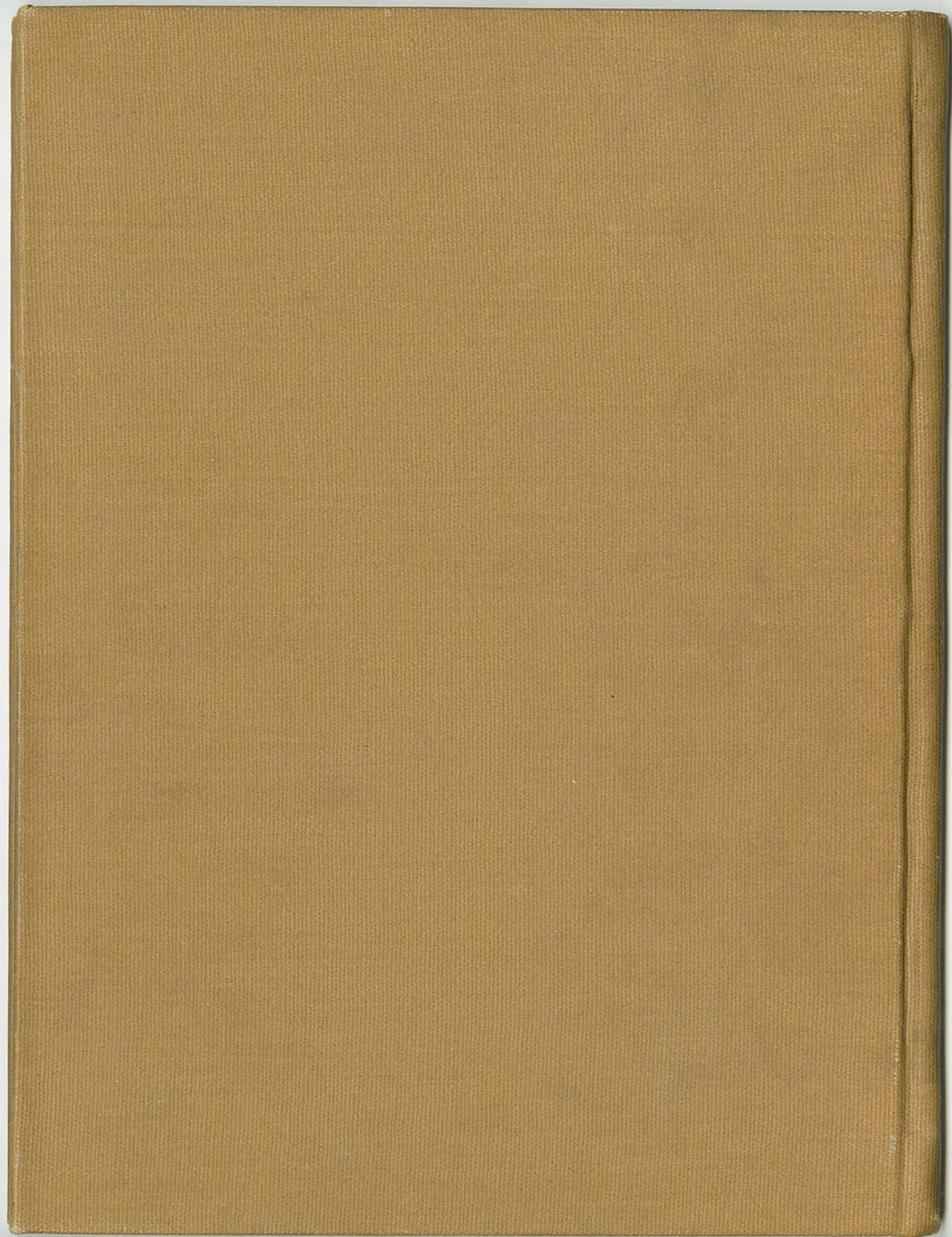


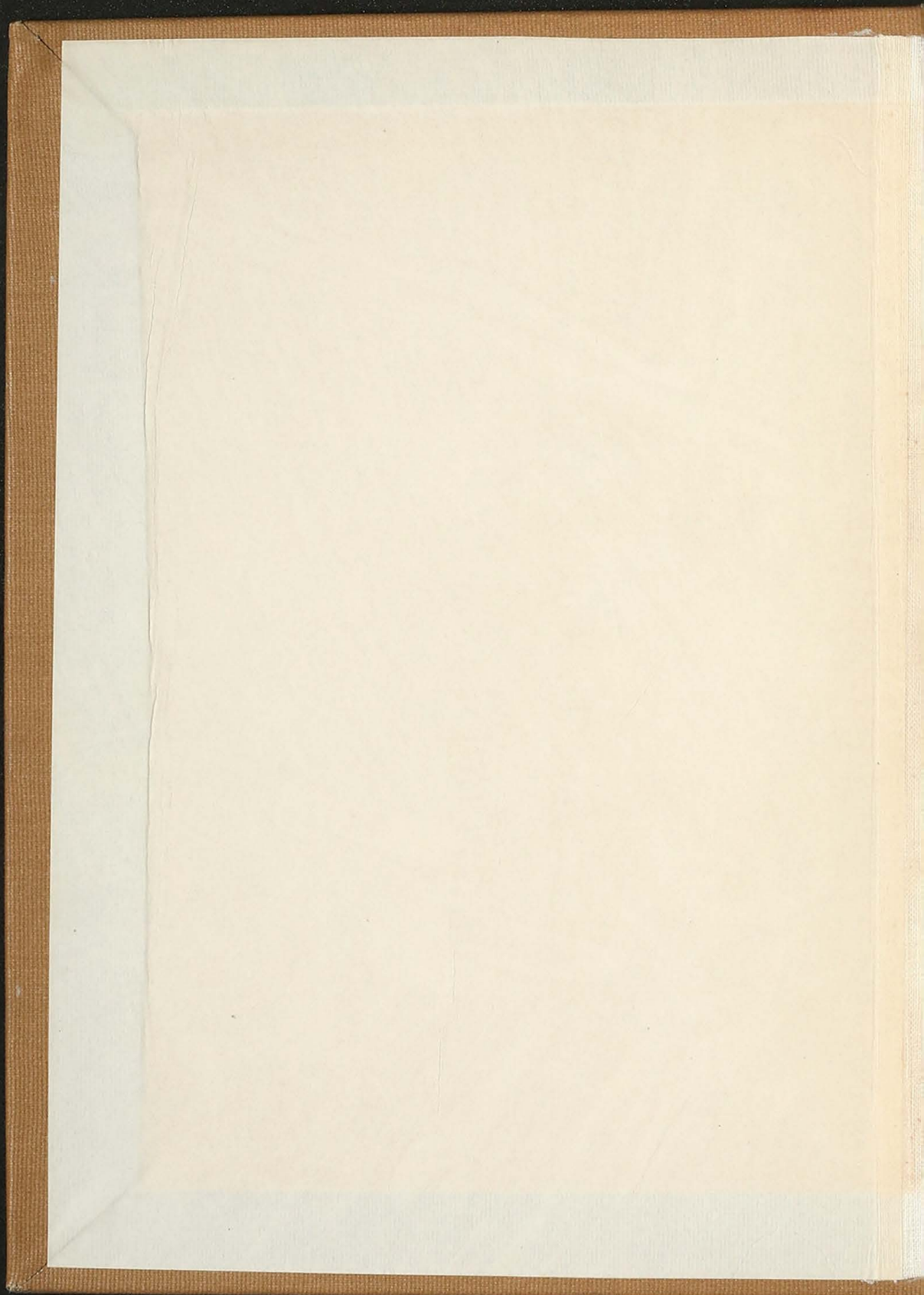
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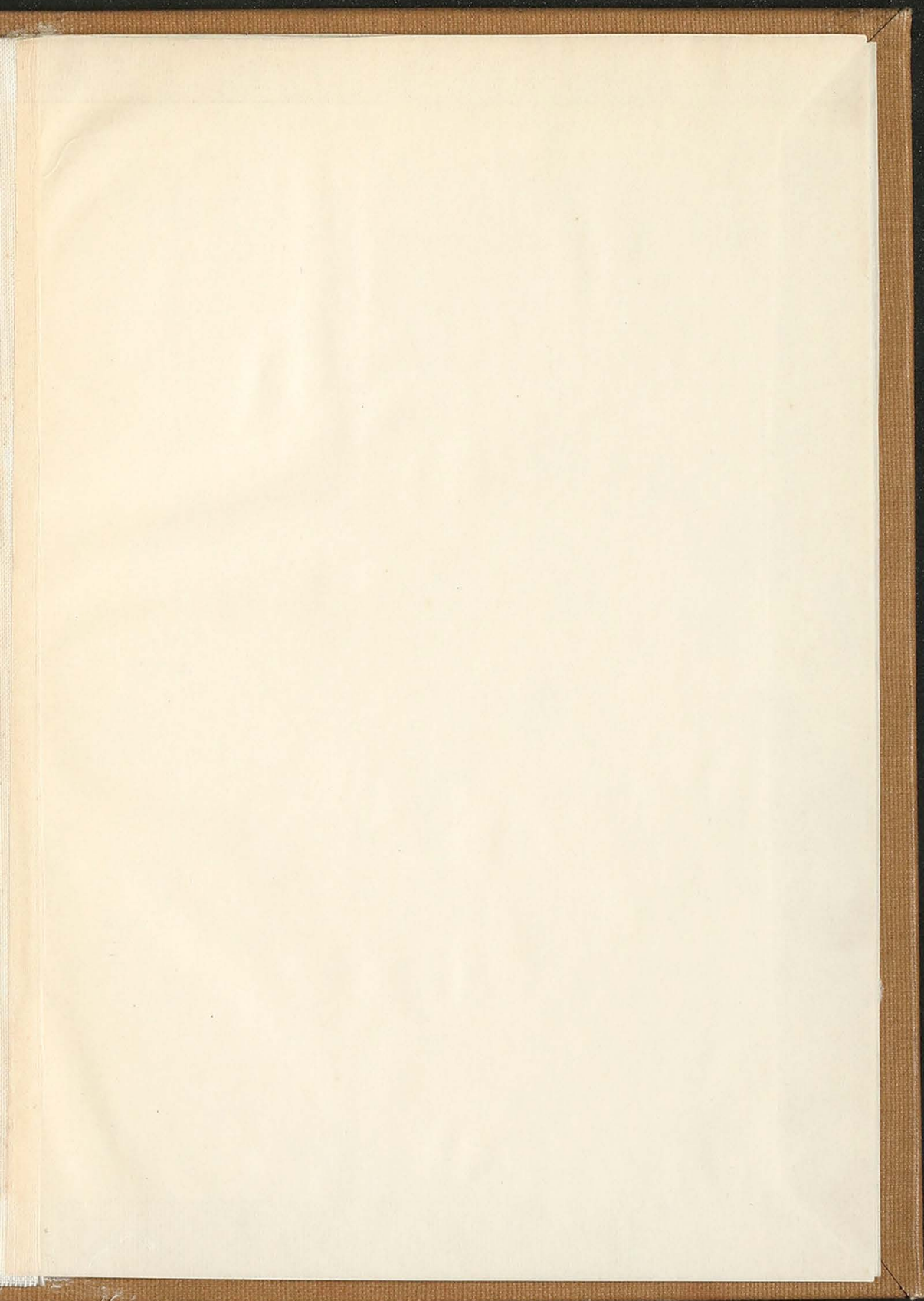
THE EYE OF LIMNEAE PEREGRINA

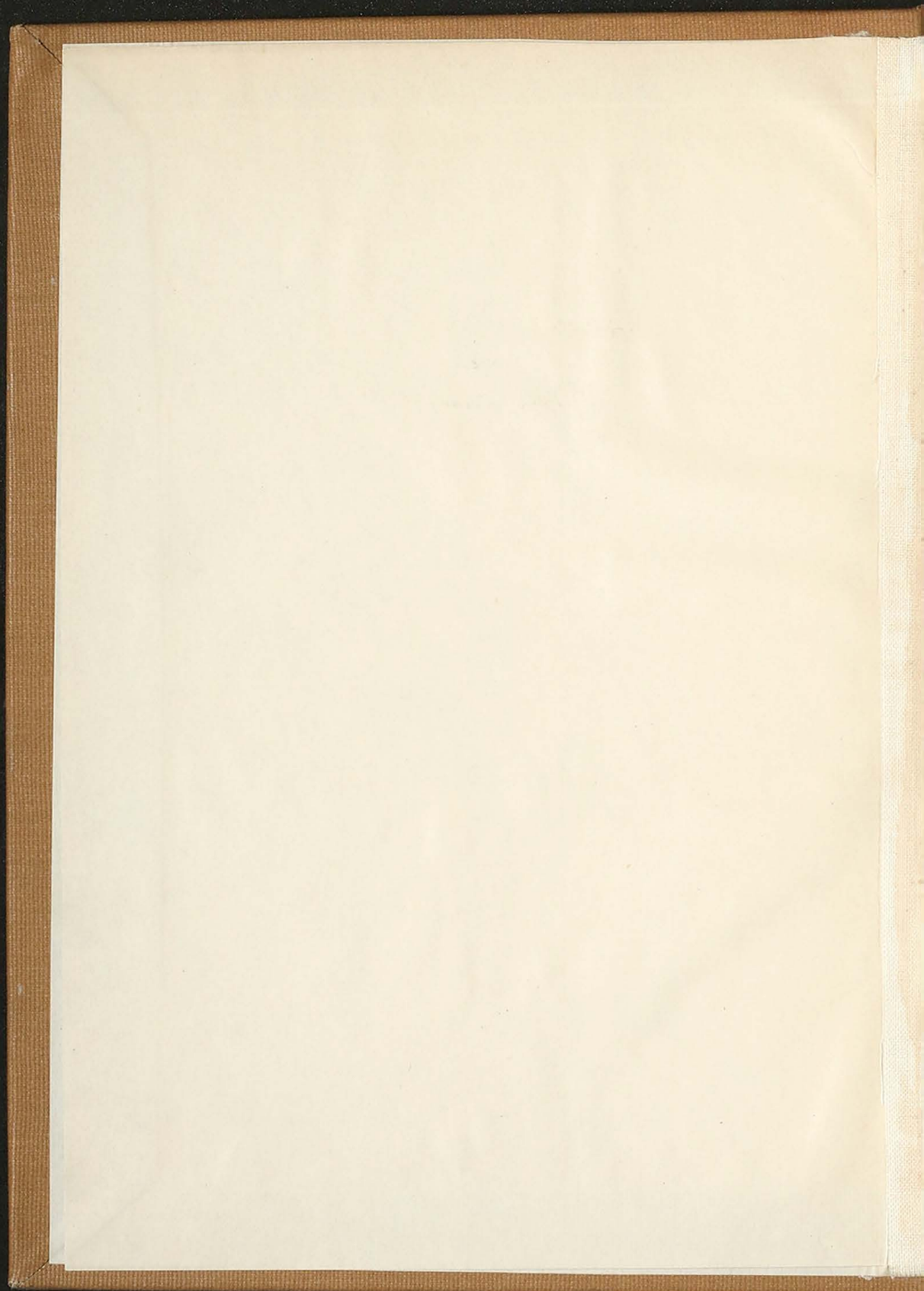
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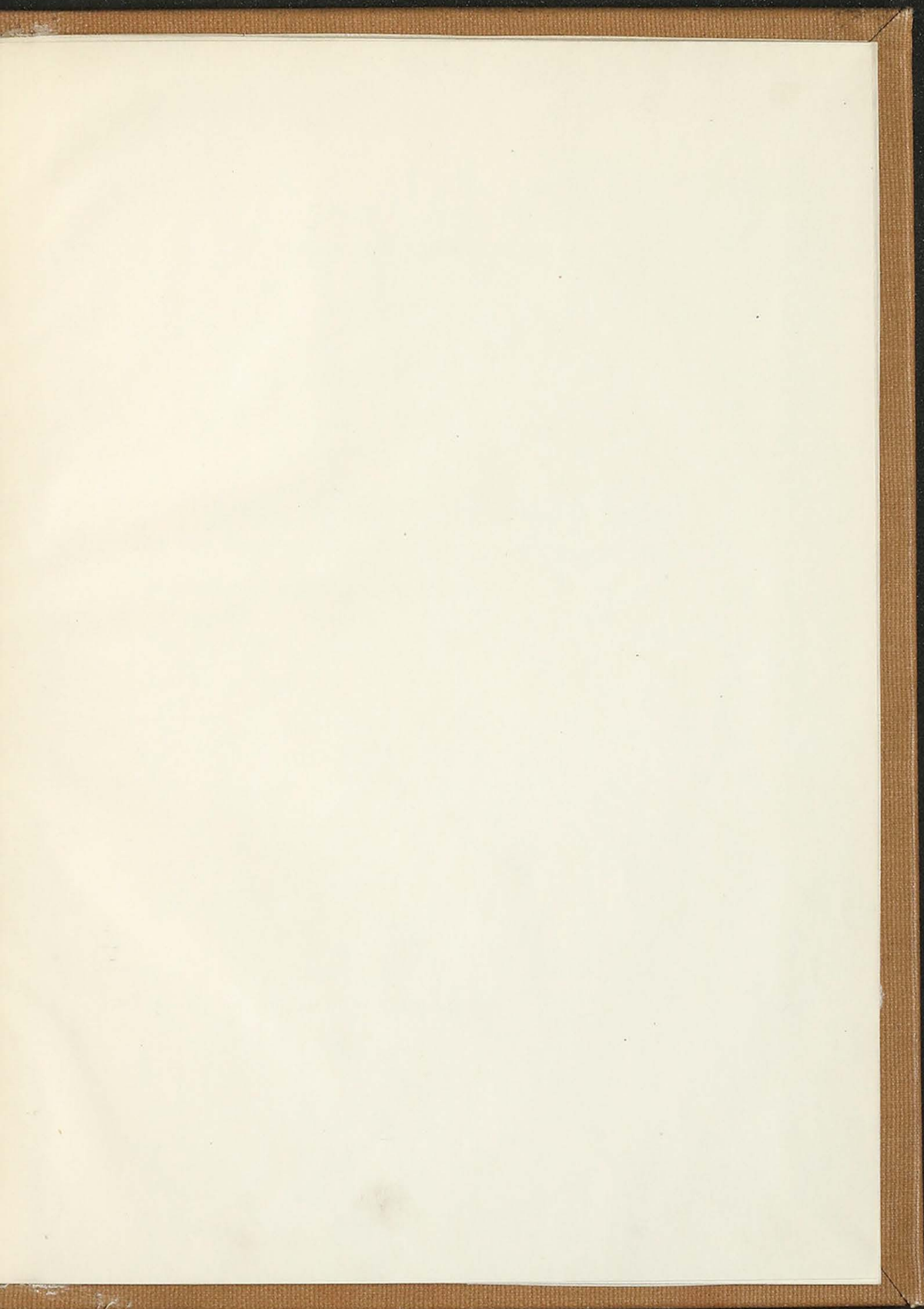


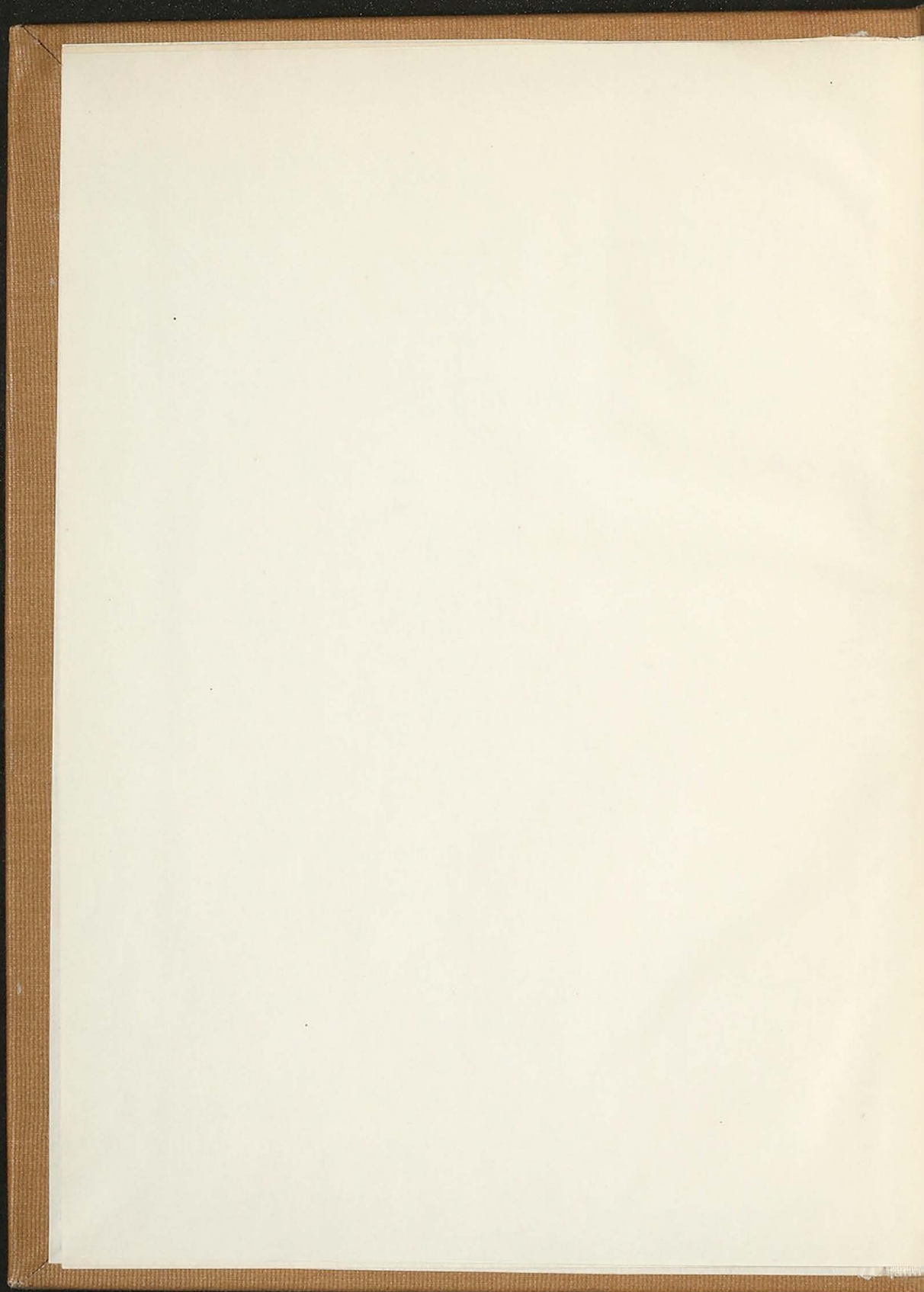








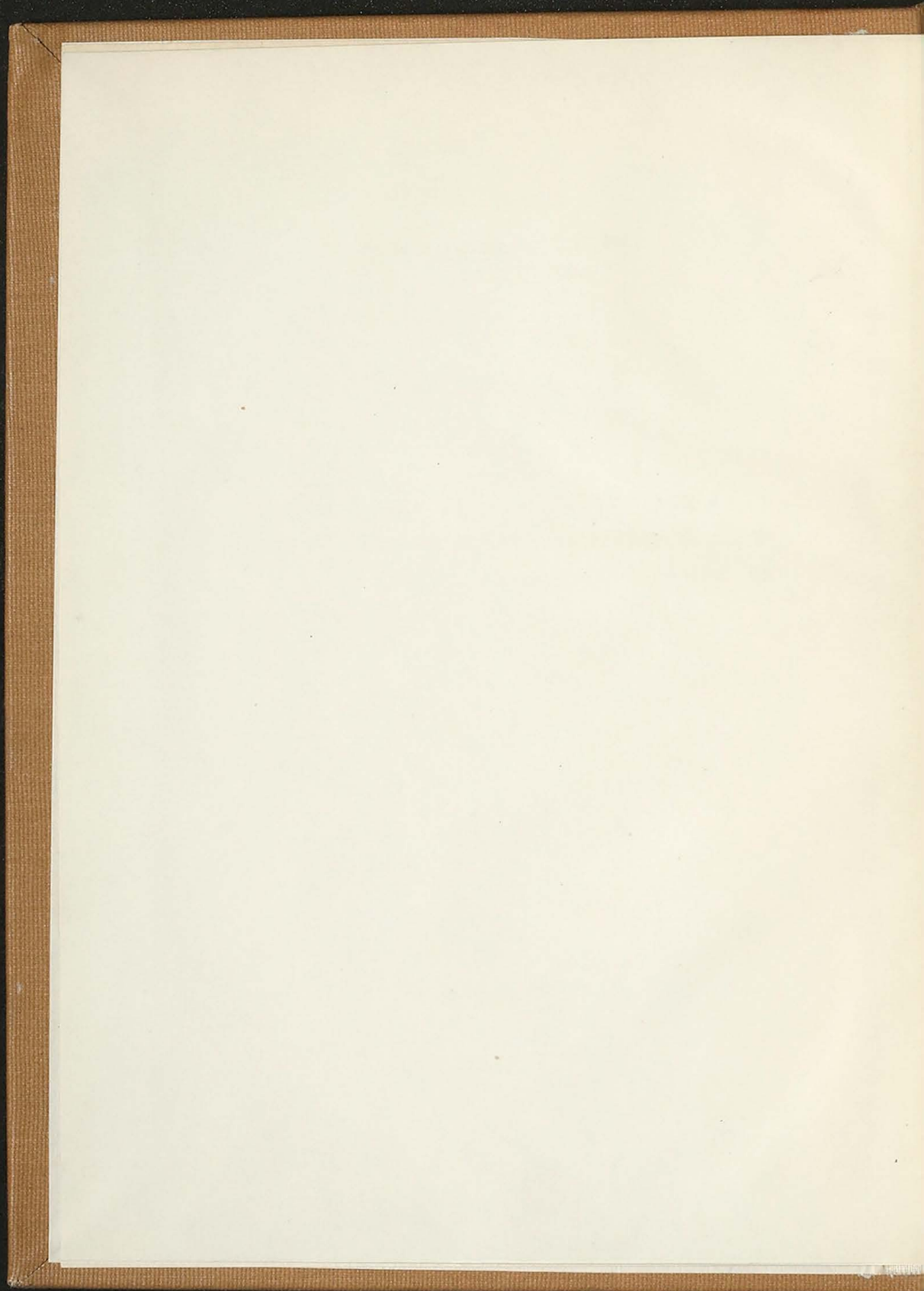




THE LIFE OF SAMUEL JOHNSON

A HISTORY OF THE
LIFE OF SAMUEL JOHNSON
BY JAMES BOSWELL
THE HISTORY OF SAMUEL JOHNSON

1791



THE EYE OF LINEAE PEREGRINA

A THESIS PRESENTED TO THE ACADEMIC FACULTY
OF THE UNIVERSITY OF VIRGINIA IN CANDIDACY FOR
THE DEGREE OF MASTER OF ARTS.

BY

D. D. CARR

[1924]

GIFT

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Thesis

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CHAPTER I

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THE EYE OF LIMNEAE PEREGRINA

I. Introduction

The present paper embodies the results of investigation regarding the histology of the eye of the Mollusc, *Limnaea peregrina*, with special attention given to the visual cells or retinulae. This animal appears most abundant during the cold months of the year in the protected places of running water. During the egg laying season and probably the following warm months it takes to more seclusive places, making it more difficult to find. This study is comparable, in so far as it goes, with the histology of the elements of the eye as pointed out by Kepner and Taliaferro ('16) in their study of *Prorhynchus applanatus*, of *Polycystis goettei* by Kepner and Lawrence ('18), or of *Planaria maculata* as maintained by Taliaferro ('20).

II. Histology of the eye of *Limnaea peregrina*

In *Limnaea peregrina* the eye appears as two small and yet conspicuous black spots at the

inner base of the stocky, broad, and brown tentacles that protrude anterio-laterally, hence making it a member of the sub-order Basommatophora. The positions occupied by the eyes with respect to the cephalic ganglion is almost directly over the anterior lateral border of the latter. The dark pigmented areas is made up of the pigment cups and the lenses within the cups located about midway with respect to all directions or almost centrally disposed. It is to be further noticed that the mouth of the pigment cup is not dorsally directed but has a slight anterior and lateral slant. A layer of pigment or accessory cells (Fig. 1, AC) constitutes, for the most part, its formation. In the same figure, (Fig. 1, P-G), it is seen that the pigment of the so called pigment cup is represented and consists of granules that densely crowd the area surrounding the outer surface of the accessory cells. This concentration of pigment granules is easily recognized after partial depigmentation. The pigment cup has approximately at its center a lens (Fig. 1, L) having a diameter ranging

THE HISTORY OF THE
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JOHN STOW.
1618.

from one half to two thirds that of the cup at the place it is located.

Hesse ('97) in his work with the eye of *Turbellaria* showed that two sets of cells enter into its formation. These two sets of elements are the pigment cells and the visual cells. The pigment elements are columnar cells, the cytoplasm of which is densely crowded with pigment. The pigment cells may be considered to be the accessory cells of the eye. They lie at right angles to the surface of the lens and form, for the most part, the body of the pigment cup's wall.

Entering this wall also are the distal ends of the visual cells. It is with these visual cells or the retinulae that this paper is chiefly concerned. Until the work done on the retinulae of the rhabdocoeles in the last ten years at the University of Virginia, the retinulae of invertebrates were not known to present any striking similarity to the retinulae of vertebrates. Our study has, therefore, been concentrated upon the number, distribution, and position of these retinulae in this invertebrate, *Limnaea peregra*.

It is from the outer side of the pigment cup that the retinulae or visual cells in this eye issue forth being approximately perpendicular to the pigment cup's surface. The retinulae are most numerous at the deepest part of the pigment cup and probably more so on its caudal surface as compared to its cephalic region. It is impossible to ascertain the number of retinulae for a single eye but an approximation of it is near three hundred.

The relative distribution of retinulae with reference to certain projected axes of the eye is of special interest. Since the pigment cup is directed both anteriorally and at a slant dorsally, there are two possible axes of light most used. The rays of light entering from an anterior oblique angle and those entering from an anterior horizontal plane probably concern *Limnaea peregra* most in discerning whatever may be ahead and above. The rays coming from an anterior oblique angle fall directly upon the bottom of the pigment cup while the rays coming from an anterior horizontal plane fall

on the caudal surface of the cup. Since this covers most of the field accessible to the eye it may be deduced that therein lies the reason for the retinulae being most numerous in the regions indicated above, viz., at the posterior ventral and caudal parts of the pigment cup.

The position of retinulae with reference to the light rays entering the eye in *Limnaea peregra* stands in sharp contrast with the relations existing between the light rays entering the eyes of the frog, *Polycystis goettei*, or *Prorhynchus applanatus* and their respective retinulae. For in this case the light ray falls first upon the distal end of the visual cell, whereas in the frog, *Polycystis goettei*, and *Prorhynchus applanatus* the light ray strikes the proximal end first and must pass through the entire extent of these cells to play upon their distal ends. In short, in this eye we have a visual cell of the erect type; whereas in the eyes of the frog, *Polycystis goettei*, and *Prorhynchus applanatus* we have inverted types as shown in Fig. 2.

III. Cytology of retinulae

Because of the presence of numerous pigment granules and because of the great number of cells involved in this eye, special methods had to be employed to enable me to study the detailed anatomy of the retinulae.

In order to render distinct the cytology of the three regions of the retinula of *Limnaea peregra*, sections of five and seven microns thickness were carefully depigmented by the use of fresh hydrogen peroxide (H_2O_2) for a period of one hundred hours before staining in iron hematoxylin. Other methods of depigmentation were used but not with the success of hydrogen peroxide.

The retinula as observed in this study presents three regions --- a distal part or a rhabdome, a middle portion highly refractive in nature of the ellipsoid, and a third bearing a nucleus or the myoid.

The rhabdomes are the essential structures which stand at right angles to the surface of the spheroidal lens. These rhabdomes lie within

the wall of the pigment cup and display their uniform slenderness and smooth contour (Fig. 1, R). There is a slight curvature in the rhabdome near the periphery of the pigment layer, which curvature terminates on reaching the refractive region and is always bent in the direction of the base of the pigment cup. This rhabdome is void of striae and extends outward from the pigment cup to the transparent wedge shaped division or ellipsoid (Fig. 1, E) of the retinula. The refractive body is somewhat elongated and in general is similar in shape to that of a wedge, the blunt end, or base of the wedge, being in the direction of that portion having the nucleus and the pointed end, or apex, in the direction of the rhabdome. The third region contains a nucleus and is confluent with a nerve-like fiber. This fiber, in leaving the general contour of the eye, curves in the direction of the cephalic ganglion as a tapered fiber. The nucleus in the myoid of this retinula is in close proximity to the central refractive region. The iron

The will of the people is the only basis for the
action of the government. The people are the
source of all power and authority. The
government is a creature of the people and
must be responsible to them. The
people have the right to elect their
representatives and to remove them if
they are not satisfied. The
government must protect the rights of the
people and must not oppress them. The
people have the right to free speech and
free press. The government must not
interfere with these rights. The
people have the right to assemble
peaceably and to petition the
government. The government must not
interfere with these rights. The
people have the right to a fair trial
by jury. The government must not
interfere with these rights. The
people have the right to life, liberty
and the pursuit of happiness. The
government must protect these rights.

hematoxylin stain clearly outlines the contour of the retinula by the dark coloration produced. The rhabdome assumes a fairly dark appearance, the refractive body or ellipsoid is apparently translucent, the oval shaped nucleus of the myoid contains many deeply stained granules of varying sizes, while the distal tapering end of the myoid that runs to the cephalic ganglion assumes an almost jet black appearance.

IV. Comparison with other retinulae

By observing the similarity of the retinulae in *Limnaea peregra* as over against that of the frog observed by Arey ('16), or *Prorhynchus applanatus* by Kepner and Foshee ('17), and that maintained by Kepner and Lawrence ('18) for *Polycystis goettel*, it is deduced that the retinula in *Limnaea peregra* is very much like those others and that the regions found are similar to the rhabdome, ellipsoid, and myoid occurring in the rods and cones of vertebrates.

V. SUMMARY

1. The eye of *Limnaea peregra* is the erect type.
 2. The retinulae are distributed with reference to two axes of the eye: (a) anterior oblique and (b) anterior horizontal.
 3. Accessory pigment cells and retinulae enter the formation of the eye of *Limnaea peregra*.
 4. The retinula is similar to that of *Turbellaria* and vertebrates in that it possesses three regions: (a) rhabdome, (b) ellipsoid, and (c) myoid.
- V. It is suggested that these retinular regions in these diverse groups of animals are homologous and not analagous.

D. D. Carr

D. D. Carr

University, Va.,

May 15, 1924.

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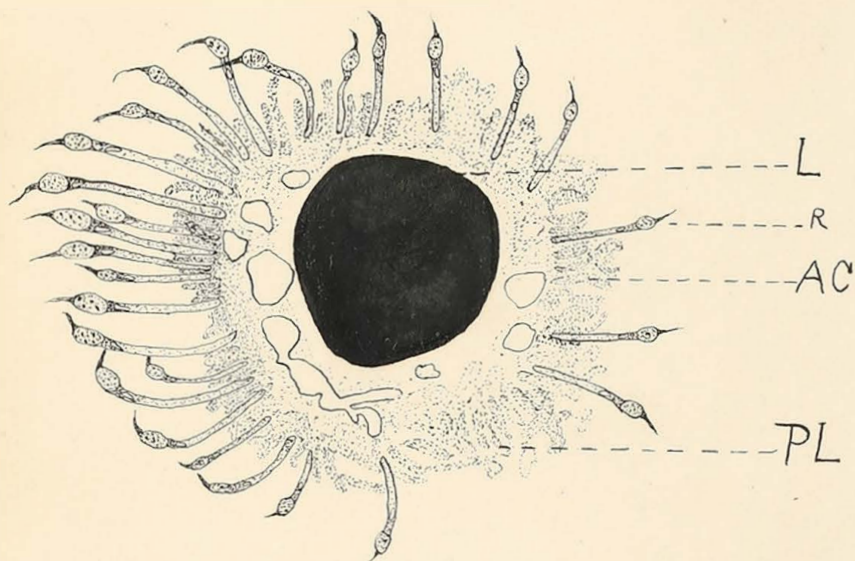
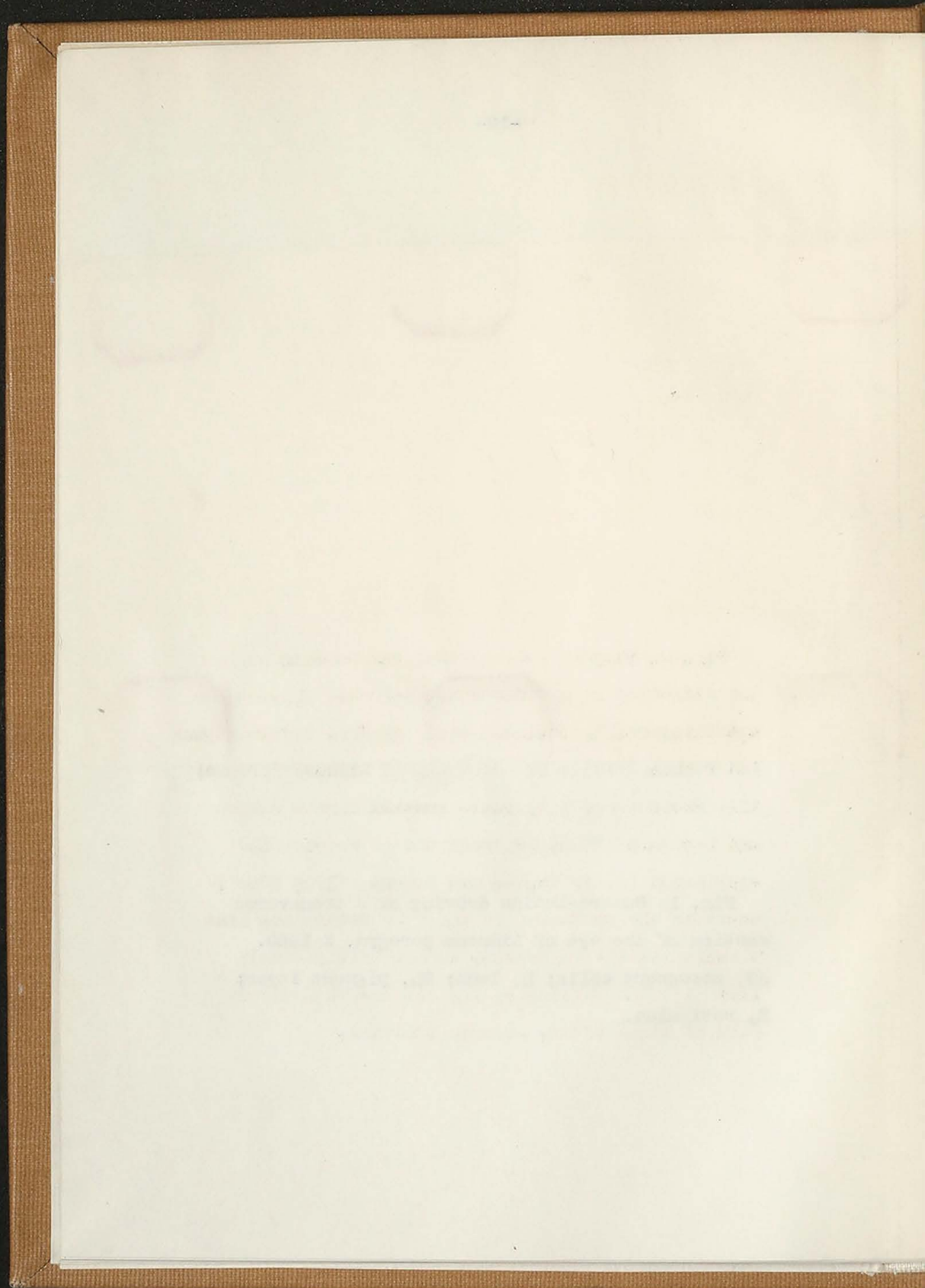


Fig. 1. Camera-lucida drawing of a transverse section of the eye of *Limnaea peregra*. X 1500.

AC, accessory cells; L, lens; PL, pigment layer; R, retinulae.



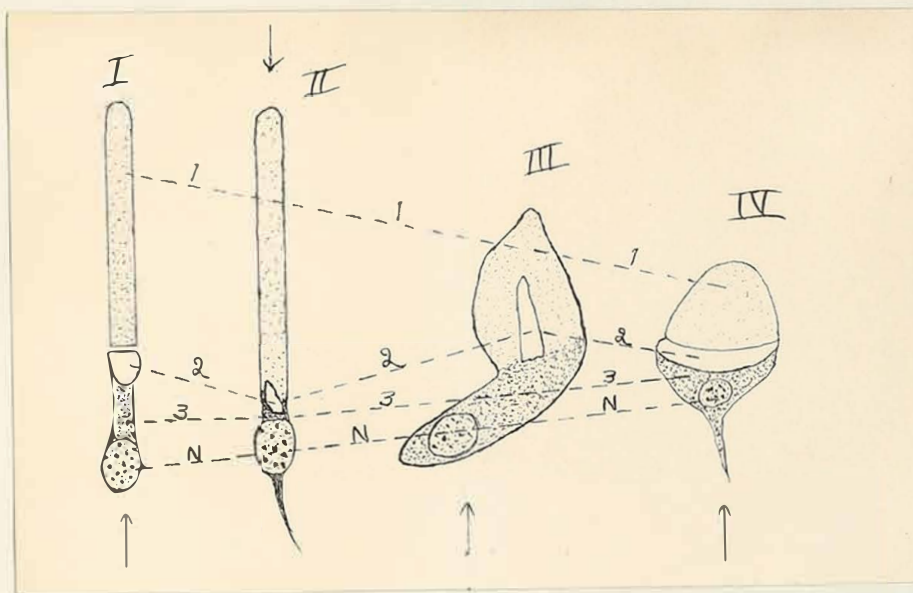


Fig. 2. Diagram representing the homologues in the retinulae of a vertebrate, Mollusc, rhabdocoele, and flatworm. I, retinula (rod) of frog (after Kepner and Foshee, '17)); II, retinula of *Limnaea peregra*; III, retinula of *Polycystis goettei* (after Kepner and Lawrence, '18); IV, retinula of *Prorhynchus applanatus* (after Kepner and Foshee, '17); Line 1 connects the rhabdomes of the four retinulae; line 2 indicates the refractive bodies (ellipsoids); line 3, the myoids; N, nuclei. Arrows indicate path of light giving sensory stimulus.

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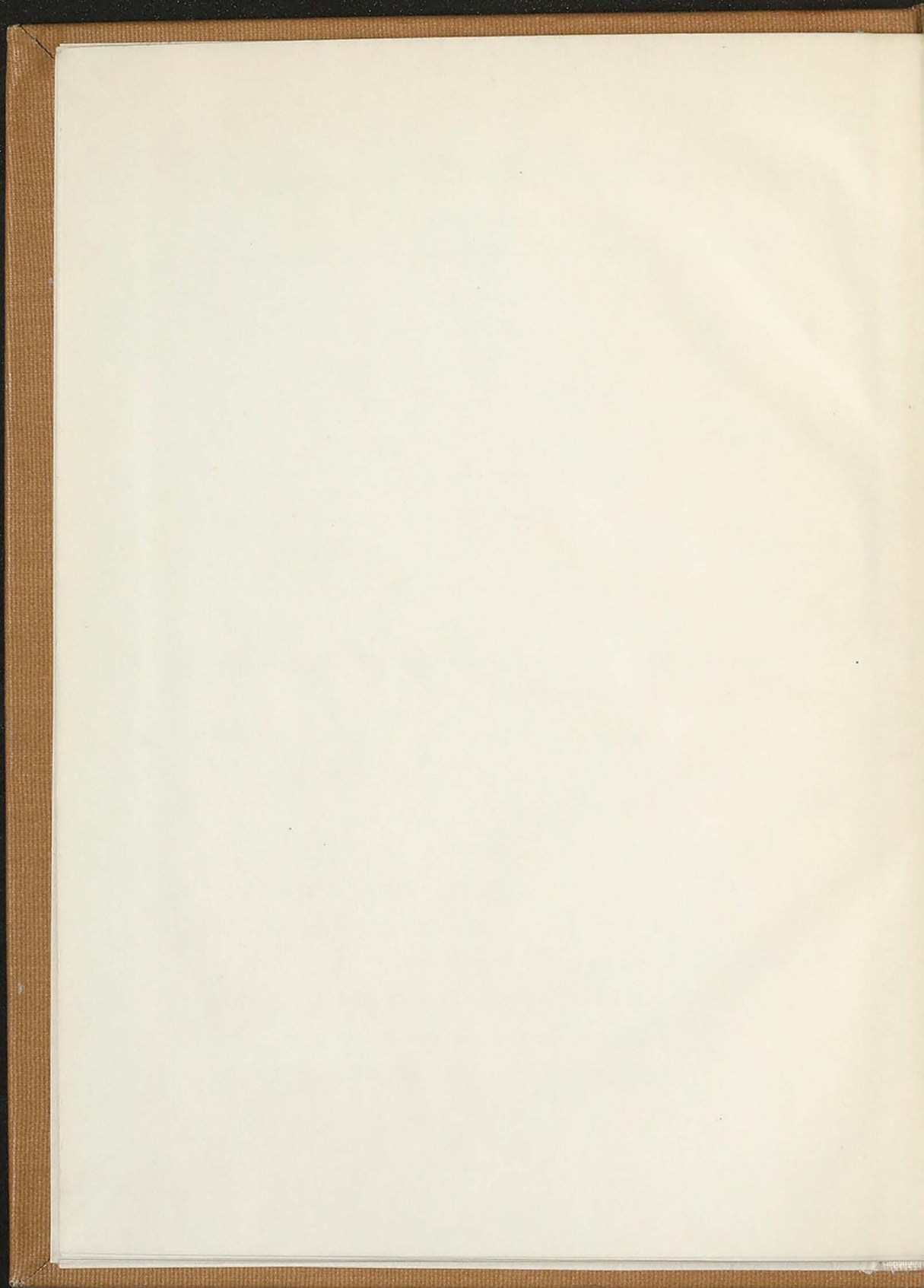
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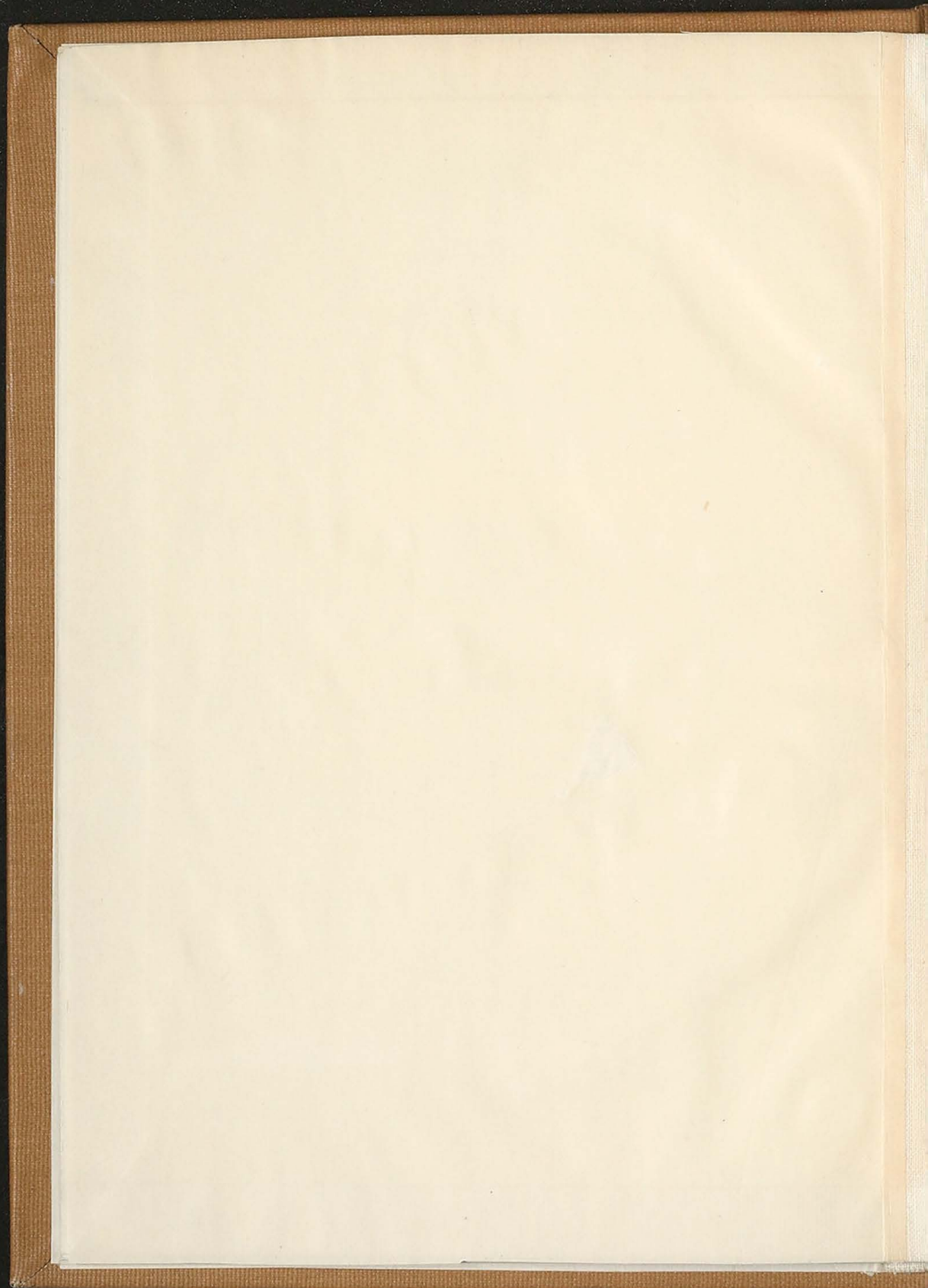
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