modification. The change consisted of using a 500-ml. mixing flask filled with water and gradually adding 2 *N* acetic acid during the elution. Fractions of 20 ml. were collected at 40 ml./hr. with a mechanical fraction collector. Each fraction was chromatographed on Whatman No. 1 paper with butanol–acetic acid–water (4 : 1 : 5). Quinic acid was detected with the Cartwright–Roberts[4] spray reagent in fractions 12 to 22, which were combined and evaporated to near dryness under reduced pressure. The residue was dissolved in 100 ml. of ethanol and precipitated by adding 4 vol. of ethyl ether. The crude quinic acid (2·5 gm.) recrystallized twice from ethanol produced 1·5 gm. of pure material. Apart from its chromatographic properties similar to quinic acid, the isolated compound had a melting point of 162° C. (ref. 8, 162° C.), which was not depressed when mixed with authentic quinic acid : $[\alpha]_D^{23} = -43°$ (ref. 8, $[\alpha]_D^{20} = -44°$) ; neutralizing equivalent, 195. Infra-red absorption was also similar to that of an authentic sample of quinic acid.

Table 1. QUINIC ACID IN MATURE CITRUS FRUIT

Variety and type of citrus fruit	Peel (mgm./100 gm. fresh weight)	Flesh (mgm./100 gm. fresh weight)
Pineapple orange	172	52
Marsh grapefruit	233	87
Dancy tangerine	206	27
Corregia lemon	161	18
Persian lime	209	146

Amounts of quinic acid present in the peel and flesh of mature fruit of several citrus varieties are given in Table 1. The quinic acid was determined by titration after elution from the column and complete removal of the acetic acid[7]. Results for the proportions of quinic acid relative to the other organic acids in citrus fruits will be published in due course.

This work was carried out in co-operation with the Florida Citrus Commission, Lakeland, Florida.

S. V. TING
E. J. DESZYCK

Citrus Experiment Station
(University of Florida),
Lake Alfred, Florida.
Jan. 20.

[1] Menchikovsky, F., and Popper, S., *Hadar*, **5**, 181 (1932).
[2] Wolf, Johannes, *Fruchtsuft-Ind.*, **3**, 93 (1958) ; *Chem. Abstracts*, **52**, 20750h (1958).
[3] Sinclair, W. B., and Eny, D. M., *Bot. Gaz.*, **108**, 398 (1947).
[4] Cartwright, R. A., and Roberts, E. A. H., *Chem. and Indust.*, 230 (1955).
[5] Hulme, A. C., *J. Exp. Bot.*, **2**, 298 (1951).
[6] Anet, E. F. L. J., and Reynolds, T. M., *Nature*, **172**, 1188 (1953).
[7] Hulme, A. C., and Wooltorton, L. S. C., *J. Sci. Food Agric.*, **9**, 150 (1958).
[8] Pigman, W. W., and Goepp, R. M., "Chemistry of the Carbohydrates", 270 (Academic Press, Inc., New York, 1948).

BIOLOGY

Old and New Solutions to the Eel Problem

THE ingenious hypothesis proposed by Dr. D. W. Tucker[1] to explain the complex problems of the biology of the European eel presents in my opinion some heavy difficulties. I believe it therefore necessary to offer some observations with the intention of clarifying the question.

(1) When the European eel descends to the sea as a silver eel it does not show "a profound degeneration of the gut". The occlusion of the vent observed by Schnakenbeck[2] is, according to my experience, an entirely exceptional occurrence. All the silver eels I have examined had a gut of normal structure, although small in volume[3]. Silver eels kept in aquaria are indeed able to take up food again, although they are not so voracious as the yellow eels.

Survival and re-feeding of silver eels is not followed by regression of the gonads. Regressive pictures are frequently observed in the eels' gonads, even in the yellow eels ; but this is a cytological phenomenon that does not affect the whole gonad as an organ[4].

The whole organization of the descending eel does not present any indication of nearing death. Changes in colour and structure of the teguments, eye enlargement, transformation of retinal pigments[5], functional activation of the endocrine system are all conditions suggesting that when silver eels are going to live in deep marine waters they are still endowed with an intense vitality.

(2) On the basis of Schmidt's[6] results, it seems that European and American eels spawn in two slightly displaced areas ; but we cannot exclude the possibility that these areas are coincident. In any event there is no evidence sufficient to support the idea that a temperature difference of a few degrees would be enough to induce two sets of genetically homogeneous larvæ to acquire such different numbers of myomeres as 103–111 (average 107·2) for *Anguilla rostrata* and 110–119 (average 114·7) for *A. anguilla*. Even in the youngest larvæ or prelarvæ, there are clearly discrete myomere numbers[7], and to admit such a strong environmental influence would require the assumption that the eggs, from the beginning of their development, are separated into two completely isolated groups, one of which is carried in warmer, the other in cooler waters, without intermediate conditions. Hydrographic hypotheses do not seem to be sufficiently well founded to explain such a clear-cut separation of two variability curves of the myomere numbers as observed by Schmidt[7] between the larvæ of the American and the European eel.

The differentiation in the myomere numbers occurs in any event too early to be related to the influence of the Atlantic currents with their different temperatures. In the spawning area there are no sharp limits between cold and warm superficial waters, but a gradual variation from south to north of only 4 deg. C.

It is true that there are still a number of difficulties in explaining the life-history of the eel. It is particularly difficult to prove that all the Mediterranean eels are compelled to go out to the Atlantic. However, the fact that we are not able to capture them in the Strait of Gibraltar is not decisive evidence against such a migration.

The biology of the eel is certainly one of the most puzzling problems in marine biology, but the interpretation proposed by Dr. Tucker requires so many new hypotheses that it is too difficult to accept it on the basis of present knowledge.

UMBERTO D'ANCONA

Zoological Department,
University, Padua.

[1] Tucker, D. W., *Nature*, **183**, 495 (1959).
[2] Schnakenbeck, W., *Zool. Anz.*, **108**, 85 (1934).
[3] D'Ancona, U., *Riv. Biol.*, **43**, 171 (1951).
[4] D'Ancona, U., *Arch. Ocean. Limnol.*, **3**, 159 (1943).
[5] Carlisle, D. B., and Denton, E. J., *J. Mar. Biol. Assoc.*, **38**, 97 (1959).
[6] Schmidt, J., "Danish Eel Investigations" (Copenhagen, 1932).
[7] Schmidt, J., *Phil. Trans. Roy. Soc.*, B, **211**, 179 (1922).

©1959 Nature Publishing Group