-bridged complexes of transition metals (R. G. Hayter), binary fluorides (E. L. Muetterties and C. W. Tullock), fluorine compounds of the platinum metals (N. Bartlett) and compounds of xenon (E. H. Appelman and J. G. Malm).

The long article on phosphazenes is particularly thorough and includes a number of detailed preparations with complete experimental details, which will be of great value to all interested in these compounds. The authors of this article are cautious to state that their subject is not yet in a state where extrapolation can be taken too