(I)

(II)

(III)

(IV)

cent). Its absorption maximum in the ultra-violet (284 mμ, ε 20,600 in ethanol) is at a shorter wave-length than that of an α-acetyltrialkylpyrrole—an effect which is also observed in model pyrroles containing a 5-membered cyclic ketone. The infra-red spectrum of the keto-amide supports the structure (IV), although it would not have by itself provided conclusive proof, owing to strong hydrogen bonding and to partial overlap of the two carbonyl stretching frequencies.

This work forms part of a programme under the general direction of Prof. C. Rimington, whose interest and advice are gratefully acknowledged. We will report our results in full in the near future.

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The 'Protactinyl' Ion

A VERY simple technique has been described by J. D. H. Strickland[1] for determining the charge of an ion in aqueous solution, which is applicable to radioactive tracer concentrations. The method involves competition for sites on mono-functional ion-exchange resins between the ion in question and varying amounts, in very large excess, of another ion of known charge.

This technique has been applied to the determina-. tion of the charge of the protactinium ion in dilute perchloric acid solution using trace amounts of protactinium-233. Dilute solutions of perchloric acid were prepared in the range of 0·1–3 M. About a million disintegrations per minute of protactinium-233 and 0·1 gm. 'Amberlite' IR 120 (hydrogen form) cation resin were added to 5 ml. volumes of acid in stoppered tubes. The mixtures were mechanically shaken for about two hours and then centrifuged to separate the resin 'fines'. Aliquots of the stock protactinium solution and of the perchloric acid solutions at equilibrium were taken for protactinium assay. The protactinium on the resin was obtained by difference. A plot of the ratio of the protactinium in solution to that on the resin at equilibrium against

the acidity on double logarithmic paper gave a straight line of approximately unit slope. Therefore, the charge on the protactinium ion in dilute perchloric acid is $+1$.

If protactinium is a member of a second rare-earth series, the actinides[2], its pentavalent ion should be similar to those of other members of this group—for example, UO_2^+, NpO_2^+ (ref. 3) and PuO_2^+ (ref. 4). As a charge of $+1$ has now been found for protactinium, it seems probable that the ion present is PaO_2^+ and not PaO^{3+}, as it should be by analogy with vanadium and niobium in the same periodic group. Since a hexavalent state of protactinium is most unlikely, as the stable rare-gas electronic structure of radon would have to be opened up, it is safe to call this ion 'protactinyl' to distinguish it from protactinium 'penta' and 'tetra' compounds.

Full details of this work will be published later together with the work, at present in progress, for determining the range of hydrogen-ion concentration over which this ion is stable. Thanks are due to the Chief Scientist, Ministry of Supply, for permission to publish this note.

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[2] Seaborg, N.N.E.S., 4, No. 14 B, 1492 (1949).
[3] Sjoblom and Hindman, J. Amer. Chem. Soc., 73, 1744 (1951).
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Bond-Orders in Aromatic Compounds

THE most satisfactory measure of the 'character' of a bond in an aromatic compound is probably given by its 'bond-order'[1]. Although this is a theoretical quantity, its significance is demonstrated by its relationship to bond-length[1] and to other bond properties which can be measured experimentally. It has also been shown[2,3] that there is a smooth-curve relationship between bond-orders and the 'corrected'[4] redox potentials of the corresponding o-quinones. As redox potentials can be measured fairly readily, this relationship offers a method whereby certain bond-orders can be evaluated experimentally.

The method has now been examined with pyrene (I) and 3 : 4-benzpyrene (II). The character of the 6 : 7 bond in 3 : 4-benzpyrene may be of importance in connexion with the carcinogenic activity of the molecule, and it therefore seemed of interest to evaluate its bond-order from the redox potential of 3 : 4-benzpyrene-6 : 7-quinone[5]. At the same time, the bond-order of the 1 : 2 bond in pyrene has been evaluated from the redox potential of pyrene-1 : 2-quinone[6].

(I)

(II)

(III)
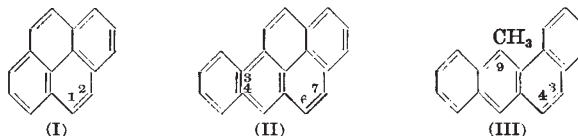
The experimentally observed redox potentials were 'corrected' in the usual way[4], and the results are summarized in the accompanying table. Redox potentials for phenanthra-9 : 10-quinone and for