heavy chain sequences of human IgA and IgM, which exhibit progressively increasing homology from the first to the last (COOH-terminal) constant region domains interrupted by the hinge region, where there is virtually no homology.

In human beings, only 10 percent of serum IgA but up to 50 percent of colostral IgA is of the IgA2 subclass (*15*), data which have led us to suggest (*4*) that the relative enrichment of secretions with the IgA2 subclass could confer selective advantage through its resistance to microbial IgA protease. This hypothesis is strengthened by the findings reported here that two unrelated microorganisms produce enzymes of nearly identical specificity for the hinge region of IgA1 proteins. An alternative interpretation would be that the IgA1 subclass evolved from IgA2 and that microorganisms encountering secretory IgA1 underwent mutation manifested by IgA protease production. This issue cannot be resolved with the data available.

If *N. gonorrhoeae* elaborates this IgA-destructive enzyme when infecting human beings, the production of the enzyme may be of clinical importance. Since this agent can infect individuals having apparently adequate secretory (urethral) antibody (*2*), one may speculate that IgA protease may allow the organisms to resist immune attack. However, the resistance of secretory IgA2 subclass proteins to the enzyme would raise theoretical objections to such a concept although the relative concentrations of the two subclasses has not been reported for the human urogenital tract, and thus the dominance of IgA2 at such mucosal sites must be considered an unproved assumption.

Finally, among the gonococcal colony forms, types 1 and 2, but not types 3 and 4, are regularly pathogenic in human volunteers (*16, 17*). As enzyme production has been found with all four colony types we cannot attribute pathogenicity to enzyme alone. We have not, however, excluded significant differences in the level of enzyme produced among the types, nor do we know whether all the enzymes are similarly active under the prevailing physiological conditions at susceptible mucosal surfaces.

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Latimeria, the Living Coelacanth, Is Ovoviviparous

Abstract. *Dissection of a specimen of* Latimeria chalumnae *in the American Museum of Natural History revealed that it is a gravid female containing five advanced young, averaging 317.8 millimeters long. Each has a large yolk sac with no apparent connection to the surrounding oviducal wall. We conclude that* Latimeria *is ovoviviparous.*

Latimeria chalumnae Smith is the only living representative of a distinctive and once widespread group of lobe-finned fishes (*Coelacanthini*) first known from rocks of Devonian age and long believed to have become extinct in the Late Cretaceous. The capture of a living representative off the coast of South Africa in 1938 triggered an extensive search for additional specimens. It was not until 1952, however, that a second specimen was collected, this time off the Comoro Islands. Since then, more than 80 specimens have been taken by Comorean fishermen, at the rate of three or four a year.

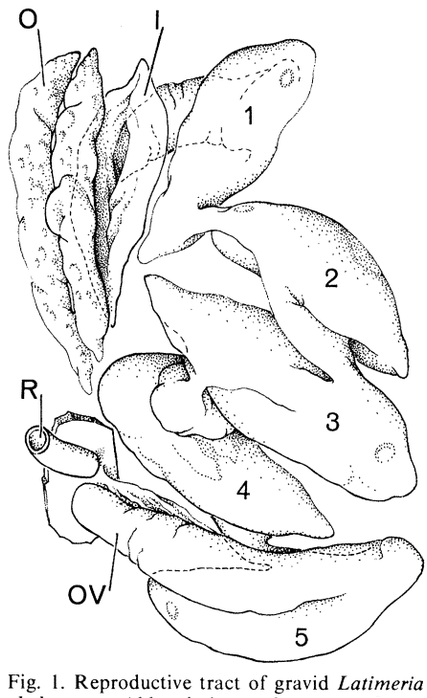

Fig. 1. Reproductive tract of gravid *Latimeria chalumnae*. Abbreviations: *O*, ovary; *I*, infundibulum of the oviduct; *OV*, distal part of the oviduct; *R*, rectum; *1–5*, yolk-sac young in expanded portions of the oviduct.

Despite the number of specimens available for study, the mode of reproduction of *Latimeria* has remained unknown. The anatomy of the urogenital system and orifices of adult males and females was described by Millot and Anthony (*1–4*), but the scarcity of mature females and the absence of any obvious copulatory organ in males left unanswered the key question of whether *Latimeria* lays eggs or gives birth to living young. On the basis of a female found with eggs in her oviduct, Millot and Anthony (*2*) concluded that *Latimeria* is oviparous. Another female containing 19 apparently ripe eggs (8.5 to 9.0 cm in diameter) confirmed these authors' point of view (*3, 5*). Griffith and Thomson (*6*), however, believed that osmoregulatory requirements would make it impossible for such a shell-less egg to survive outside the body of the female and they concluded that *Latimeria* must be ovoviviparous.

With regard to the paleontological evidence, Watson (*7*) described two small skeletons of the Jurassic coelacanth *Undina* (= *Holophagus*) found inside the body cavity of a much larger specimen of the same taxon. He suggested that *Holophagus* was viviparous. More recently, Schultze (*8*) described several isolated larvae of the Pennsylvanian coelacanth *Rhabdoderma* with preserved yolk sacs and, noting that coelacanths lack any fins in the form of intromittent organs, he postulated that these fishes were oviparous. Schultze interpreted Watson's specimen as a case of cannibalism.

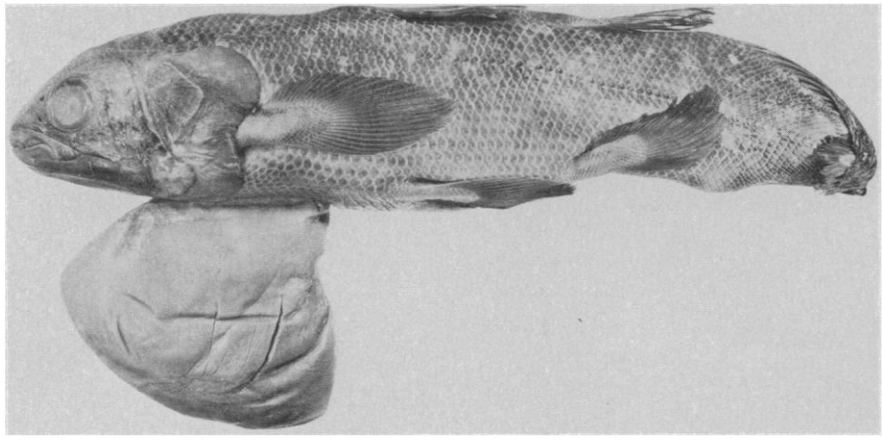

Fig. 2. Yolk-sac young of *Latimeria chalumnae*, the second of five found in a female 1.6 m long at the American Museum of Natural History. Unretouched photograph shows fins and tail as compressed by oviducal walls. Total length, 322 mm.

The specimen of *Latimeria* in the American Museum of Natural History measures 1.6 m in total length; its weight at the time of capture was reported to be 65 kg (*9*). The anatomy of the head of this specimen has been investigated (*10*), but its viscera were not dissected until recently, when samples of hemopoietic tissues were taken. During the course of the dissection, five advanced young were discovered lying free in the right oviduct. Millot and Anthony (*1, 2*) have observed that only the right oviduct is functional in *Latimeria*. As indicated in Fig. 1, all of the young were situated with their heads directed away from the urogenital orifice.

The following observations were made on four of the young that were removed from the oviduct, the fifth having been left in situ. The young resemble miniature adults, differing most noticeably in the possession of a yolk sac, the relatively larger eyes, and a more declivous profile (Fig. 2). Total length ranges from 301 to 327 mm, with an average of 317.8 mm. The maximum diameter of the yolk sac ranges from 80 to 129 mm; the largest fish has the smallest yolk sac, and vice versa. The yolk-sac stalk is broad, extending from the base of the pectoral fins approximately two-thirds of the distance to the base of the pelvic fins. Scales and fins appear to be fully developed in all four young, but they lack the denticles (odontodes) of the adult.

The gravid female under discussion was caught in January, the same month in which females with ovulated eggs have been taken. This suggests that gestation may require more than a year—not an unexpected length of time in view of the tremendous size of the ripe egg.

Millot and Anthony (*1*) showed that the male of *Latimeria* possesses a cloaca which contains a urogenital papilla and is flanked externally by two pairs of erectile caruncles. Since internal fertilization of the female must occur, it seems likely that the cloaca functions as an eversible copulatory organ, in a manner reminiscent of the situation in some birds and gymnophiones (*11*). The caruncles perhaps serve as claspers. Similar suggestions have been made by Griffith and Thomson (*6, 12*).

Paleoichthyologists usually consider the coelacanths to be most closely related to the Paleozoic rhipidistians, and the latter in turn to be the fishes most closely related to the tetrapods (*13*). Nothing is known about reproduction in the rhipidistians, and there is no way of knowing whether the ovoviviparous condition in *Latimeria* is unique or whether it is shared by other crossopterygians and primitive tetrapods. Among other major groups of bony fishes, living lungfishes are oviparous, as are all living actinopterygians except 11 families (less than 5 percent) that exhibit viviparity or ovoviviparity as a derived condition or specialization. Although the ovoviviparity of *Latimeria* sheds no light on the reproductive mode of primitive osteichthyans, including crossopterygians, it does indicate that all the information we now have about reproduction in the fossil coelacanths is consistent with the hypothesis that they were ovoviviparous.

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12. In the light of the present discovery, Griffith and Thomson also may have been correct in suggesting that the isolated yolk-sac larvae described by Schultze were prematurely released from a stressed female. Such behavior is often seen in ovoviviparous sharks, rays, and teleosts.
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14. We thank C. G. Schleifer for the drawing, C. Tarka for the photograph, and Dr. G. J. Nelson for his cogent comments on the manuscript.

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Immunoglobulin E Antibodies to Pollen Allergens Account for High Percentages of Total Immunoglobulin E Protein

Abstract. *The quantities of immunoglobulin E (IgE) antibodies to grass or ragweed allergens were measured by an immunoabsorption in the serums of patients sensitive to one of these allergens. IgE antibodies to grass or ragweed allergens accounted for means of 30 and 29 percent of the total IgE protein. After the ragweed pollination season, the levels of serum IgE antibodies to ragweed allergens rose dramatically and in postpollination serums they accounted for 39 percent of the total IgE protein with a range from 13 to 50 percent.*

IgE antibodies are responsible for the typical wheal and flare reactions induced in the skin of allergic individuals by injection of specific allergens (*1*). This activity may be transferred by serum to the skin or the leukocytes of normal subjects and may be measured by testing serum dilutions (*2*). The activity of IgE antibodies may also be measured in vitro more simply by the radioallergosorbent test (RAST) (*3*). In this procedure allergens linked to solid phase supports are incubated with serum from allergic subjects.

IgE antibodies bind to the solid phase allergen and they are detected by addition of isotopically labeled antibodies to IgE.