62.62; H, 7.36; Br, 16.67. Found: C, 62.44; H, 7.57; Br, 16.77.

A solution of hydrazone II is autoxidizable and should be protected from molecular oxygen with an inert gas. Before autoxidation of the unsaturated hydrazone was recognized dehydrobromination of the 4-bromo intermediates to give the adrenal hormones dehydrocorticosterone acetate (IV) and 17-hydroxydehydrocorticosterone acetate (V) was carried out. The yields of bromide ion, unsaturated hydrazone and IV were 96, 59 and 80% respectively. Slightly lower yields of V were obtained. The preparation of IV and V under more favorable conditions is planned as soon as the essential intermediate compounds again become available.

For the precursors of the adrenal hormones we are indebted to Merck and Co., Inc., Rahway, New Jersey.

DEPARTMENT OF BIOCHEMISTRY
MAYO FOUNDATION VERNON R. MATTOX
ROCHESTER, MINNESOTA EDWARD C. KENDALL

RECEIVED JANUARY 19, 1948

VALENCE INDUCTIVITY

Sir:

Experiments conducted in this Laboratory on supported transition group oxides have led to what appears to be a new general principle in inorganic chemistry.

The effect was first observed in supported oxides of manganese. Thermal decomposition of manganous nitrate is well known to yield manganese dioxide. But if the manganous nitrate is first impregnated on high-area *gamma*-alumina, the oxidation state of the manganese becomes dependent on the concentration of the manganese. On an alumina with area of about 200 sq. m. per g., and with a manganese concentration less than 5%, all the manganese is in the +3 oxidation state. At higher concentrations the manganese reverts increasingly to the +4 state. The oxidation state is established both by direct titration, and by measurement of the magnetic moment.

This observation suggests that the manganese oxide tends to assume the crystal structure of the alumina, even to the extent of changing oxidation state in order to do so. It is well known that the *gamma* form of manganese(III) oxide is isomorphous with *gamma*-alumina.

Confirmation of this view is obtained by supporting the manganese on a high area (94 sq. m. per g.) rutile, which is isomorphous with pyrolusite. In this case the oxidation state of the manganese remains at +4, even at very low concentrations.

The experiments leading to the above results were performed by Marylinn Ellis and Kathryn Wethington. The effect described is strikingly shown by supported nickel in experiments performed by Fred N. Hill.

Magnesia is isomorphous with nickel(II) oxide. Supported nickel prepared by impregnation and ignition of high area magnesia is all in the +2 oxidation state. But dilute nickel oxide supported on high area alumina has the nickel in the +3 oxidation state. This state is established by direct quantitative uptake of hydrogen during reduction, and by magnetic measurements. It has proved possible to obtain up to 10% of nickel, all in the +3 state, by using multiple impregnation. This supported oxide is pale blue in color.

On the other hand, copper supported on alumina shows no tendency to assume the +3 state, nor does supported silver. It appears, therefore, that the effect is shown only when the supported positive ion may fairly readily assume a charge and radius similar to that of the positive ion in the support.

The effect illustrated for manganese and nickel may be described as a leading of the supported ion to take a different oxidation state than it would normally assume. Following a suggestion by Prof. Robert L. Burwell, Jr., we offer "valence inductivity" as a name for this effect. The general principle illustrated may be described as an induced change of valence brought about when a transition group ion is supported on a high area surface with which it may become isomorphous, and in which the ions may become isometric. The effect is somewhat related to the phenomenon of oriented overgrowth. It may be expected to aid in the understanding of several problems in catalysis and promoter action, and to be useful in the fields of mineralogy, crystallography, and coprecipitation.

DEPARTMENT OF CHEMISTRY P. W. SELWOOD
NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS

RECEIVED JANUARY 29, 1948

EXCHANGE REACTION BETWEEN FERRIC AND FERROUS IONS IN PERCHLORIC ACID USING A DIFFUSION SEPARATION METHOD

Sir:

Equilibrium exchange was found to occur by Nahinsky in Professor Ruben's laboratory[1] when ferrous and tagged ferric ions mixed in perchloric acid solution were immediately separated by a chemical method. In a chemical separation of the ions, other ionic or molecular species formed through chemical change during the separation may exchange. For the perchlorate system, for example, ether–hydrochloric acid extraction of iron (III) leads to erroneous conclusions, because in 6 *M* hydrochloric acid ferrous and ferric iron exchange rapidly.[2] If separation is achieved by a physical method, without changing the environment of the ions, exchange incidental to chemical changes during separation may be avoided. Since catalytic effects of trace impurities and surfaces cannot be excluded, the results must still be interpreted cautiously.

(1) Nahinsky, Ph.D. Thesis, University of California, 1942.

(2) Seaborg, *Chem. Rev.*, **27**, 256 (1940).

We have investigated electronic exchange between ferric and ferrous ions in 3 *M* perchloric acid using radioferric ion[3] as indicator. The concentration ratio of ferric to ferrous ions (R_0) was consistently close to 0.25 and the total iron concentration was 0.023 *M*. Exchange was allowed to proceed for periods up to nine days. No measurable oxidation of ferrous to ferric ion by air occurred in this time. Hydrolysis of ferric ion was slight.[4]

Measurement of exchange was dependent on partially separating ferric and ferrous ions by their diffusion from the exchange mixture across a sintered glass membrane[5] into 3 *M* perchloric acid.

Ferric and ferrous ion concentrations were determined colorimetrically at 480 mμ employing the thiocyanate method.

In thirty-minute diffusion periods at 25° ratios (R) of around 0.54 were obtained for ferric to ferrous ion concentrations in the diffusate. The average separation factor ($S = R_0/R$) of about 0.47 indicates ferric ion diffuses relatively more rapidly than ferrous ion.

If the half time for exchange is much greater than the time required for diffusion separation, it is possible to derive the relation

$$F = \left(\frac{A}{a_0W} - 1\right)\frac{R_0 + 1}{S - 1}$$

where the fraction of equilibrium exchange (F) is related to the radioactivity of the diffusate (A, in counts min.$^{-1}$), the specific activity of ferric ion (a_0, in counts min.$^{-1}$ mmol.$^{-1}$), and the millimoles of ferric ion in the diffusate (W) through the separation terms previously defined.

Initial results, subject to deviations of ±5% by virtue of the separation technique used, are: for thirty minutes, 2.2 and 3.8% of equilibrium exchange and for one case of poor separation, 9.6%; for two days, 8.7%; for five days, 13.9%; for seven days, 26.2%; and for nine days, 30.7%. These figures give a half time for exchange[6] of 18.5 ± 2.5 days.

We gratefully acknowledge the interest shown by Professor T. de Vries. Experimental results for ferric–ferrous ion exchange under other conditions will be the subject of a later communication.

CHEMISTRY DEPARTMENT
PURDUE UNIVERSITY
LAFAYETTE, INDIANA
L. VAN ALTEN
C. N. RICE[7]

RECEIVED DECEMBER 13, 1947

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(3) Supplied by U. S. Atomic Energy Commission.

(4) Rabinowitch and Stockmayer, THIS JOURNAL, **64**, 338 (1942).

(5) Northrop and Anson, *J. Gen. Physiol.*, **12**, 543 (1929).

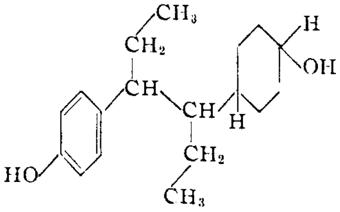
(6) Mackay, *Nature*, **144**, 997 (1938).

(7) Present address: The Lilly Research Laboratories, Indianapolis 6, Indiana.

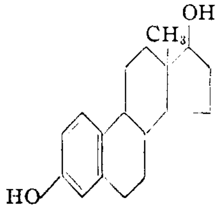
THE HEXAHYDRO DERIVATIVES OF *meso*-HEXESTROL

Sir:

After it was discovered that hexestrol is a highly potent estrogen, it became of considerable interest to prepare the hexahydro derivatives I since these bear a closer resemblance to the phenolic alcohol estradiol (II) than does the diphenol hexestrol itself. The activity of I would be of considerable significance in deciding whether the high physiological activities of hexestrol and diethylstilbestrol result from their superficial resemblance to the natural hormone II.



I



II

Our efforts to synthesize I (begun in 1940) have now proved successful, leading to the two stereoisomers corresponding in configuration at the bridge carbon atoms to *meso*-hexestrol. Recently Ungnade and Ludutsky [THIS JOURNAL, **69**, 2629 (1947)] reported the synthesis of the isomers of I related in configuration to the much less potent racemic hexestrol. In our synthesis hexestrol monomethyl ether was hydrogenated in the presence of copper chromium oxide catalyst at 240° and 425 atmospheres pressure, to obtain selective reduction of the phenolic ring. Demethylation of the mixture of methyl ethers by heating with methylmagnesium iodide at 170–190° gave a mixture of the phenolic alcohols I (soluble in Claisen alkali) in 40–50% yield. By recrystallization from dilute alcohol and benzene isomer A, m. p. 183–184° (cor.), was obtained. *Anal.* Calcd. for $C_{18}H_{28}O_2$: C, 78.2; H, 10.2. Found: C, 78.2; H, 9.9. The monobenzoate of A (Schotten–Baumann) melted at 68–69°. *Anal.* Calcd. for $C_{25}H_{32}O_3$: C, 78.9; H, 8.5. Found: C, 79.0; H, 8.6. Isomer B was obtained from the original filtrate and purified through the monobenzoate, m. p. 129.5–130° (cor.). *Anal.* Found: C, 79.0; H, 8.3. Saponification of the pure monobenzoate gave isomer B, which showed a variable melting point behavior. Recrystallization from benzene and from dilute methanol gave samples with the m. p. 133–134°; sublimation at 120° (0.01 mm.) resulted in material of m. p. 128–129.5°. When the 134° material was dried at 60° (0.1 mm.) the m. p. broadened to 134–141.5° (*Anal.* Found: C, 78.2; H, 10.0). Other samples melting as high as 143–145° were obtained. This behavior is indicative of polymorphism. Isomer B may be the same as the compound, m. p. 144–145°, obtained by Hoehn and Ungnade [THIS JOURNAL, **67**, 1617 (1945)] in low yield by hydrogenation of diethylstilbestrol.

Preliminary physiological assays carried out under the direction of Drs. R. K. Meyer and Elva Shipley Meyer of the Department of Zoology, indicate that both isomers are definitely weaker in