point has different values[13]. The pK values calculated from the pH at the point of half neutralization in the titration curves with concentrated alkalis decrease with a decrease in the silica content of the sol. The dissociation constant calculated from the pH at the second inflexion and from a consideration of the solubility of silicic acid varies from $4 \cdot 4 \times 10^{-10}$ to $5 \cdot 9 \times 10^{-10}$ with different sols and is found within the range (10^{-9}–10^{-10}) observed by previous workers[5,6,7,8].

The amounts of acid liberated from the sol by neutral salts as shown by the diminution in its pH[15,16] on the addition of salts and by the total amount of acid[16] found in the salt extracts are in the order: $Ba^{++} > Ca^{++} > K^{+} > Na^{+} > Li^{+}$, which follows the lyotrope series and illustrates what has been designated[12,20] as the 'regular cation effect'. The greater relative effect of Ba^{++} ions compared with Ca^{++} ions is definitely against the explanation that the development of acidity is due to the formation of insoluble silicates[9,10], since calcium silicate is more insoluble than barium silicate. The order, on the other hand, follows from an electrical adsorption of the cations together with their hydration envelopes.

The amount of acid liberated by continually leaching the sol with a definite concentration of a neutral salt diminishes[16] to an almost negligible value as the leaching progresses. The total amount of acid thus liberated, especially by barium and calcium chlorides, is considerably greater than that neutralized at the first inflexion point in the titration curve with a dilute base. This indicates that 'bound' H^{+} ions[19] are present in addition to those which can react with the base at the first inflexion point. The total quantity of the so-called salt that is formed by continued leaching of the sol with a solution of neutral salt is a small fraction (0·13 per cent) of the number of moles of silicon dioxide present (cf. also Moltschanowa[10]), indicating that the reaction with the salt is limited to the surface and does not appear to lead to the formation of a second solid phase.

At very low concentrations the alkali metal cations cannot easily displace the 'bound' H^{+} ions associated with the colloidal particles, but only effect an osmotic displacement of the mobile H^{+} ions[16]. With lithium chloride the displacement of mobile H^{+} ions is complete at a concentration of $0 \cdot 01\ N$.

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SCIENCE IN THE MODERN STATE

MR. H. S. MORRISON'S L. T. Hobhouse Memorial Trust Lecture, which was read on his behalf by the Provost of University College, London, at Cambridge on May 9, 1944, has now been published under the title "Science and Administration in Modern Government" (London: Oxford University Press. Pp. 20. 2*s*. net). The lecture is concerned mainly with the part which science can and must play in our affairs after the War if we are to survive and progress as a community, and more especially with social research or social engineering. Mr. Morrison emphasized first the speed of scientific development at the present time and the scale upon which much of it proceeds. War-time experience seems to have established that there is no reason in the nature of things why Britain, admittedly a leader in fundamental research, should be any less good in the sphere of development and application; secondly, progress in the theoretical and practical solution of specific problems can be incredibly quick when 'all the brakes are off', and the object is not to serve the *status quo* but to surpass it as rapidly and as far as possible; and thirdly, that science as a method can be applied to almost any problem, however unlikely, and almost any material, however apparently intractable.

With regard to the first point, Mr. Morrison urged that we must reduce the risk of important and fundamental British inventions being developed abroad and then brought back in the form of finished and patented processes upon which the British manufacturer must pay a substantial royalty if he wishes to use them. The second lesson, the possibility of accelerating the rate of progress by removing obstacles, takes us deep into questions of economic and industrial policy, and Mr. Morrison pointed out that every large change in the social and economic sphere has its costs as well as its advantages; the calculation which has to be made will not necessarily show a result favourable to immediate change. It should, however, be our practice as a community to write off our existing capital assets at a good rapid rate; but it should not, he urged, be left to the unaided devices of large firms to calculate whether a certain change is justifiable or not. The calculation 'to scrap or not to scrap' may yield one answer to the company accountant and another answer to the Chancellor of the Exchequer. We ought to bear in mind, in considering the appropriate form of relationship between the State and industry after the War, the importance of ensuring that public policy is effectively operative when great and vital decisions affecting our industrial progress are being taken.

After referring here to the possibilities of scientific development of the supplies of coal, oil and sugar within the British Commonwealth, and to the possibilities of biological development as indicated by penicillin, biological control of plant, insect and animal life, including the biological use of X-rays, Mr. Morrison illustrated the third lesson from the work of the Research and Experiments Department of the Ministry of Home Security in the application of scientific methods to problems of civil defence, such as the evaluation and development of types of shelter. Such methods have obvious application in building, and one of the first-fruits of such operational research has been the preparation of more than a score of monographs on the technique of building structures. Lord Portal's temporary post-war dwelling-house is a further example of the practical application of research techniques and a precursor of greater things to come.

Such social research is part of a distinctive tradition of British social science, and Mr. Morrison expects a great extension of the techniques of exact quantitative study on society, social groups and their environment on one hand, and on the other the extension of social research into the qualitative field. In regard to the first, Mr. Morrison urged the importance of a study of social mobility—the rate and machinery of transfer from one social class or group in one society to another. He suggested that a study in Great Britain might show the universities acting to some extent as engines of social mobility, and to a greater extent as instruments of individual economic advancement. Again, the problem of marriage and the question of actual geographic mobility requires investigation. In spite of their increasing importance in the age structure, we know little about the old as a social factor beyond their numbers. We know little about the factors that shape the choice of occupation on leaving school, and how far this is affected by the occupation of their parents. Besides this quantitative approach, we need as supplement a development of the case-history method—an intensive study of a number of individuals either by specially worked out methods of question and answer or by methods of word-association and picture-association. The development of personality and ability tests in the Services is a small beginning of this kind of approach, but the programme of extended social research would call for the creation of a new generation of social workers, and the training of large groups of students. Mr. Morrison is looking with keen anticipation to the extension in the social field of scientific techniques. Social scientists have a tremendous contribution to make to intelligent enlightened government, and Mr. Morrison believes that the full fruition of the social sciences, at present in a stage corresponding to the early phases of the physical sciences when they were uncertain about their explanations of cause, may not lie so far ahead of us.

PETROLEUM IN WAR AND PEACE

THE American Office of War Information has recently received a publication entitled "Developments and Trends in American Industries (Oil Mining and Refining; High Octane Gasoline)" which is in fact a collation of excerpts from trade magazine articles and other sources. It covers practically every activity of the American petroleum industry to-day, and gives some striking pointers as to the way in which war-time scientific discoveries will be harnessed to meet peace-time requirements.

Driven by the necessity for producing high-quality aviation fuels in enormous quantities, research workers, sponsored by the Petroleum Industry for War Council and the Aviation Gasoline Advisory Committee, have made startling progress. Until recently, 100-octane gasoline was regarded as an optimum fuel; but it has been superseded as a standard. There is a new 'Supergas' called triptane (paraffinic-trimethyl-butane), which is 50 per cent superior to *iso*-octane from which 100-octane gas is obtained; its anti-knock qualities are such that no commercial engine has been built which is capable of utilizing its full power. There is 'Dynafuel', which is also 50 per cent more powerful than standard 100-octane fuel, and there are no doubt other fuels of similar calibre which will become commercially available in peace-time. One is tempted to forget that the use of 100-octane spirit or super-gasoline for post-war motoring purposes implies the evolution of a 'super-car'. It is, in fact, unlikely that such fuels will be used in motor-cars for some long time to come, but it is interesting to note that petroleum chemists do envisage the production of a 70-mile-to-the-gallon motor spirit, not to mention 100,000-mile tyres, and 20,000-mile lubricating oils.

Second only to aviation gasoline in war-time importance is the production of toluene for T.N.T. (trinitrotoluene). During the War of 1914–18, practically all the toluene used was produced from coal tar; but to-day, although more toluene is being manufactured in that way than ever before, the greater part is being supplied from petroleum oil refineries. Indeed, the capacity of hydroformer installations and attendant toluene extraction and purification plants has been so increased that it has been found possible to divert some of the toluene to 100-octane activities, after fulfilment of all requirements for explosives. Toluene in peace-time is a commercial solvent used in dyes and paint manufacture; but quantities required are not in any way proportionate to war-time demands. Petroleum chemists foresee a sharp decline in toluene production after the War, but they equally foresee the possibility of converting toluene-manufacturing plants into machinery for making gasoline-blending agents.

Other war-time activities of the petroleum industry include the supply of a large part of the butadiene for the production of Buna-*S* type synthetic rubber; production of high-quality lubricating oils, hydraulic oils, and special types of lubricants capable of withstanding the bitter winter conditions of Greenland or alternatively the heat of the Sahara desert. Waxes more moisture-proof than tin, rust preventives, de-icing materials, fireproofing compositions for soldiers' tents, preservatives for mosquito nets, medicines, anæsthetics and a host of other war-time commodities are prepared from petroleum derivatives. In fact, refining has become so highly skilled compared with the old days when cuts were made to satisfy demand for one product only that its repercussions on post-war industry will be nothing short of revolutionary. To-day the petroleum chemist is master of a formidable number of highly specialized processes; for example, hydrogenation, dehydrogenation, hydroforming, reforming, alkylation, polymerization, isomerization, catalytic cracking, aromatization, cyclization, etc., and he literally tears apart (cracks) the petroleum molecule and reassembles it into the pattern he desires.

But it is not only the petroleum chemist who has forged ahead. Other branches of the industry have made parallel advances. In 1922 the deepest producing well in the world was in the Orange Field, Texas; it reached a depth of 5,490 ft. To-day a well in the Terrebone Parish Field of Louisiana has been drilled to, and is producing at, a depth of 13,475–90 ft. A new era in the art of exploration and discovery began with the use of the torsion balance and the seismograph. To-day gravimetric methods, electrical measurements, aerial mapping, geochemical and radiation techniques are all available to assist in the search for oil. Before the entry of the United States into the War, practically all the petroleum and petroleum products consumed in the