During the course of an experiment involving mutation studies on the variety Single Yellow of annual chrysanthemum, a large number of plants were found on selfing to be completely sterile. Seven of them which formed the progeny of a cross, attempted primarily to study the inheritance of a radiation induced character, were intercrossed in all possible combinations. Their crossibility relationships indicated four intra-sterile groups, having 2, 2, 1, and 2 plants respectively. The inter-group compatibility of these plants is indicated in the following Table.

♀ \ ♂	Group I	Group II	Group III	Group IV
Group I . . .	−	−	+	+
Group II . . .	−	−	+	+
Group III . . .	−	+	−	−
Group IV . . .	+	+	−	−

+ Compatible. − Incompatible.

The above observations show that not all the groups are inter-fertile. Groups I and II, for instance, show inter-sterility both ways and a similar behaviour is shown by Groups III and IV. Groups I and II also show inter-sterility but in one direction only. These features of the results obviously cannot be explained on the basis of the gametophytic determination of incompatibility genes as in *Nicotiana*. They appear however to be quite similar to those reported for other members of Compositae; and, of the two genetic mechanisms proposed for this group, the one by GERSTEL[1], and by HUGHES and BABCOCK[2] suggesting sporophytic control of pollen reaction, accounts for them.

According to the scheme put forward by GERSTEL, the multiple alleles of the gene R determine the mating system. Assuming for the two parental plants involved in the present cross, the genetic constitutions of R_1R_2 and R_3R_4, the four groups of plants expected in the progeny are R_1R_3, R_1R_4, R_2R_3, and R_2R_4 respectively. These genotypes for the four intra-sterile groups observed in the progeny are entirely consistent with their intercrossibility relationships if it is supposed that the genes show independent action in the style, and the two alleles of the male parent, on the basis of their dominance relation, determine the reaction of the pollen. From the results it is possible to deduce the dominance of R_1 over R_4 and of R_2 over both R_3 and R_4. R_1 and R_3 show no mutual interaction, in other words, they show equal dominance as is indicated by the inter-sterility of group II with I ($R_1R_4 \times R_1R_3$) and of group III with I ($R_2R_3 \times R_1R_3$). In the absence of parent progeny crosses, the interaction of R_1 with R_2 and of R_3 with R_4 could not be determined. Special techniques are being employed to achieve such crosses.

The above interpretation of the results shows that self-incompatibility in annual chrysanthemum can be explained on the basis of the scheme postulated for *Parthenium argentatum* and *Crepis foetida*, and differs from that in *Cosmos* in which dominance between alleles has been demonstrated to occur both in the pollen and the style. This would suggest that the Composite scheme developed from observations on the first two plants is probably more typical of the family.

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Botany Division, Indian Agricultural Research Institute, New Delhi, September 3, 1959.

Zusammenfassung

Es werden Beweise für die sporophytische Determinierung der Selbst-Inkompatibilität von *Chrysanthemum carinatum* erbracht. Die Resultate weisen auch darauf hin, dass die Inkompatibilitäts-Allele im Pollen Dominanz zeigen, während sie im Griffel unabhängig sind. Der Inkompatibilitäts-Typus in dieser Pflanze stimmt mit jenem von *Parthenium* und *Crepis* überein, weicht aber von dem bei *Cosmos* gefundenen ab. Es wird angenommen, dass das Schema, wie es bei den erstgenannten Gattungen nachgewiesen wurde, typisch ist für die Familie der Kompositen.

The Mechanism of External Pancreatic Secretion

In the external secretion of the pancreas of dogs, the concentration of bicarbonate increases and that of chloride decreases with increasing rates of secretion[1,2]. The sum total is almost constant and the secretion is always isotonic with the extracellular fluid[2]. Experimental data are represented in Figure 1.

Since, at high rates of secretion, actual values of bicarbonate of 152 meq/l were observed, whereas in plasma the maximal bicarbonate concentration is about 30 meq/l, it seems that we are dealing in the primary, active secretion with an isotonic fluid, containing bicarbonate as the sole anion, associated chiefly with sodium[2]. This secretion is then modified as it passes through the ductal system.

The fact that with decreasing flow Cl^- concentration increases and HCO_3^- decreases, approaching blood plasma levels, may be explained by either of the following hypotheses: (a) the bicarbonate secretion of the glandular cells is mixed on its way with a plasma ultrafiltrate[3], or (b) the

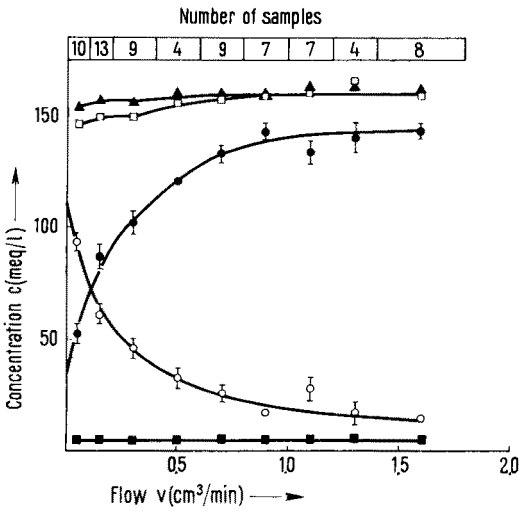

Fig. 1. Average concentration of bicarbonate (●), chloride (○), sodium (▲), potassium (■), and sum of anions (□) at various rates of external pancreatic secretion. The vertical lines show the standard deviation of the mean.

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secretion of the glandular cells is equilibrated by anion exchange as it passes along the ductal system.

We wish to point to some evidence which seems to exclude the first possibility and to support the second hypothesis. The relative impermeability of the ducts to cations is indicated by the fact that sodium is excreted in almost constant concentration, somewhat above its level in the extracellular fluid, and that its concentration is independent of the rate of flow (Fig. 1)[1]. Moreover it was shown, that in contrast to cations, both inorganic monovalent anions and small neutral molecules[4] and likewise acidic or some amphoteric dyes[5] appear in the pancreatic juice soon after their intravenous injection – an evidence which would suggest an anion exchange property of the ductal epithelium. This property would require that the total amount of anions, other than HCO_3^-, transported per min through the wall of the duct, is constant and independent of the flow rate. This applies, indeed, for Cl^-, the maximum output being about 16 µeq/min at flow rates higher than 0·4 ml/min (Table). However, at low rates of flow, reabsorption seems to diminish the chloride output.

Another important fact is the constancy of the ratio of concentrations of certain compounds in pancreatic juice to their concentration in plasma. This ratio was proven to be independent of flow and plasma level for the following compounds: Urea 0·8[1], glucose 0·2[1], creatinine, and inorganic phosphate[6]. If the pancreatic secretion consisted of a primary fluid containing bicarbonate and an admixed plasma filtrate, we should expect varying concentrations of the above materials as the flow changes. Otherwise, it would be necessary to assume that the primary secretion contains the above materials exactly in the same proportion in which they permeate the hypothetical filtrating membrane.

By assuming admixture of primary secretion and passive filtrate through the ductal membrane, it would be necessary to admit a changing rate of filtration corresponding to the changing rate of secretion. This would require an exact nervous or hormonal regulation of the admixing rate; otherwise it would be difficult to understand why the filtration rate should change at all at constant blood pressure. The fact that backpressure does not modify the composition of the pancreatic juice may serve as further evidence against a filtration mechanism[7].

In the light of the evidence cited it seems more probable that we are dealing with a diffusion phenomenon rather than with admixture, i. e. the primary active secretion is modified on its way out be exchange of anions through the ductal membrane.

Appendix. According to equation 5 of BERGMANN and DIKSTEIN[8,9]

$$c_x = \frac{C''}{v x} \exp\left[-2\pi r K_T \int \frac{c_x - c_e}{c_x v_x}\, dx\right]$$

which for v = constant is reduced to

$$c_x = C \exp\left[-\frac{2\pi r K_T x}{v}\right] + C' \,. \qquad (1)$$

The boundary condition: if $K_T \to \infty$ or $v \to 0$ gives

$$C' = c_e \qquad (2)$$

and $K_T \to 0$ or $v \to \infty$ gives

$$C = c_0 - c_e \,. \qquad (3)$$

By substituting equations (2) and (3) into equation (1) and rearranging, we obtain

$$\ln \frac{c_x - c_e}{c_0 - c_e} = -\frac{2\pi r K_T x}{v} \,. \qquad (4)$$

This means that $\ln(c_\alpha - c_e)$ versus $1/v$ should give a straight line. This is the case indeed for medium flow rates as can be seen on Figure 2. In the right hand of expression (4), magnitudes in the coefficient $2\pi r K_T x$ are identical for different solutes, with the exception of K_T. Therefore, the slope of the straight lines in Figure 2 are proportional to K_T. Since the slopes are identical, $K_T^{Cl^-} = K_T^{HCO_3^-}$, which further supports our hypothesis of anion exchange.

Range of flow		Chloride output in µeq/min	
0 –0·1	0·8–1·0	6·7 ± 0·25	15·4 ± 6·0
0·1–0·2	1·0–1·2	8·9 ± 0·5	25·0 ± 2·5[a]
0·2–0·4	1·2–1·4	13·0 ± 0·6	13·2 ± 4·5
0·4–0·6	1·4–1·8	16·9 ± 3·2	21·3 ± 5·0
0·6–0·8		13·2 ± 3·0	

[a] According to Fig. 1, the values for Cl^- are somewhat higher and those for HCO_3^- are somewhat lower than expected, i. e. they fit for a lower rate. Thus the high value for Cl^- output in this group is presumably caused by experimental error, working in non-steady state condition.

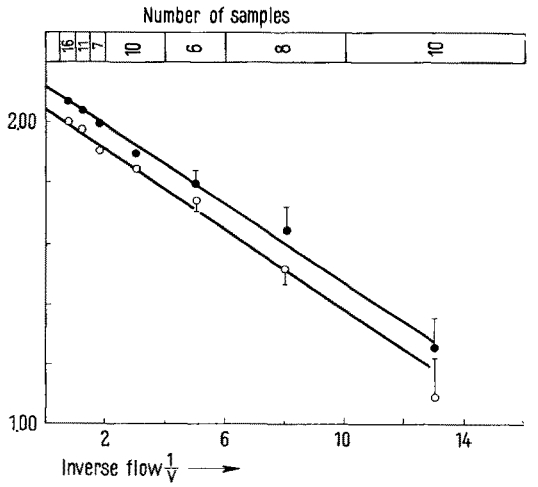

Fig. 2. Relation of the logarithm of [HCO_3 – 30] and logarithm of [110-Cl] to the reciprocal rate of secretion. The same symbols are used as in Fig. 1.

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[9] *Symbols.* c = concentration, v = flow, K_T = transfer constant, r = radius of the duct, x = length of the duct, C = constants. *Subscripts.* x = at distance x, 0 = at the origin, e = external.

Zusammenfassung

Gegenwärtig vorliegenden Daten gemäss kann der Mechanismus der äusseren Sekretion der Bauchspeicheldrüsen am besten durch die Hypothese erklärt werden, dass zuerst eine bikarbonatreiche Lösung gebildet wird, die dann auf dem Weg durch die Gänge der Bauchspeicheldrüse mit dem extrazellulären Chlorid ausgetauscht wird. Die Wände der Gänge wirken als eine anionendurchlässige Membrane.

Absorption of L-Lysine in the Small Intestine of Rats

WISEMANN[1] reported that isolated loops of rat's intestine transfer monoamino acids but not diamino acids, lysine, and ornithine, against a concentration gradient. Since L-lysine is essential to animals, it seemed worth while to carry out further investigations upon *in vitro* and *in vivo* L-lysine intestinal absorption.

Methods and results. Male rats, weighing 150–200 g were used, they were fed on a standard diet with at least 12 h fasting before the experiments.

1. Perfusion of isolated surviving rat small intestine. Each animal was killed by decapitation and bled.

The apparatus used for the intestinal perfusion was based on the original DARLINGTON and QUASTEL one[2], but substantially modified to make it more practical (see Figure).

Loops of small intestine of about 25 cm, adjacent to duodenum, were used. As soon as removed from an intact animal, a loop was placed in a small beaker and the inside was washed out with the solutions to be used in the experiments. The upper and lower ends of a loop were then tied on (S) and (S') of the apparatus with a silk thread. Description in fuller details may be found elsewhere[3]).

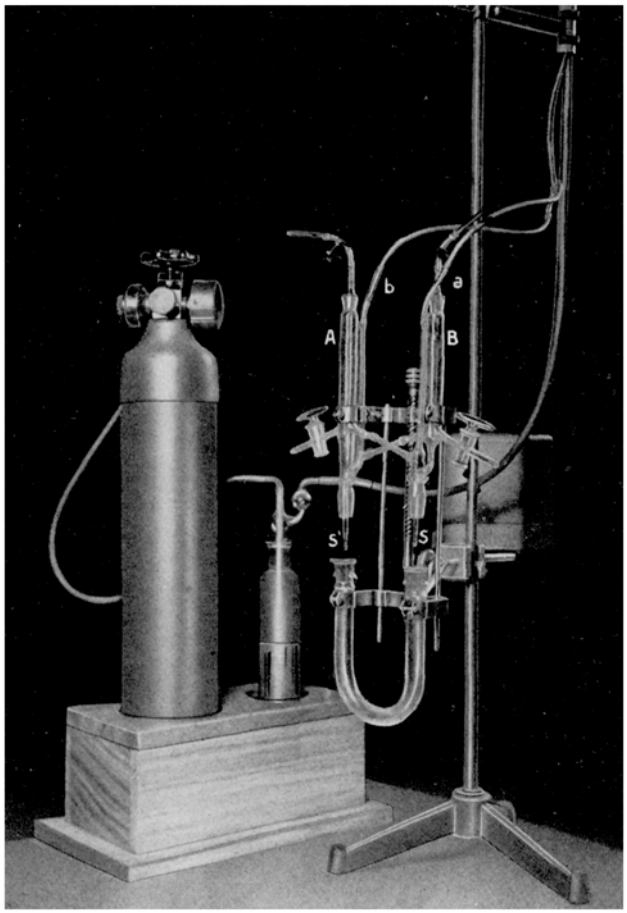
On assembling the intestinal segment in the apparatus, two independent systems are involved: the former inside, the latter outside the intestinal lumen. In both systems, the perfusion fluid runs in opposite directions, if a gas flow is led to the apparatus under a moderate pressure. Gas flows through (a) and (b), which are connected to the reservoirs (A) and (B) by two side connections. Therefore, in passing through (A) and (B) filled with a perfusion fluid (Ringer-bicarbonate), a gas carries some fluid with it in such a way that the level in the reservoirs (A) and (B) are made higher than in (a) and (b). By the difference between the fluid levels, two circulations result: the inner solution running through the intestinal lumen and the outer solution outside.

The apparatus, when in use, is kept in a bath maintained at 38°C.

Samples of inner and outer solutions for lysine estimation are taken through two glass coks on the apparatus; L-lysine is analyzed by the method reported by ALLPORT and KEYSER[4].

Perfusion results are given in Table I, where data of experiments, each corresponding to a different L-lysine concentration are reported.

2. Uptake of L-lysine by intestinal tissue. The small intestine was removed with the same care taken in the previous experiments. After dipping in a Ringer-bicarbonate solution at 38°C, and drying on a filter paper, an isolated loop was then cut into pieces of ÷ 0·25–0·5 cm ÷ 0·25 to 0·50 cm with scissors.



The intestinal tissue was transferred to Warburg flasks of 50 ml capacity, which contained Ringer-bicarbonate buffer, with or without L-lysine.

The flasks were kept in a bath at a constant temperature (38°C). At intervals, samples of the fluid were taken for lysine estimations. At the end of an experiment, the tissue was precipitated with 10% TCA (0·5 ml), then separated from the incubation fluid by centrifugation, and finally minced with Quartz sand in a mortar containing distilled water. Extracts were made, and analyzed for lysine. The volumes of the extracts correspond to the

Table I. Absorption of L-lysine from isolated surviving rat small intestine.

Inner solution: L-lysine as shown in the 1st line, in Ringer-bicarbonate, pH 7; 20 ml. Outer solution: Ringer-bicarbonate, pH 7; 60 ml. Gas: 95% O_2 + 5% CO_2. Duration of an experiment: 60 min; temperature 38°C.

Inner solution	μM L-lysine before the experiment	130	300	653	910	1317	1750
	μM L-lysine/h found after the experiment	90	144	215	316	622	675
Outer solution	μM L-lysine/h found after the experiment	19	58	84	96	74	21

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