Cytological and Morphological Studies on the Gametophytes of Ferns IX The Polar Plasmolysis on Fern-prothallium (2)*

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伊倉伊三美: 羊齒類の配偶体に関する細胞学的並に形態学的研究 IX
羊齒類前葉体の有極性原形質分離 (2)

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From the results shown in Table 1 in the preceding paper, the following facts are explained. The plasmolyses of the prothallial cells occurred, first of all, at Region I and extended by degrees to II, III, IV, V and VI but occurred often almost at the same time at I and II. Accordingly, the plasmolytic gradient was observed among the regions in the whole field of the prothallium, and the basal pole produces the plasmolysis earlier than the apical one. The spot at which the cytoplasm separates from the membrane firstly in a single prothallial cell was regarded as the corner of the apical pole in many cases (Photo. I), while sometimes the cases which were contrary to this fact were observed. That is to say, in a single cell, the plasmolysis is generally positive, at the beginning, in the corner of the cell at the apical pole and negative at the basal one, and the cytoplasm is apt to draw near the latter. The reverse phenomenon of this behaviour of the cytoplasm, however, was observed in some portions. Namely, in a certain cell the cytoplasm separated from the membrane at the corner of the cell at the basal pole and gradually reached A-type.

The region which reached, at first, the A-type of the form of plasmolysis in the prothallial cell was I also, and the other regions followed I one after another. In the same mol.-solution and the same duration each region showed the different type, that is, though Region I and II presented A-type, the other regions did not get A-type and remained at B- or C-type (Photos. 2, 3, 4-6, and 7-9). B- and C-type changed their forms by degrees into A- or B-type, at last after some times, different as the time was according to the species of the prothallia or the concentration of mol.-solution, all regions got A-types (Photos 10, 11). In the prothallial cell which seemed to be divided into two cells by the transversal membrane, the negative plasmolysis was observed at the both sides of this transversal membrane in spite of the cell polarity (Photo. 7), and the opposite sides to this membrane showed the incipient plasmolysis. This result may be due to the fact that the cytoplasm contacts

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Table II. The duration of plasmolysis at each region in the whole field of the prothallium

Plasmolytica	Species	Mol.	Regions						Remarks		
			I	II	III	IV	V	VI	date	temp. °C	
Saccharose	Ai	II, III 0.30	(mins.)						II-6	12, 7	
	Tj	0.30	80-90	90-110	110-120	110-120	110-130	II-12	18, 10		
	Lt	0.30	90-100	90-100	100-110	100-120	100-130	II-24	15, 11 5		
	Lm	II 0.30	80-90	80-100	90-100	100-110			II-16	19, 12	
		IV-V 0.40	50-60	50-60	60-50	60-65			II-17	20. 11	
CaCl ₂	Ai	0.20	60-65	60-65	65-75	70-90			II-5	17, 8.5	
		V 0.30 0.50	} 30-35	30-50	60-65	70-80	70-80				
	Tj	V 0.30						50-60	50-60	50-70	60-70
	Lm	III-IV 0.18	0-60	50-60	50-70	60-70 ?	60-70 ?	II-20	19.5, 12		
IV-V 0.30		30-35	30-35	35-50	65-75	75-100 ?					
Urea	Ai	0.30	120-150	120-150	120-160	140-160			III-2	16, 9	
		II 0.42	60-70	60-80	70-80	70-80	80-90				
		V 0.70	20-25	20-25	30-40	40-50	50-60				
		1.00	} 15-20	15-20	20-30	40-50	40-50				
		1.20									
	Tj	IV 0.40 0.70	60-70 15-20	60-70 15-20	70-80 30-40	40-50 40-50	40-50	III-8	20, 10		
	Lt	IV-V 0.38	40-50	40-50	50-60	50-60		III-10	19.5, 12		
V-VI 0.58		30-40	30-40	40-50	50-60	60-70					
V-VI 0.62		20-30	20-30	30-40	40-50	50-60					
KCl	Ai	V 0.30 1.00	30-40 20-30	30-40 20-30	40-50 30-40	60-70 40-50	70-80 60-70	70-80 ?	III-12	19, 12	
		Tj	V 0.30	20-30	20-30	30-40	40-50	40-50	III-15	16, 11.5	
KNO ₃	Ai	V 0.30 1.00	15-20 5-10	15-20 5-10	20-30 10-15	30-40 10-15	40-50 15-20	40-50 ? 15-20 ?	III-16	16, 11.5	
		Tj	IV 0.28	15-25	15-25	20-30	30-40		III-17	17.5, 11	
Glucose	Ai	IV 0.40	30-40	30-40	40-50	40-60	40-60		III-19	18, 12.5	
	Tj	IV 0.40	15-20	15-20	20-30	30-40	50-60		III-22	22, 14	
NaCl	Ai	IV 0.30 1.00	20-25 10-20	20-25 10-20	30-50 30-30	50-60 30-50	40-60		IV-21	18, 13.5	
AlCl ₃		IV 0.36	30-40	30-40	40-50	40-50	50-60		IV-30	17.5, 16	
		V 0.46	40-50	40-50 ?	50-60 ?	50-60 ?	60-70 ?				
MgCl ₂		IV 0.40	40-50	40-50	80-90	90-120			V-7	17, 16	
		V 0.70	10-15	10-15	15-25	20-30	25-35	35-40 ?			
NH ₄ Cl			IV 0.40 1.00	20-30 5-15	20-30 5-15	30-40 20-30	30-40 120 ?	120 ?	130 ?	V-15	16, 15.5

Foot-note: 1) Ai *Asplenium incisum* Thunberg, Tj *Thelypteris japonica* Ching, Lt *Leptogramma totta* J. Smith Lm *Leptorumohra Miqueliana* H. Ito. 2) In the column of Remarks, the date, the room- and water-temperature in the experiment were represented respectively. 3) II, III, IV, V, and VI in the column of Mol. indicate the region in which these mol.-values are the limit concentrations. ? no clear observation.

closely to the transversal membrane which is assumed to be formed newly, in other words, this membrane may possess the high viscosity which disturbs the cell polarity. At the tangential or the radial polarity, in general, the prothallial cell

Fig. 4. The forms of plasmolysis of the glandular hair in *Thelypteris japonica* Ching. ($\times 240$). In 0.34 mol. glucose-solution. The portion of the oblique lines is that of the cytoplasm

begin the plasmolysis earlier at the apical pole than at the basal one, too, but occasionally this phenomenon is not clear. The cytoplasm of the glandular hair is observed to show, on the whole, the positive plasmolysis at the basal portion and the negative at the apical (i. e. 0.3, 0.6, 0.54 mol. urea, 0.3 mol. CaCl_2 , 0.22, 0.24 mol. KCl , 0.28 mol. KNO_3 , 0.34, 0.60, 0.68 mol. glucose) (Fig. 4). In HCl or ethyl alcohol solution the plasmolysis was negative.

II The Duration of Plasmolysis

At the portion of Region VI the form of plasmolysis of the prothallial cell could not be recognized clearly and no perfect form of A-type was found in general at the neighbourhood of Region V, whereas in the other regions the clear A-types could be observed especially in saccharose-, urea-, and KNO_3 -solutions. The duration of plasmolysis (plasmolysis time) is the one in which the form of plasmolysis gets to A-type since the incipient plasmolysis occurred, and it is decided as shown in Table II in which the extracts of the experiments were given.

The duration of plasmolysis is shorter at the basal pole than at the portion of the apical pole in the longitudinal polarity within the whole field of the prothallium and is shortest at Region I, and it becomes long gradually according as the region approaches Region VI. At the tangential or the radial polarity, though no exact observations were often got, the basal pole seemed to indicate also the short duration, compared with that of the apical pole. The more the solution of the plasmolyticum is hypertonic, the shorter the duration grows at each region. The difference of the species of the fern-prothallium or the plasmolyticum gives rise to that of the duration of plasmolysis more or less.

(to be continued)

Explanation of Plates

The polar plasmolysis of the prothallial cell in *Asplenium incisum* Thunberg.

Photo. 1. Incipient plasmolysis in 0.36 mol. glucose-solution after four minutes. Region I.

Photos. 2, 3. Plasmolysis in 0.36 mol. MgCl_2 -solution after seven minutes. 2. Going to reach A-type in Region I and II. 3. The plasmolysis in Region III occurred slightly while in Region I and II are going to A-type.

Photos. 4, 5, 6. Plasmolysis in 0.42 mol. KCl -solution after eight minutes. 4. The Region II; almost perfect A-type. 5. Region IV; advanced B-type. 6. Region V, VI; B- or C-type.

Photos. 7, 8, 9. Plasmolysis in 0.6 mol. saccharose-solution after fifty minutes. 7. Region III; almost A-type. 8. Region IV; advanced B-type. Not perfect A-type. 9. Region V, VI; B-type.

Photos. 10, 11. A-type forms of plasmolysis in 0.70 mol. urea-solution after seventy minutes. 10. Neighbourhood of Region II, III, and IV. 11. Neighbourhood of Region IV, V, VI.

I. Igura: Gametophytes of Ferns 1X.

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