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AGE, CHANGE AND THE ADAPTED LIFE[1]

By Dr. WM. de B. MacNIDER

KENAN RESEARCH PROFESSOR OF PHARMACOLOGY, THE UNIVERSITY OF NORTH CAROLINA

THE interest in ageing which has expressed itself here in such a happy and helpful fashion during the past two days is not new as an intellectual adventure. The application of such understanding is in the period of its anticipated commencement. To date it has not related itself to life in the form of a basic consideration of such a process on which and from which specific interpretations of the varied manifestations of life at different age periods may be considered. The average individual, too frequently the biologist and usually the pathologist, limits his interest and confines his intelligence of ageing to narrow categories of thought. He fails to appreciate the yearning of tissues for life and the amazing chemical and structural modifications they may participate in, even gross structural changes designated disease, in order to bring about organ adaptation and the adaptation of the individual as a whole to those changes which occur as the life span progresses. The certainty of the termination of this life span and the fact that all living things are concerned with it has stimulated the imagination of poets and philosophers. Their inquisitiveness has been either romantic or dominated by resignation and has not been demonstrably helpful. Another period which concerns itself with the facts of life is in its beginning, and as these facts accumulate through chemical, biological and psychical research the romance of life will find sound ground on which to express its related beauty. Ultimate resignation will become lost in an interest in the transitory prolongation and effectiveness of the different periods of the life span. The Browning concept of the "last of life for which the first was made" will assume tangible significance.

For centuries before Cicero's great statement concerning old age thought had been given to this state of man, but only in what may be designated recent

[1] An address at the Symposium on Ageing, Washington University Medical School, Saint Louis, March 24 and 25, 1944.

strongly reducing substance, II. Both I and II showed positive ketose tests with Seliwanoff's reagent, and were levorotatory. The osazone of II was identical with that of fructose.

On the basis of the above observations it is concluded that fructosan is one of the carbohydrate constituents of guayule. In so far as tests conducted to date indicate, this polysaccharide (I) appears to be inulin,[1] but its exact constitution remains to be determined.

Using a colorimetric method, values for the fructosan content in the stem and roots of guayule have ranged from 0.2 to 12 per cent. (dry weight basis), depending on the conditions under which the plants were grown. Evidence that this polysaccharide is the chief storage carbohydrate in this species will be presented in detail elsewhere.

WILLARD L. MCRARY
HAMILTON P. TRAUB

U. S. DEPARTMENT OF AGRICULTURE,
AGRICULTURAL RESEARCH ADMINISTRATION,
BUREAU OF PLANT INDUSTRY, SOILS AND
AGRICULTURAL ENGINEERING
GUAYULE RESEARCH PROJECT,
SALINAS, CALIF.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NUCLEAR BEHAVIOR IN RELATION TO CULTURE METHODS FOR PENICILLIUM NOTATUM WESTLING

DIFFERENCES in the yield of penicillin from *Penicillium notatum* Westling occur among strains or in subcultures of the same strain, even when grown from single spore isolations. Clutterbuck, Lovell and Raistrick[1] reported difficulty in maintaining Fleming's strain of *P. notatum*. Currently Hansen and Snyder[2] attribute this variation to the dual phenomenon which they have found to be characteristic of many fungi.[3] To maintain an active culture these authors recommend selection of a suitable strain following single spore isolation and tests for yield. Subsequent transfers can then be made by mass spore transfer.

Foster *et al.*[4] recommend merely the selection of a high potency strain and its maintenance by mass spore transfers. An analysis of the 19 substrains they derived from 3 different parent colonies clearly suggests that association and dissociation of genetic factors can not be overlooked as an explanation of the varied results recorded by these and other investigators.

In none of these accounts has the nuclear behavior been taken into consideration. If heterokaryosis or the interaction of genetically different haploid nuclei in the same mycelium is responsible for the variation in penicillin production it is necessary to know whether *P. notatum* has a nuclear cycle capable of such behavior. The details of a cytological investigation of this fungus are now in press, to be published shortly.[5] It will suffice here to say that the conidia of this fungus are predominantly uninucleate although occasionally binucleate conidia occur. Using C and M to designate types, single conidia then could comprise either of these genetic factors or their possible combinations: C, M, CM, CC or MM, depending on the number of nuclei per conidium. If a spore is heterotypic then the genetic means of variation are present from the outset. If it is homotypic presumably the line can be developed monotypically provided no mutations occur. However, in mass spore transfers a few hours after germination there is marked anastomosis among the developing germ tubes, conidia and mycelia, giving abundant opportunity for nuclear interchange. Since analysis of cultural isolates indicates that the variations are due to a mixture of genetic factors following anastomosis and the establishment of heterokaryosis, it would appear that at present mass spore transfer methods would offer as certain a way as any of keeping active cultures. Unless a spore is binucleate and heterotypic, an infrequent condition in this fungus, the effect of heterokaryosis is eliminated by single spore transfer. Mass spore transfer increases the chances of nuclear mixing and consequently heterokaryotic vigor.

GLADYS E. BAKER

PLANT SCIENCE DEPARTMENT,
VASSAR COLLEGE

[1] After this note was submitted for publication, an incidental statement (not supported by data) to the effect that inulin occurs in guayule was found in a report of the Experimental Chemical Laboratory of the Italian Ministry of War (Silvio Guglielminetti, *Azzurra Agricola-Floreale*, 16: 63, 1936).

[1] P. W. Clutterbuck, R. Lovell and H. Raistrick, *Biochem. Jour.*, 26: 1907, 1932.

[2] H. N. Hansen and W. C. Snyder, SCIENCE, 99: 264, 1944.

[3] H. N. Hansen, *Mycologia*, 30: 442, 1938.

[4] J. W. Foster, H. B. Woodruff and L. E. McDaniel, *Jour. Bact.*, 46: 421, 1943.

[5] G. E. Baker, *Bull. Torrey Bot. Club*. In press.

BOOKS RECEIVED

ANDRES, PAUL G., HUGH J. MISER and HAIM REINGOLD. *Basic Mathematics*. Illustrated. Pp. x + 726. John Wiley and Sons, Inc. $4.00.

GRAHAM, EDWARD H. *Natural Principles of Land Use*. Illustrated. Pp. xiii + 274. Oxford University Press. $3.50.

SMITH, GILBERT. *Marine Algae of the Monterey Peninsula*. Illustrated. Pp. ix + 622. Stanford University Press. $6.00.

YOST, DON M. and HORACE RUSSELL, JR. *Systematic Inorganic Chemistry*. Illustrated. Pp. xx + 423. Prentice-Hall. $4.60.