Society. The books of this series are expected to be authoritative and comprehensive within the field covered up to the time of publication. They will be of incalculable value to research mathematicians, who until the war were largely indebted to foreign publishers for such treatises. The present book by Jacobson is a worthy member of this series. It is not, however, recommended to the beginner.

The ring is the present evolutionary form to which linear algebras and hypercomplex systems are ancestral and of which they are special instances. The modern structure theory of linear algebras dates from the publication in 1907 of Wedderburn's thesis, and the structure of rings dates from Artin's paper of 1927. The representation theory of rings and their ideal theory is due to Emmy Noether and many other workers.

The author divides his subject into three parts: structure theory, representation theory and arithmetic ideal theory. In Chapter 1 he lays the foundations of the theory of endomorphisms of a group and throughout the book makes extensive use of the theory of rings of endomorphisms. By using the regular representations, the theory of abstract rings is obtained as a special case of the more concrete theory of endomorphisms. Moreover, the theory of modules, and hence representation theory, may be regarded as the study of a set of rings of endomorphisms all of which are homomorphic images of a fixed ring.

Chapter 2 deals with vector spaces and Chapter 3 with the arithmetic of non-commutative principal ideal domains. Chapter 4 is devoted to the development of these theories and to some applications to the problem of the representation of groups by projective transformations and to the Galois theory of division rings. The first part of Chapter 5 treats the theory of simple algebras over a general field; the second part is concerned with the theory of the characteristic and minimum polynomials of an algebra and the trace criterion for separability of an algebra.

The book is practically self-contained and embraces in its 150 pages a large amount of factual material. Such conciseness is obtained at the expense of elegance of typography, for many equations which would have looked better in displayed form have been run into the text. But this is a minor criticism of a book which is well planned and executed in a masterly manner.

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SPECIAL ARTICLES

THE ISOLATION OF PITUITARY GROWTH HORMONE[1]

IN this paper a method is described for the isolation of a protein from the anterior lobes of ox pituitaries which electively causes the resumption of body growth in hypophysectomized rats and which behaves as a single substance in electrophoresis.

The 2.0 *m* $(NH_4)_2SO_4$ precipitate of the $Ca(OH)_2$ extract[2] from the acetone dried powder of freshly dissected anterior lobes of ox pituitaries was made by a method previously described.[3] The precipitate was suspended in water and dialysed until free from electrolytes. The insoluble material after dialysis was dissolved in water and brought to pH 4.0 with 1.0 *m* HCl; a saturated NaCl solution was then added until the concentration was 0.1 *m*. A precipitate formed. The 0.1 *m* NaCl precipitate, found to be devoid of growth activity, was removed by centrifugation. The supernatant was brought to 5.0 *m* with solid NaCl,

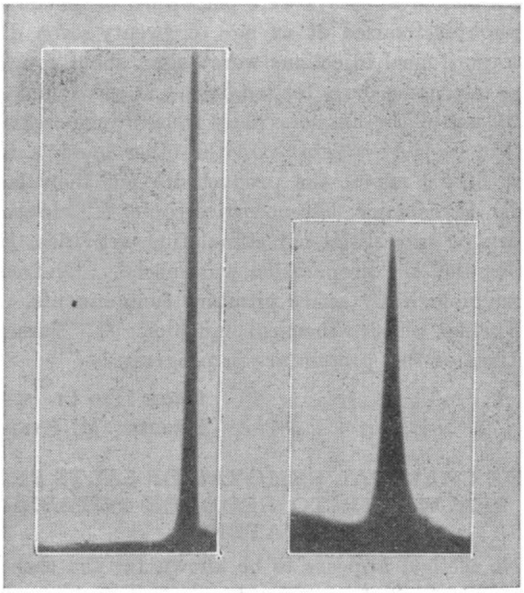
(A) (B)

FIG. 1. Electrophoretic patterns of ascending boundaries of pituitary growth hormone preparations. (A) in pH 4.00 acetate buffer and (B) in pH 9.80 borate buffer after the current has been put on for 135 and 140 minutes respectively with a potential gradient of about 6 volts per cm.

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[1] From the Institute of Experimental Biology, University of California, Berkeley. Aided by grants from the Rockefeller Foundation, New York City; the Josiah Macy Jr. Foundation, New York City; and the National Research Council Committee on Research in Endocrinology.

[2] All procedures were performed at 2 to 3° C.

[3] W. Marx, M. E. Simpson and H. M. Evans, *Jour. Biol. Chem.*, 147: 77, 1943.

and the precipitate formed was dissolved in pH 4.0. This NaCl fractionation was repeated twice. The final 5.0 *m* NaCl precipitate was dissolved in water and dialysed until salt-free. The dialysed solution was adjusted to pH 5.7–5.8 and the precipitate[4] formed was centrifuged off. The supernatant was then made alkaline and adjusted to pH 8.7–8.8, the precipitate[4] again being removed by centrifugation. The clear fluid was then next brought to 1.65 *m* $(NH_4)_2SO_4$ at pH 7.0. The $(NH_4)_2SO_4$ precipitate was dissolved in water and dialysed. The pH and $(NH_4)_2SO_4$ fractionation was repeated twice. The dialysed solution of the final 1.65 *m* $(NH_4)_2SO_4$ precipitate was made to pH 5.7–5.8. After the precipitate was removed by centrifugation, the supernatant was adjusted to pH 8.7–8.8. The precipitate formed was centrifuged off and the supernatant fluid brought to pH 6.8–6.9. The resulting precipitate was next dissolved in slightly acid solution and the isoelectric precipitation repeated twice.

The final pH 6.8–6.9 precipitate was examined in a Tiselius electrophoresis apparatus[5] using the scanning method of Longworth.[6] Experiments were carried out over a range of pH values from a pH 4.0 to 9.8 at a constant ionic strength of 0.10 using the acetate and borate buffers at 1.5°. In all these experiments the material appeared as a single substance (Fig. 1) with an isoelectric point at pH 6.85.

All biological assays were performed in female rats hypophysectomized at an age of twenty-seven days. Intraperitoneal injections were begun about fourteen days later, once daily for ten days. It was found that 0.010 mg of the hormone daily caused an increase of 10 gm in body weight. On the other hand, a total dose of 5.0 mg of the product did not show lactogenic, thyrotropic, adrenocorticotropic, follicle-stimulating or interstitial-cell stimulating activities, indicating that the preparation was substantially free of other biologically active pituitary contaminants.

Further physico-chemical and biological characterizations of this protein are in progress.

CHOH HAO LI
HERBERT M. EVANS

THE CHEMICAL REMOVAL OF SALTS FROM SEA WATER TO PRODUCE POTABLE WATER[1]

NO method appears to be known for the chemical removal of salts from sea water; in fact, such a method has been considered impossible by some.[2] The method herein described should therefore be of interest. The general principle involved is the addition of a sufficient quantity of a suitable base to precipitate the anions present followed by the addition of a sufficient quantity of a suitable acid to precipitate the cations. The method actually used is a special case of this general principle in that both the base (Ag_2O) and acid (uric acid) used as precipitants are practically insoluble; this fact obviates the necessity of accurate measurement of these reagents.

The chemical reactions in the order in which they are carried out may be illustrated as follows:

$$(1)\quad 2\overset{+}{Na} + 2\overset{-}{Cl} + Ag_2O + H_2O = 2\overset{+}{Na} + 2\overset{-}{OH} + 2\,AgCl$$

$$(2)\quad \overset{+}{Na} + \overset{-}{OH} + \text{uric acid} = \text{Na-urate} + H_2O$$

The AgCl is filtered off before the addition of the uric acid. The solution is again filtered after reaction (2), the filtrate of which is nearly free of dissolved materials (see below). The reactions above are written for the precipitation of NaCl; but most of the other important salts present in sea water appear to react in the same manner. However Ca^{++} and Mg^{++} would also be partly or wholly precipitated as hydroxides in reaction (1). The sulfate ion would not be expected to precipitate since Ag_2SO_4 is fairly soluble.

The following data show the experimental procedure and typical results obtained with artificial (McClendon's) sea water:[3]

<table>
<tr><th>Solution</th><th>Amount (cc)</th><th>pH</th><th>Total solids (gms/100 cc)</th><th>Remarks</th></tr>
<tr><td>1. Art. sea water</td><td>1,000 cc</td><td>ca. 7</td><td>3.40</td><td>solution clear and colorless.</td></tr>
<tr><td colspan="5">0.35 moles of Ag₂O added gradually over a period of about 20 minutes with stirring. Solution filtered immediately. Completion of reaction determined by persistence of brown Ag₂O in beaker.</td></tr>
<tr><td>2. Filtrate from (1)</td><td>1,000 cc</td><td>10</td><td>2.17</td><td>solution clear; brown in color.</td></tr>
<tr><td colspan="5">0.6 moles of uric acid added and solution stirred for about 20 minutes. Completion of reaction determined by noting fall of pH to near neutrality with indicator paper.</td></tr>
<tr><td>3. Filtrate from (2)</td><td>790 cc</td><td>ca. 8</td><td>0.58</td><td>solution clear; sl. brownish.</td></tr>
</table>

To determine how much of the total solids was urates and uric acid, a 20 cc portion of the filtrate from (3) was acidified with 1 N HCl to pH 3. A white precipitate soon formed. After standing a few

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[4] Both the pH 5.8 and pH 8.8 precipitates were found low in growth activity.

[5] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

[6] L. G. Longsworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

[1] The manuscript of this article was received on January 30, 1943. Publication was postponed at the request of the committee on medical research of the Office of Scientific Research and Development.

[2] R. F. Braddish and others, *Jour. Am. Med. Asn.*, 120, 683, 1942.

[3] C. G. Rogers, Textbook of Comparative Physiology, p. 154. New York: McGraw-Hill, 1927.