

**THE EYES AND
SUBNEURAL GLAND OF
SALPA; AN ABSTRACT
OF A DISSERTATION**

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THE EYES
AND
SUBNEURAL GLAND OF SALPA
1898

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PREFACE.

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The original paper of which this is a partial abstract described the anatomy and development of the eyes and subneural gland in both the solitary and the chain forms of *Cyclosalpa pinnata* (Forsk.), and compared these organs in this species with the similar organs in the following species:—

Cyclosalpa Chamissonis (Brooks), solitary and chain forms.

Salpa cylindrica (Cuv.), solitary and chain forms.

S. runcinata-fusifformis (Cham.-Cuv.), solitary and chain forms.

S. africana-maxima (Forsk.), solitary and chain forms.

Thalia democratica-mucronata (Forsk.), solitary and chain forms.

Pegea scutigera-confederata (Cuv.-Forsk.), solitary and chain forms.

P. scutigera-confederata, var. *bicaudata* (Quoy and Gaimard), chain form.

Iasis cordiformis-zonaria (Quoy and Gaimard), solitary and chain forms.

I. costata-Tilesii (Quoy and Gaimard), solitary and chain forms.

I. hexagona (Quoy and Gaimard), solitary and chain forms.

The homology of the ganglion of *Salpa* with the nervous system of other groups of Tunicates was discussed, and the conclusion reached that *Salpa*'s ganglion is homologous with the ganglion of an adult Ascidian rather than with the elongated nerve cord of the Ascidian tadpole. The nervous system of *Salpa* at an early stage of its development closely resembles that of *Doliolum*. *Salpa africana-maxima* retains certain features of this *Doliolum* stage in the adult.

The eyes were found to be new structures not homologous with the eye of the Ascidian tadpole, or with the pineal eye of Vertebrates. The eyes of *Pegea scutigera-confederata* and the variety

bicaudata were shown to be simpler than those of the other Salpidae. The Cyclosalpas have the most highly developed eye. Observations were described which seemed to indicate a rich innervation for the ciliated funnel of Salpidae.

Any homology between the neural gland of Ascidians or Pyrosoma and that of Salpa was shown to be doubtful, although the condition of the gland in *Phallusia mammillata* suggests a possible genetic connection between the neural glands of Ascidians and Salpa.

In appendices, Bütschli's¹ and Göppert's² papers upon the eye of Salpa were discussed.

The present paper is an abstract of those portions of the original publication which dealt with the anatomy and development of the eyes and of the neural gland of *Cyclosalpa pinnata*.

¹O. Bütschli, "Einige Bemerkungen über die Augen der Salpen"; in *Zool. Anz.*, Sept., 1892, No. 401.

²E. Göppert, "Untersuchungen über das Sehorgan der Salpen"; in *Morph. Jahrbuch*, Bd. 19, Heft 3.

INTRODUCTION.

At Professor Brooks' suggestion I undertook a study of the eye of *Salpa* in connection with his more extensive study of the genus. In the course of the work I discovered that *Salpa* shows a more or less well-developed subneural gland, a point of so much interest that I include a description of this organ in the present paper. I am indebted to Professor Brooks for the material upon which I worked and for the use of his own prepared sections of the embryos and developing stolons of *Salpa pinnata*. During the progress of this work I have received much assistance from him as my instructor, and I take this opportunity to express to him my warmest thanks.

The extensive collections of *Salpa* made by the United States Fish Commission, which were placed at the disposal of Professor Brooks, were the material upon which the investigations here recorded were made.¹

METHODS.—Tunicate tissue is so easily manipulated that the simplest methods have given the best results. For staining, Kleinenberg's hæmatoxylin was used almost exclusively. For surface views the specimens were studied unstained. Dissociation was effected in a mixture of glycerine and acetic acid strongly tinged with methyl green.

Up to the present time no comparative study of the eyes of the different species of *Salpa* has been made. Perhaps this is not strange, for the group *Salpidae* is so highly specialized that a knowledge of the eye of this group is not likely to throw much light upon the relation between the visual organs of the Chordata in general. A very casual glance at the structure of the eye in

¹I have followed for the most part the nomenclature given by M. P. A. Traustedt: *Spolia atlantica. Bidrag til Kundskab om Salperne*, in *Vidensk. Selsk. Skr.*, 6 Række naturvidenskabelig og matematisk, Afd. II, 8.

the different species of Salpa is enough, however, to show that such a comparative study is likely to prove of considerable value within the group.

So far as I can learn, the ciliated funnel is the only structure as yet described in Salpa that has been regarded as homologous with any part of the subneural gland of Ascidians.¹ In the course of the present paper I shall describe certain other structures, till now undescribed (see footnote), that seem to have some relation to the Ascidian gland itself and to the lateral ducts from the gland of *Phallusia mammillata* to the peribranchial chamber.

¹In a preliminary notice of this paper I gave a brief description of the organs here described at greater length.

SECTION I.—EYES.

DESCRIPTIVE.

The most noticeable feature of the anatomy of the eye of *Salpa* is its quite uniform shape throughout the solitary forms of the different species, and the strongly contrasted diversity of form that it shows in the chain individuals of these same species. These diverse forms are constant and characteristic for each species. In no case does the shape of the eye in the chain form agree with the shape in the solitary form of the same or any other species. The variations in the histological structure must be described in detail. The eye of the chain individual is closely related to that of the solitary *Salpa*, for it passes through an ontogenetic stage corresponding in shape to the adult condition of the latter. The eye of the solitary *Salpa* must then be regarded as the type from which the eye of the chain *Salpa* has diverged to a greater or less extent in the different species. The eye of the chain *Salpa* is not, however, in all cases a simple structure with a single origin, as is the case in the solitary form, but in several species distinct eyes are developed, or new portions of distinct origin are added to that part of the eye which is homologous with the eye of the solitary form.

First I will describe the adult eye of the solitary *Cyclosalpa pinnata* and its development, as the type to which to refer. Then I will describe the adult eyes of the chain form of the same species and trace their development.

THE ANATOMY OF THE EYE OF CYCLOSALPA PINNATA,
SOLITARY FORM.

On the dorsal surface of the ganglion of the solitary form of *Cyclosalpa pinnata* there is a ridge shaped like a horse-shoe, with the open end of the horse-shoe anterior. This ridge, like the ganglion, is composed of a cellular peripheral portion and a non-cellular core; the cellular portion of the one being continuous with that of the other, while the core of the ridge is continuous with the central, non-cellular portion of the ganglion (Fig. 1). The height of the ridge above the ganglion is a little greater than