FICHES D'IDENTIFICATION DU ZOOPLANCTON

Editées par
J. H. FRASER

Marine Laboratory, P.O. Box 101, Victoria Road,
Aberdeen AB9 8DB, Scotland

FICHE NO. 150/151

SOLEIDAE
OF THE EASTERN NORTH ATLANTIC

by

J. H. Nichols

Fisheries Laboratory
Lowestoft, Suffolk NR 33 OHT, England

(This sheet may be referred to in the following form:
Nichols, J. H. 1976. Soleidae,
Fich. Ident. Zooplancton 150/151: 10 pp.)

Conseil International pour l'Exploration de la Mer
Charlottenlund Slot, DK-2920 Charlottenlund
Danemark

SEPTEMBRE 1976

INTRODUCTION

This sheet deals in detail with the four species of Soleidae occurring commonly within the areas listed in Table 1. The Soleidae are a warm-water family, reaching the northerly limit of their distribution in the northern North Sea. Consequently, many more genera are found south of the Atlantic area covered by Table 1, and in the Mediterranean. The adult of one of the southerly genera *Dicologlossa azevia*, has been recorded once in the western English Channel and it also occurs occasionally in the southern part of the Bay of Biscay. Insufficient information on the egg and larval development of this genus, and the rare deep-water form *Bathysolea profondicola*, is available for them to be included here.

This sheet should be used together with no. 4–6, (Nichols, 1971), on the Pleuronectidae, which includes a key to the families in the order Heterosomata. The information on material and methods in that sheet is also applicable here. Since its publication I have found the use of a polarized light system on a steroscopic microscope extremely useful for counting vertebrae and myotomes when these are necessary.

The eggs of the Soleidae are quite distinctive as a group, but reference may be made to complete egg keys (Ehrenbaum and Hoek, 1911; Lee, 1966; Bal, 1940–41) or a size chart (Simpson, 1956).

IDENTIFICATION

A. Eggs

Order Heterosomata – Family Soleidae

The eggs are planktonic, round, and contain more than one oil globule. The yolk is segmented around the perimeter of the egg. Small perivitelline space.

(a) Numerous small oil globules arranged into many irregular groups
  (i) Oil globules of varying size in a few large groups around the surface of the yolk. Large egg, 0.95–1.58 mm diameter ..... *Solea solea*
  (ii) Oil globules of varying size, some in small groups, some isolated. Large egg, 1.00–1.40 mm diameter[1] ..... *Pegusa lascaris*

(b) Oil globules of varying size, remaining separate and distributed at equal distances over the yolk.
  (i) Large egg, 1.16–1.42 mm, containing 30–50 oil globules ..... *Microchirus variegatus*
  (ii) Small egg, 0.64–0.94 mm diameter, containing about 12–15 large oil globules ..... *Buglossidium luteum*

[1]) Based on Mediterranean samples. (Lee, 1966).

B. Larvae

Family Soleidae

Yolk-sac stages

Many oil globules present in the yolk sac; yolk segmented; vesicular expansion of the embryonic dorsal fin above the mid brain; mid brain well developed, frontal region prominent. Eyes unpigmented on hatching.

Larva hatches at less than 2.5 mm length 1
Larva hatches at 2.5 mm length or greater 2

1. A few large oil globules spread evenly over the yolk sac. Larva hatches at about 2 mm length (Fig. 3a) ..... 1.1 *Buglossidium luteum*
2. Oil globules of varying size in a few large groups in yolk sac. Larva hatches at about 3 mm length; large stellate chromatophores present in the marginal fins (Fig. 2a–b) ..... 2.1 *Solea solea*
   Oil globules of varying size, some in small groups, others isolated. Larva hatches at less than 4 mm length. The dorsal marginal fin extends well over the head, giving the larva a distinct hooded appearance. (Fig. 1a) ..... 2.2 *Pegusa lascaris*
   Oil globules of varying size but remaining separate. Larva hatches at about 2.5 mm. Pigmentation, in the form of small stellate chromatophores over the body and marginal fins, is very light. (Fig. 4a) ..... 2.3. *Microchirus variegatus*

Mid-larval stages prior to the onset of asymmetry

Pigment in the form of a few large stellate chromatophores in the marginal fins, with denser patches of pigment along the dorsal and ventral body margins. 1
Pigment in the form of many small stellate chromatophores – in the marginal fins and on the body. 2

1. Large irregular stellate chromatophores in the marginal fins and along the body margins; no regular pattern distinguishable. 45–50 myotomes visible. (Fig. 2, c–f) ..... 1.1 *Solea solea*
A few large stellate chromatophores in the marginal fins and on the body margin. There is an aggregation of pigment across the post anal portion of the body and on the ventral abdominal wall forming distinct patches. 36–38 myotomes visible. The larva develops a distinct indentation of the forehead ("pug nose"). (Fig. 3 b–e) ..... 1.2 *Buglossidium luteum*

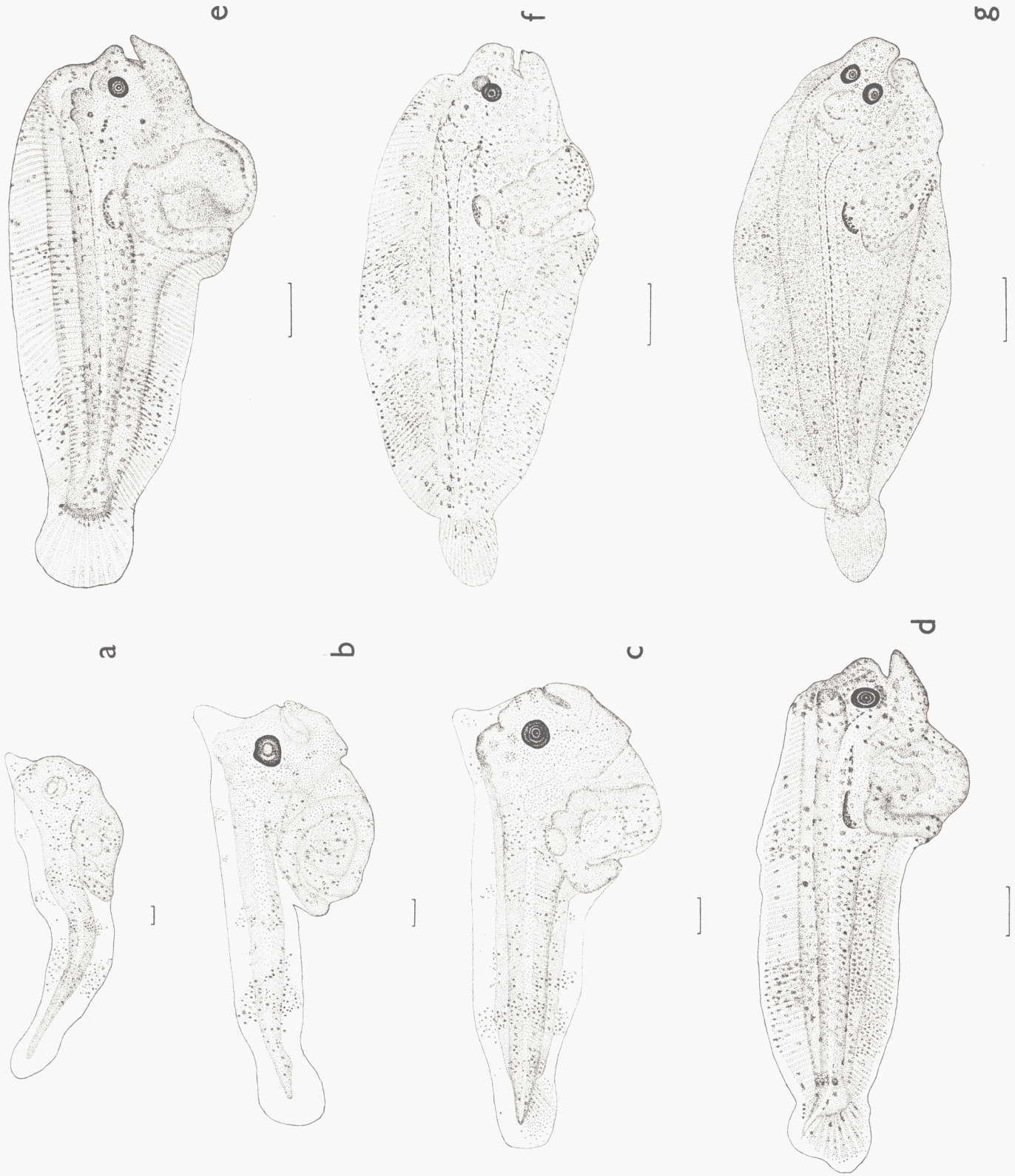

Figure 1. *Pegusa lascaris*. a–3.2 mm: yolk sac; b–4.7 mm; c–6.4 mm; d–8.7 mm; (after Clark, fig. 8); e–9.5 mm: (after Clark, fig. 9); f–11.0 mm; (after Clark, fig. 10); g–11.25 mm; (after Clark, fig. 11).

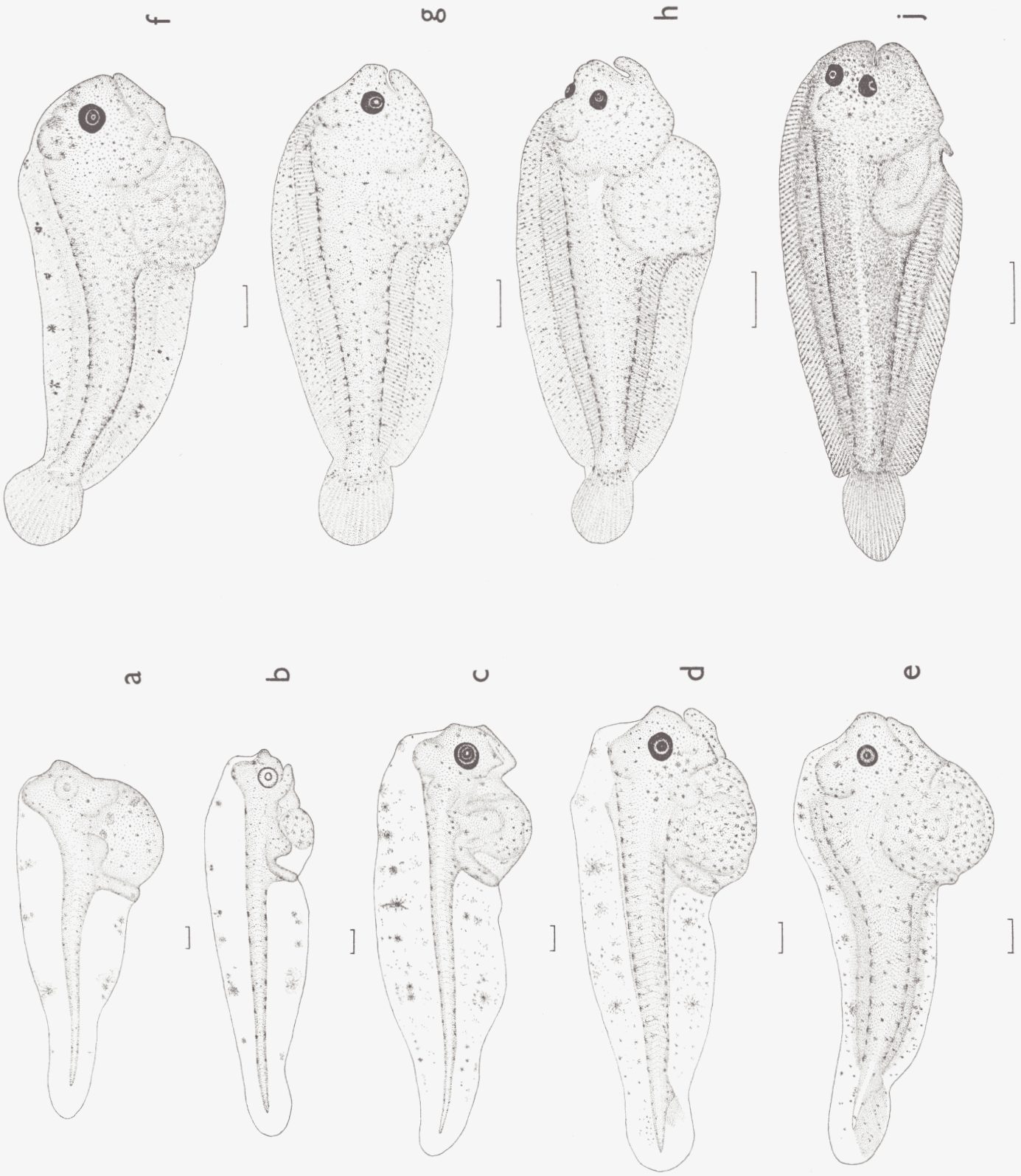

Figure 2. *Solea solea*. a–3.8 mm: yolk sac; b–4.1 mm; yolk sac; c–4.4 mm; d–5.4 mm; e–6.0 mm; f–7.2 mm; g–8.3 mm; h–9.8 mm; j–10.9 mm.

Figure 3. *Buglossidium luteum*. a–2.2 mm: yolk sac; b–3.5 mm; c–4.6 mm; d–5.5 mm; e–6.1 mm; f–7.4 mm; g–7.6 mm; h–8.3 mm.

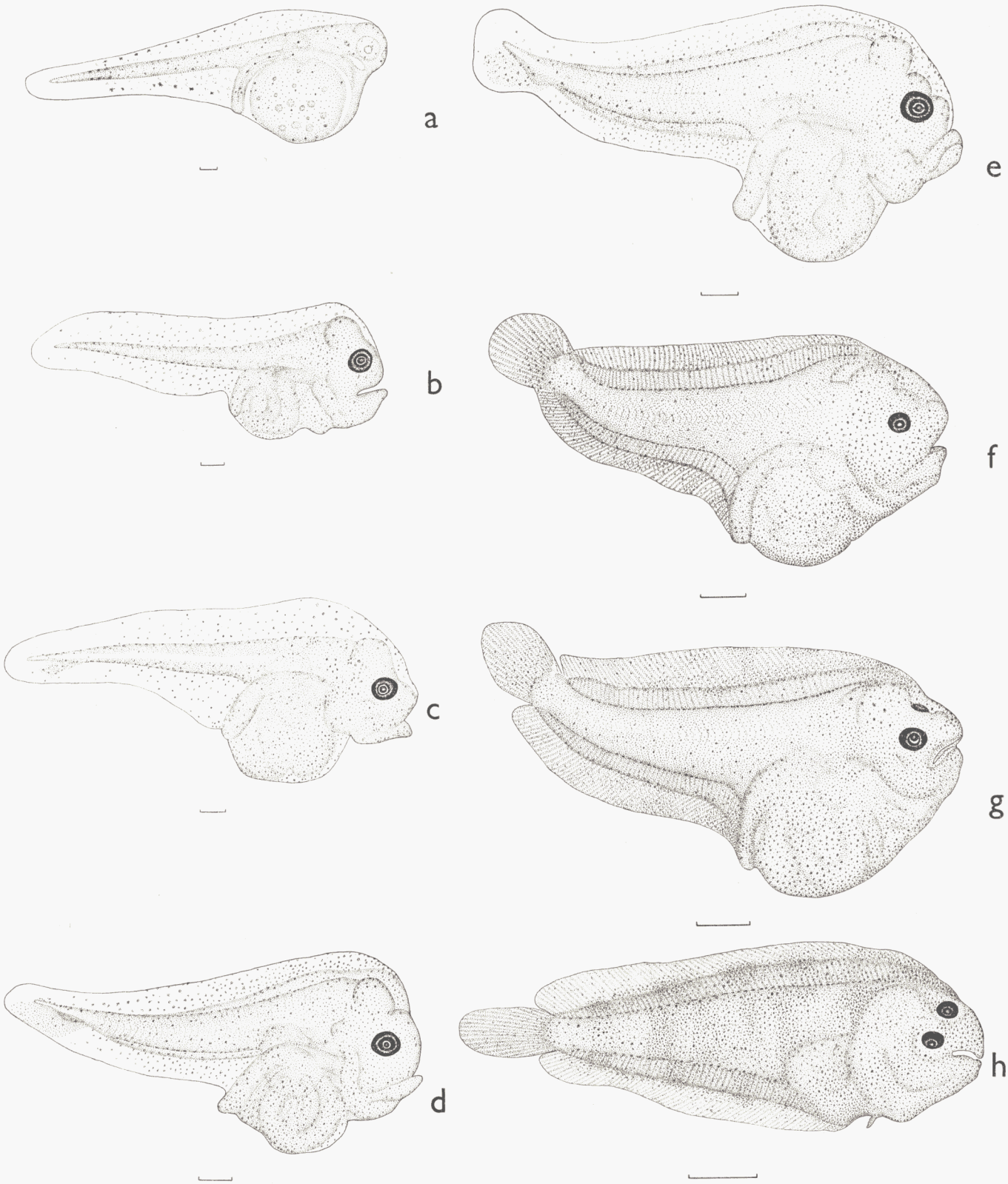

Figure 4. *Microchirus variegatus*. a–3.0 mm: yolk sac (after Cunningham Pl XVII, fig. 2); b–4.0 mm; c–4.8 mm; d–5.8 mm; e–6.5 mm; f–8.0 mm; g–9.3 mm; h–12.0 mm.

2. Small stellate chromatophores develop mainly in three areas of the marginal fins and body, one above the gut and two postanally (one in the very early stages), forming three (or two) indistinct bands. Lower jaw protruding. (Fig. 1 b–e) ..... 2.1 *Pegusa lascaris*
Small light stellate chromatophores are spread evenly over the body and marginal fins. In addition four indistinct longitudinal rows develop in the marginal fins and on the body. Later the pigmentation becomes denser on the left side than on the right. (Fig. 4 b–f). 2.2 *Microchirus variegatus*

KEY TO THE METAMORPHOSING STAGES

Number of caudal fin rays less than 19: Number of vertebrae less than 43 1
Number of caudal fin rays greater than 19: Number of vertebrae greater than 43 2

1. Small stellate chromatophores diffused over the body, head, gut and fins. More densely pigmented on the underside (left). Swimbladder not evident. Number of vertebrae 39–42 (9, 10 + 30, 31, 32). (Fig. 4 g–h) ..... 1.1 *Microchirus variegatus*
Pigment in the form of large stellate chromatophores. Larva very small at metamorphosis (less than 9 mm). Head shape very distinctive with a definite "pug snout". Swimbladder prominent. Number of vertebrae 36–38 (9 + 27, 28, 29). (Fig. 3 f–h) ..... 1.2 *Buglossidium luteum*

2. Large prominent swimbladder. Pigment in three horizontal diffuse bands. Lower jaw protruding. The first dorsal ray insertion is well in advanc- of the left eye. (Fig. 1 f–g) ..... 2.1 *Pegusa lascari-*
Swimbladder not clearly visible. Pigment not in the form of bands, but spread evenly over the whole larva. (Fig. 2 g–j.) ..... 2.2 *Solea solea*

Notes on identification

1. *Pegusa lascaris* (Risso, 1810) (The French sole or Sand sole)

This species, whilst not common on the coasts of the British Isles, is found in the English Channel and occasionally in the North and Irish Seas (JENKINS, 1925). It is locally quite common on the coasts of the Bay of Biscay. The recently metamorphosed young occur regularly in small numbers in the shallow bays along the coast of North Cornwall (J. D. RILEY, pers. comm.). The main spawning takes place from May–August (CLARK 1920; JENKINS 1925), but Hefford (1910–13) found a single egg in samples from off Plymouth in March. (RUSSELL 1969) occasionally records the larvae from Plymouth as early as May but, of ten larvae I found in monthly samples from this area in 1971, none occurred before the end of July. The eggs are similar in size to those of *Solea solea*, but the oil globules are quite different in appearance from those of *S. solea*, *M. variegatus* or *B. luteum*, some being separate whilst others are in small groups over the whole yolk surface.
The larva on hatching is less than 4 mm in length and shows the characteristic "hooded appearance" produced by the expansion of the marginal fin over the head (CLARK, 1914). The larval pigmentation from hatching and throughout development is characteristic. The form of the stellate chromatophores is not as distinct as in the other species, giving the pigment a smudged appearance. In the early stages there is a large aggregation of stellate chromatophores, postanally across the body and into the marginal fins, forming a distinct bar (CLARK, 1914). Two distinct chromatophores appear in the dorsal marginal fin, around which other chromatophores develop, eventually forming two more distinct bars, one preanal and one postanal. The large swimbladder is prominent throughout the later larval development. Asymmetry begins at 9–10 mm, complete metamorphosis occurring at 11–12 mm. Difficulty may be experienced in separating the very latest pelagic phases from those of *Solea solea*, after the loss of larval pigment and before the appearance of the characteristic nasal rosette of *P. lascaris* (see WHEELER, 1969).

2. *Solea solea* (Linnaeus, 1758) (Common sole, Dover sole)

This species reaches the northerly limits of its distribution in the northern North Sea, but is abundant in the southern North Sea, English Channel, Bristol Channel, Irish Sea and Bay of Biscay. Eggs may be found as early as February (ARBOULT and BOUTIN, 1968) in the Bay of Biscay, from mid February–May in the English Channel (CUNNINGHAM, 1890), from April to June in the southern North Sea, and through to August in the northern North Sea. Hefford (1910–13) found few eggs in samples off Plymouth and concluded that the fish were spawning in the offshore area. However, in the southern North Sea eggs are frequently taken in shallow water (5–10 fm) off the Suffolk, Essex and Lincolnshire coasts and in the Thames and Blackwater estuaries in water with salinity as low as 26‰ (J. D. RILEY, pers. comm.). The highest catches of recently metamorphosed sole in young fish surveys around the coasts of England and Wales have been taken in rivers and estuaries on muddy ground, rather than in the coastal nursery areas (J. D. RILEY, pers. comm.).
The larva hatches at about 3 mm with unpigmented eyes, and may be easily identified by the appearance of the oil globules during the yolk-sac stage. The larva may be confused in the early stages with *Buglossidium luteum* in spite of the differences in size and shape. I have found that after the yolk-sac stage the number of myotomes can be easily counted, 45–50 being visible throughout development. This feature immediately distinguishes this species from *B. luteum*. The later larval stages are characterized by the presence of large stellate chromatophores over the body and in the marginal fins. Asymmetry begins at about 8–9 mm and complete bottom adaptation at about 12 mm.

3. *Buglossidium luteum* (Risso, 1810) (The Solonette)

The Solonette is the smallest member of the Soleidae, the adult only reaching a size of 10–13 cm. It is distributed widely around the British coasts and in the Bay of Biscay, but is absent from the Baltic.

Spawning begins in the Bay of Biscay in February (Arboult and Boutin, 1968) and continues through to May. At the northerly limit of its distribution (north of Scotland) spawning occurs from April to August (Jenkins, 1925). The egg is small and has only a few large oil globules distributed over the yolk. making this species quite distinct from all the other Soleidae described here.

The larva hatches at about 2 mm and remains comparatively small throughout development, metamorphosis beginning at 7 mm and being completed at 8–9 mm. The larva throughout its development is similar in appearance to that of the common sole but with fewer large stellate chromatophores both on the body and in the marginal fins; there is a tendency for some of them to aggregate in a large patch at the commencement of the posterior half of the tail (Hefford 1910–13). Throughout development there is a distinct area of pigment on the ventral abdominal wall. The head shape of this species with its distinct indentation of the fore-head ("pug nose") is also characteristic in the early stages. Once the marginal fin rays are formed, the vertebrae can be counted, but prior to this the myotomes are visible and the low number (36–38)compared with the other species described (see Table 3) will always separate this species.

4. *Microchirus variegatus* (Donovan, 1802) (The Thickback sole)

Holt (1893) concludes that this sole inhabits deeper water than the three preceding species, and that the young stages probably do not frequent shallow water. Whilst this may be true for the adult, J. D. Riley (pers. comm.) has frequently taken the recently metamorphosed young in depths less than two fathoms, in St Brides Bay, Pembrokeshire and in other nursery areas on the south and south-west coasts of Britain, and during 1975 the young stages have been recorded from Manx waters in depths less than 20 m.

The pelagic stages occur frequently off Plymouth (Clark 1920, Russell, 1969; 1971) and in the Bay of Biscay (Arboult and Boutin, 1968), and Petersen (1909) records their presence over deep water 1000–4000 metres south-west of Ireland. This species is only occasionally found north and north-west of the British Isles (McIntosh and Masterman, 1897; R. J. Wood, pers. comm.) and is absent from the southern North Sea and the eastern end of the English Channel. Spawning begins in the Bay of Biscay in February (Arboult and Boutin, 1968) and in the English Channel in early spring (Petersen, 1909; Hefford, 1910–13; Russell, 1969; 1971). Some adults spawn as late as July (Clark, 1920). The egg may be easily separated from that of the common sole by the appearance of the 30–50 oil globules. These globules which are variable in size are spread over the yolk surface and remain separate.

The larva hatches at about 2.5 mm and may reach a length of 9–10 mm by the onset of metamorphosis. Throughout development the pigment, consisting of small stellate chromatophores, is more delicate than in the case of the three preceding species. As the larvae develop there is a tendency for ongitudinal rows of chromatophores to develop along the body and fin-ray -root margins. The larva becomes very broad in comparison with other Soleidae; a feature which readily allows initial separation of most of the plankton stages by eye. The swim bladder is not apparent in the larval development of this species.

I have noticed on the many specimens that I have examined from the area off Plymouth, that this species tends to pigment more densely on the underside (left), from midway through its larval stage (early fin-ray development). I have seen this unusual feature in only one other member of the Heterosomata, namely the Norway Topknot, *Phrynorhombus norvegicus* which is also common off Plymouth during the summer months.

5. *Dicologlossa azevia* (Capello, 1867)

Only a single specimen of the adult of this species has been recorded from the western English Channel, namely off the Eddystone Lighthouse in July 1953 (Plymouth Marine Fauna 1957), but the adult does occur in the south of the Bay of Biscay. I can find no record of occurrence, or description of the eggs or larvae of this species from the area being considered for this key. Arboult and Boutin (1968) surveyed the Bay of Biscay for eggs and larvae of fishes in February, May, August and November 1964 and found the eggs of the preceding four species and the larvae of three of them, but neither egg nor larva of this species. It seems likely that *Dicologlossa azevia* does not normally spawn in the area under consideration, and the occurrence of the planktonic form here will be rare.

6. *Bathysolea profondicola* (Vaillant, 1888)

This is an extremely rare deep-water form which has been recorded from the Atlantic slope ground south-west of Ireland, and is known to range from there to south of the Canaries. The biology of this species is at present unknown (Wheeler 1969).

ACKNOWLEDGEMENTS

I would like to express my thanks to Dr. F. S. Russell and Dr. A. J. Southward of the Plymouth Marine Laboratory both for the provision of samples from off Plymouth and for their helpful advice.

Table 1. Distribution of adults

Baltic	–	2ø	–	–	–	–
Belt Sea	–	2	3	–	–	–
Kattegat	–	2	3	–	–	–
Skagerrak	–	2	3	–	–	–
N. North Sea	–	2	3	–	–	–
S. North Sea	(1)	2	3	–	–	–
English Channel E.	(1)	2	3	–	–	–
English Channel W.	1	2	3	4	–	–
W. Coast of Scotland	(1)	2	3	(4)	–	–
Bristol Channel–Irish Sea	1	2	3	4	–	–
SW Coasts of Britain	1	2	3	4	(5)*	–
Atlantic – SW Ireland	–	–	–	4	–	(6)
Irish Coast	(1)	2	3	(4)	–	–
Bay of Biscay	1	2	3	4	(5)	–
S Norway Coast	–	(2)	–	–	–	–
Shetland	–	2	–	–	–	–
Faroes	–	(2)	–	–	–	–

N.B. Species in parentheses occur only occasionally

ø Western part; * Single specimen

No. 1 *Pegusa lascaris*, 2 *Solea solea*, 3 *Buglossidium luteum*, 4 *Microchirus variegatus*, 5 *Dicologlossa azevia*, 6 *Bathysolea profondicola*.

Table 2

Spawning time	Jan.	Feb.	Mar.	April	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Pegusa lascaris	–	–	–	–	x	x	x	x	–	–	–	–
Solea solea	–	x	x	x	x	x	x	x	–	–	–	–
Buglossidium luteum	–	x	x	x	x	x	x	x	–	–	–	–
Microchirus variegatus	–	x	x	x	x	x	x	x	–	–	–	–

Table 3

Species	Fin rays			Vertebrae
	Dorsal	Anal	Caudal	
Pegusa lascaris	71–96	55–76	20	46–48
Solea solea	75–93	59–79	20–22	48–52
Buglossidium luteum	65–78	50–63	16–18	36–38
Microchirus variegatus	63–78	51–67	16–18	39–42

SELECTED BIBLIOGRAPHY

Larval descriptions with plates: Arboult, S., Boutin, N. (1968), species 1, 2, 4. Clark, R. S. (1914), species 1. Cunningham, J. T. (1890), species 2, 4. Ehrenbaum, E. (1905), species 2, 3. Fabre-Domergue, P., Bietrix, E. (1905), species 2. Padoa, E. (1956), species 1, 2, 3, 4. Petersen, C. G. Joh. (1909), species 4. Russell, F. S. (in press), species 1, 2, 3, 4.

Description of the eggs: Arboult, S., Boutin, N. (1968), species 1, 2, 3, 4. Bal, D. V. (1941), species 2, 3, 4. Ehrenbaum, E., Hoek, P. P. C. (1911), species 1, 2, 3, 4. Lee, J. Y. (1966), species 1, 2, 3, 4. Russell, F. S. (in press), species 1, 2, 3, 4. Simpson, A. C. (1956), species 1, 2, 3, 4.

Distribution and spawning: Arboult, S., Boutin, N. (1968), species, 1, 2, 3, 4. Chabanaud, P. (1927), species 1, 2, 3, 4, 5, 6. Clark, R. S. (1920), species 1, 2, 3, 4. Hefford, A. E. (1910), species 1, 2, 3, 4. Holt, E. W. L., Byrne, L. W. (1905), species 1, 2, 3, 4, 6. Jenkins, J. T. (1925), species 1, 2, 3, 4. McIntosh, W. C., Masterman, A. T. (1897), species 2, 4. Russell, F. S. (in press), species 1, 2, 3, 4. Wheeler, A. (1969), species 1, 2, 3, 4, 5, 6.

REFERENCES

ARBOULT, S. & BOUTIN, N., 1968. Ichthyoplancton. Oeufs et larves de poissons téléostéens dans le golfe de Gascogne en 1964. Revue Trav. Inst. (scient. tech.) Pêch. marit., 32 (4): 413–76.

BAL, D. V., 1941. Observations on spawning periods and key to pelagic eggs of fishes in Manx waters. Proc. Trans. Lpool biol. Soc., 54: 1–7.

CHABANAUD, P., 1927. Les soles de l'Atlantique oriental nord et des mers adjacentes. Bull. Inst. oceanogr. Monaco, 24 (488): 1–68.

CLARK, R. S., 1914. General report on the larval and post larval teleosteans in Plymouth waters. J. mar. biol. Ass. U.K., 10: 327–94.

CLARK, R. S., 1920. The pelagic young and early bottom stages of teleosteans. J. mar. biol. Ass. U.K., 12: 159–240.

CUNNINGHAM, J. T., 1890. A treatise on the common sole (*Solea vulgaris*). Plymouth, Mar. biol. Ass. U.K., 147 pp.

CUNNINGHAM, J. T., 1896. The natural history of the marketable marine fishes of the British Islands. Macmillan and Co., London: 375 pp.

EHRENBAUM, E., 1905. Eier und Larven von Fishen. Nord Plankt., (1): 413 pp.

EHRENBAUM, E., 1911. Die Plattfischlarven der Nordsee und benachbarter Gewässer nach Zeit und Ort ihres Vorkommens. Rapp. P.-v. Réun. Cons. perm. int. Explor Mer, 13C (3): 22 pp. and Append: 19 pp.

FABRE-DOMERGUE, P. & BIETRIX, E., 1905. Developpement de la sole (*Solea vulgaris*). Vuibert et Nony, Paris: 247 pp.

HEFFORD, A. E., 1910. Notes on teleostean ova and larvae observed at Plymouth in the spring and summer 1909. J. mar. biol. Ass. U.K., 9: (1). 1–58.

HOLT, E. W. L., 1891. Survey of fishing grounds, west coast of Ireland, 1890. I. – On the eggs and larvae of teleosteans. Scient. Trans. R. Dubl. Soc., ser. 2, 4, Art. 7: 435–74.

HOLT, E. W. L., 1893. Survey of fishing grounds, west coast of Ireland, 1890–91. – On the eggs and larvae and postlarvae of teleosteans. Scient. Trans. R. Dubl. Soc., ser. 2, 5, Art. 2: 5–121.

HOLT, E. W. L. & BYRNE, L. W., 1905. Figures and description of the British and Irish Species of Solea. Rep. Sea inld Fish. Ire. 1902–3, (2) Scient. Invest., (5): 164–175.

JENKINS, J. T., 1925. The fishes of the British Isles both freshwater and salt. Frederick Warne, London: 408 pp.

LEE, J. Y., 1966. Planktonic eggs and larvae of fishes. Revue Trav. Inst. (scient. tech.) Pêch. marit., 30: 171–208.

MCINTOSH, W. C. & MASTERMAN, A. T., 1897. The life-histories of the British marine food-fishes. Cambridge Univ. Press, London: 516 pp.

NICHOLS, J. H., 1971. Pleuronectidae. Fich. Ident. Oeufs Larves Poissons, 4–6. Cons. int. Explor. Mer.

PADOA, E., 1956. Ordine: Heterosomata: Fauna Flora Golfo Napoli. 38: 783–888.

PETERSEN, C. G., JOH., 1909. On the larval and post-larval stages of some Pleuronectidae (*Zeugopterus, Arnoglossus, Solea*): Meddr Kommn Havunders., Ser. Fisk., 3 (1): 18 pp.

PLYMOUTH MARINE FAUNA 1957. Marine Biological Association, 1957, Plymouth Marine Fauna. 457 pp.

RUSSELL, F. S., 1969. On the seasonal abundance of young fish XI. The year 1966. J. mar. biol. Ass. U.K., 49: 305–310.

RUSSELL, F. S., 1971. On the seasonal abundance of young fish XII. The years 1967, 1968, 1969 and 1970. J. mar. biol. Ass. U.K., 51: 127–130.

RUSSELL, F. S. (in press). The eggs and planktonic stages of British marine fishes: 524 pp.

SIMPSON, A. C., 1956. The pelagic phase (*In*) Sea Fisheries, ed. by M. Graham. Edward Arnold: London, 204–50.

WHEELER, A., 1969. The fishes of the British Isles and north-west Europe. Macmillan, London: 613 pp.