growth. The rice bran filtrate furnished adequate amounts of filtrate factor and the whey adsorbate adequate amounts of riboflavin as determined by separate assays. The soybean oil furnished ample vitamin K and the sardine oil adequate amounts of vitamins A and D. Growth was restored when dried brewers' yeast or extracts made from it were added. Representative weights, at 6 weeks, of chicks not receiving the yeast supplement were 156 grams and of those receiving it 451 grams.

This growth factor has been found in dried brewers' yeast, yeast grown in a whey medium, wheat bran, middlings and alfalfa meal. The factor is insoluble in ether, acetone, isopropanol, and slightly soluble in methanol. It can readily be extracted by 50 per cent. methanol. The factor can be adsorbed on fuller's earth and on activated charcoal. A 1:1:4 solution of pyridine, methanol and water will elute the factor from fuller's earth. Refluxing for thirty minutes at pH 11.0 and at pH 1.7 did not destroy the factor present in a yeast extract. Autoclaving for five hours at 120° C. destroyed the factor present in alfalfa meal but not in dried yeast.

E. L. R. STOKSTAD
P. D. V. MANNING

RESEARCH LABORATORY,
WESTERN CONDENSING CO.,
PETALUMA, CALIF.

REPORTS

NATIONAL RESEARCH FELLOWSHIPS IN THE NATURAL SCIENCES OF THE NATIONAL RESEARCH COUNCIL

THE National Research Fellowships Board in the Natural Sciences, of the National Research Council, has made the following fellowship appointments for the academic year, 1938–1939:

REAPPOINTMENTS FOR A SECOND YEAR

James Forbes Bell (Ph.D. in geology, University of Munich, 1935). To work at Massachusetts Institute of Technology. Subject: The plastic deformation of crystals with especial attention to twin-gliding.

Ralph Philip Boas, Jr. (Ph.D. in mathematics, Harvard University, 1937). To work at Princeton University. Subject: Trigonometric integrals; moment problems; Laplace transforms.

Bryce Low Crawford, Jr. (Ph.D. in chemistry, Stanford University, 1937). To work at Harvard University. Subject: The spectroscopic determination of molecular structure and energetics of organic compounds.

Ralph Emerson (Ph.D. in biology, Harvard University, 1937). To work at the University of Cambridge, England. Subject: An experimental investigation of *Allomyces* and related forms, bearing on general biological problems of sexuality, alternation of generations, and cytoplasmic heredity.

Jesse Leonard Greenstein (Ph.D. in astronomy, Harvard University, 1937). To work at Yerkes and McDonald Observatories of the University of Chicago. Subject: The interstellar medium and problems of interstellar absorption.

William Conyers Herring (Ph.D. in mathematical physics, Princeton University, 1937). To work at Massachusetts Institute of Technology. Subject: The quantum mechanics of crystals.

Paul Henry Settlage (Ph.D. in psychology, University of Wisconsin, 1937). To work at the Sprague Institute, University of Chicago. Subject: Corticalization of function in man: the parieto-occipital area.

Fred Beals Stitt (Ph.D. in physical chemistry, California Institute of Technology, 1936). To work at Harvard University. Subject: Internal rotation in ethane and diborane.

NEW APPOINTMENTS

Arthur B. Burch (Ph.D. in zoology, University of California, 1938). To work at the Zoologisches Institut, Freiburg, Germany. Subject: The early embryology of the pituitary body; investigation of the developmental relationships of the *pars buccalis* and the *pars neuralis*.

Ray Fields Dawson (Ph.D. in botany, Yale University, 1938). To work at Columbia University. Subject: The physiology of nicotine in tobacco.

Philip Drucker (Ph.D. in anthropology, University of California, 1936). To work at Columbia University. Subject: Archeological survey of the Northwest Coast.

Robert Eli Duncan (Ph.D. in botany, University of Wisconsin, 1938). To work at Victoria University of Manchester, England. Subject: Experimental induction of apogamy and study of allied phenomena in ferns.

Eugene Henderson Eyster (Ph.D. in physical chemistry, California Institute of Technology, 1938). To work at the University of Michigan. Subject: The application of infrared spectroscopy to problems of molecular structure.

William D. Gray (Ph.D. in phytopathology, University of Pennsylvania, 1938). To work at the University of Wisconsin. Subject: Physiological studies on myxomycetes; their laboratory cultivation and factors influencing rhythmical fruiting.

George Kenneth Green (Ph.D. in physics, University of Illinois, 1937). To work at the University of California. Subject: The scattering of charged particles at high energies.

Arthur Feodor Hagner (Ph.D. in geology, Columbia University, 1938). To work at Columbia University. Subject: Fundamental studies of the montmorillonite group of clay minerals.

Dick Wick Hall (Ph.D. in mathematics, University of Virginia, 1938). To work at the University of Pennsylvania. Subject: The structure of true cyclic elements and the properties of sets under pointwise

periodic and pointwise almost periodic transformations.

Lloyd Girton Humphreys (Ph.D. in psychology, Stanford University, 1938). To work at Yale University. Subject: The relationship of simple reinforcement and success as factors in the acquisition and extinction of conditioned responses.

Willis Eugene Lamb, Jr. (Ph.D. in physics, University of California, 1938). To work at the University of Wisconsin. Subject: Problems in nuclear physics.

Raymond Braislin Montgomery (D.Sc. in meteorology, Massachusetts Institute of Technology, 1938). To work at the Institut für Meereskunde, Berlin, Germany. Subject: Isentropic analysis of the major circulation phenomena of the upper layers of the southern North Atlantic Ocean.

Keith Roberts Porter (Ph.D. in biology, Harvard University, 1938). To work at Princeton University. Subject: The development of androgenetic frog embryos.

Van Rensselaer Potter (Ph.D. in agricultural chemistry, University of Wisconsin, 1938). To work at the Biokemiska Institutet, Stockholm, Sweden. Subject: A study of the physiological action of the antipellagra vitamin (nicotinic acid).

Hermann Rahn (Ph.D. in embryology genetics, University of Rochester, 1938). To work at Harvard University. Subject: Cytology and physiology of the bird pituitary.

Birdsey Renshaw (Ph.D. in zoology, Harvard University, 1938). To work at the Rockefeller Institute for Medical Research. Subject: The activity of the nervous system investigated with microelectrodes.

Lewis Joseph Sargent (Ph.D. in organic chemistry, University of Edinburgh, 1938). To work at the University of Virginia. Subject: To attempt the synthesis of oestrogenic substances.

Hurst Hugh Shoemaker (Ph.D. in zoology, University of Chicago, 1938). To work at Stanford University. Subject: A study of hormonal influences on position in the social hierarchy among canaries.

Lyman Spitzer, Jr. (Ph.D. in physics, Princeton University, 1938). To work at Harvard College Observatory. Subject: The structure of stellar atmospheres.

David P. Stevenson (Ph.D. in chemistry, Princeton University, 1938). To work at California Institute of Technology. Subject: The electric diffraction investigation of the structure of oximes and related molecules.

Gustav McKee Watkins (Ph.D. in plant cytology, Columbia University, 1935). To work at the Bureau of Plant Industry, Washington, D. C. Subject: A study of host-parasite relations in the *Phymatotrichum* root rot disease.

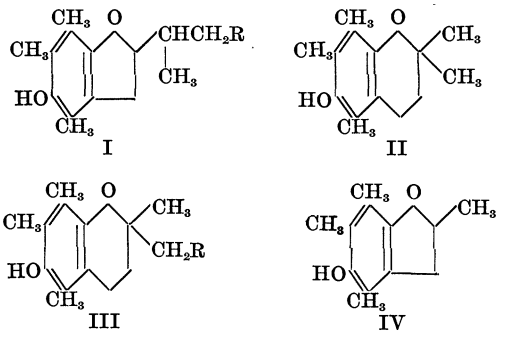
Frederick Taylor Wolf (Ph.D. in botany, University of Wisconsin, 1938). To work at Harvard University. Subject: The biology and cytology of the aquatic Phycomycetes.

ROSS G. HARRISON,
Chairman, National Research Council

SPECIAL ARTICLES

THE CHEMISTRY OF VITAMIN E. I. THE STRUCTURE AND SYNTHESIS OF α-TOCOPHEROL

IN a recent publication Karrer[1] has reported the synthesis of α-tocopherol from trimethylhydroquinone, phytylbromide and zinc chloride. On the basis of a supposed analogy in this reaction between phytylbromide and allylbromide, Karrer has assigned to the vitamin the structure I (R = perhydrofarnesyl), with a 5-membered hetero ring. It is true that the reaction between trimethylhydroquinone and allylbromide leads to IV, mp. 123–123.5 (uncorr.) with a 5-membered hetero ring. We prepared IV in this manner, and also by reduction of the corresponding coumarone which was obtained from trimethylquinone and acetoacetic ester;[2] the two syntheses led to the same substance, which is certainly, therefore, a coumarane. Bergel, Jacob, Todd and Work[3] have also synthesized IV, mp. 124–125°. Several years ago, Claisen[4] showed that, while phenols and allyl bromide condensed to give coumaranes, the use of γ,γ-disubstituted allyl bromides led to chromanes. We have prepared II in three different ways: (a) from trimethylhydroquinone and γ,γ-dimethylallylbromide; (b) from trimethylhydroquinone and isoprene, and (c) from 5,7,8-trimethyl-6-hydroxy-3,4-dihydrocoumarin[5] and methyl magnesium iodide. All three syntheses led to the same crystalline product, mp., and mixed mp., 94–94.5°. The third synthesis could lead only to a chromane; therefore the product of all these syntheses is II. If, therefore, the analogy is correct and phytyl bromide is regarded as a γ,γ-disubstituted allylic bromide, it should react with



[1] *Helv. Chim. Acta.*, 21: 520, 1938.

[2] Smith and MacMullen, *Jour. Am. Chem. Soc.*, 58: 629, 1936.

[3] *Nature*, 141: 646, 1938.

[4] *Ann.*, 442: 228, 1925.

[5] Smith and Denyes, *Jour. Am. Chem. Soc.*, 58: 304, 1936.