schärfer begrenzten Keratohyalingranula legen. Da häufig sowohl innerhalb als auch unmittelbar aussen auf der Kernmembran Granula vorkommen, wird vermutet, dass diese durch die Kernmembran in das Cytoplasma wandern. Dort lagern sich Ribosomen an ihrer Oberfläche an. Als Arbeitshypothese für weitere Untersuchungen stellen wir uns auf Grund der Befunde vor, dass – wenigstens beim vorliegenden Objekt – ein Anteil des Keratohyalins im Kern gebildet und durch die Kernmembran durchgeschleust werden muss. Im Cytoplasma könnte mit Hilfe der sich auflagernden Ribosomen ein zweiter Bestandteil synthetisiert werden, wodurch die Vergrösserung der intraplasmatisch gelegenen Keratohyalingranula bedingt wäre.

Diese Annahme wird durch die Befunde von LEUCHTENBERGER und LUND[2] unterstützt, nach denen Ribonuklease die Anfärbbarkeit eines Teiles der Keratohyalinkörnchen aufhob. Nach MONTAGNA[3] und RHODIN und REITH[4] besteht der Partikelbesatz der Keratohyalingranula aus Ribosomen. Folglich muss die RNS ein Bestandteil des Keratohyalins sein. Die Untersuchungen von SMITH und PARKHURST[5], sowie BERN, ELIAS, PIKETT, POWERS und HARKNESS[6] bestätigen ebenfalls den RNS-Gehalt der Keratohyalingranula.

Das Auftreten von Keratohyalingranula im Kern ist unseres Wissens noch nicht beobachtet worden. Es wäre denkbar, dass im Epithel des Rattenoesophagus die Keratohyalinbildung bereits im Kern teilweise sichtbar wird, während sie sonst erst im Cytoplasma aus den vom Kern ausgeschiedenen, weniger sichtbar zu machenden Vorstufen erfolgt. Im vorliegenden Objekt liessen sich neben den kontrastreichen Granula auch weniger kontrastreiche beiderseits der Kernmembran nachweisen, die als solche Vorstufen gedeutet werden können, zumal einige von ihnen Übergänge in die dichteren Granula zeigten.

Ein ausführlicher Bericht folgt in der Zeitschrift für Zellforschung.

Summary. Electron microscopic studies on the oesophageal epithelium of the rat revealed for the first time intranuclear granules of keratohyalin. The results strongly suggest that these granules were extruded from the nucleus and were enlarged in the cytoplasm by ribonucleoprotein (RNP) particles aggregating to the keratohyalin.

H.-J. OEHMKE und G. PETRY

Anatomisches Institut der Universität Marburg an der Lahn (Deutschland), 29. April 1964.

[2] C. LEUCHTENBERGER und H. Z. LUND, Exp. Cell Res. *2*, 150 (1951).
[3] W. MONTAGNA, *The Structure and Function of Skin*, 2. ed. (Academic Press, 1962).
[4] J. A. H. RHODIN und E. J. REITH, in *Fundamentals of Keratinisation* (Publ. No. 70; Am. Association for the Advancement of Science, 1962).
[5] C. SMITH und H. T. PARKHURST, Anat. Rec. *103*, 649 (1949).
[6] H. A. BERN, J. J. ELIAS, T. B. PICKETT, T. R. POWERS und M. N. HARKNESS, zit. nach E. HORSTMANN, *Die Haut*, in *Handbuch der mikroskopischen Anatomie des Menschen* (Springer-Verlag, 1957), Bd. III/3.

Flow of a Solution into a Tube Filled with Solvent: Static Concentration and Flow Concentration of the Solute

We consider a straight cylindrical tube filled with solvent, into which a solution is introduced at one end. We assume that convection takes place only according to POISEUILLE's law and that the effects on the solute of diffusion, gravity or transverse hydrodynamic forces are negligible. We chose a tube section having unit volume and unit length, from $x=0$ to $x=1$, connected to a reservoir above $x=0$. The tube is filled with solvent and the solution introduced at $x=0$. At $x=1$ we place a monitoring device (colorimeter, radiation detector), or we interrupt the tube and collect samples.

Let V_1 be the volume of a thin cross-section of the tube at $x=1$, and v_1 the volume of original solution contained in it at a particular moment: $v_1/V_1=e$ may be called the relative local or static concentration of the solute at $x=1$. Now let V_2 be the volume of a small amount of fluid that crosses a transverse plane at $x=1$, and v_2 the amount of solution that this volume carries; $v_2/V_2=c$ will be the relative flow concentration of the solute at $x=1$, at that moment. The monitoring device yields e, analysis of effluent samples yields c.

The reader is referred to TAYLOR[1] and to our publications[2] for the understanding of what follows.

We study three simple theoretical cases.

(1) An unlimited amount of solution is introduced at $x=0$. Its distribution at various times is given (Figure 1A) by lines $\overline{a\,x_1}$, $\overline{a\,x_2}$, etc. As shown prevously[2] the local concentration at $x=1$ is $e=1-1/2U$, in which $U=x/2$ is the amount of fluid that has passed $x=1$ and is equal to the amount delivered by the reservoir[3]. The flow concentration is then $c=1-1/4U^2$. These equations are valid for $U \geqq 0.5$.

(2) The tube, filled with solvent, receives only a small specimen of solution. The reservoir is then rinsed and filled with solvent, which follows the solution into the tube. The specimen, of fractional value S, is shown (Figure 1A) as it occupies area $\overline{a\,x_2\,x_1}$. Let us call U_2 the area $\overline{a\,x_2\,0}$, and U_1 the area $\overline{a\,x_1\,0}$, so that $U_1+S=U_2=U$, the total amount of fluid delivered. Note that $x_2-x_1=2S=$ constant, and that $e=y_2-y_1$.

We seek the relations between U, e and c.

For $x_1<1<x_2$, equivalent to $x_2-2S<1<x_2$, or $U-S<0.5<U$, in other words, before the solvent that follows the specimen has reached the monitoring point, the relations are the same as in case 1:

$$e=1-1/2U,\ c=1-1/4U^2.$$

[1] G. TAYLOR, Proc. Roy. Soc. (A) *219*, 186 (1953).
[2] J. BOURDILLON, Exper. *18*, 530 (1962); *19*, 250 (1963).
[3] In our previous publication, the symbol y was used instead of e.

For $U - S \sim 0.5$, we have:

$$e = y_2 - y_1 = \left(1 - \frac{1}{2\,U_2}\right) - \left(1 - \frac{1}{2\,U_1}\right) = \frac{1}{2}\left(\frac{1}{U-S} - \frac{1}{U}\right)$$

To assess c, we consider in Figure 1A the triangle $\overline{y_2\,x_2\,1}$, whose area represents the sum of the solution expelled, $\overline{y_2\,x_2\,x_1\,y_1}$, and of some pure solvent introduced after the specimen, $\overline{y_1\,x_1\,1}$. To this material there corresponds a static 'concentration' $e_2 = y_2$, and consequently, by analogy with case 1, a flow 'concentration' $c_2 = 1 - 1/4\,U_2^2$. The same reasoning applies to triangle $\overline{y_1\,x_1\,1}$, so that

$$c = c_2 - c_1 = \left(1 - \frac{1}{4\,U_2^2}\right) - \left(1 - \frac{1}{4\,U_1^2}\right) = \frac{1}{4}\left(\frac{1}{(U-S)^2} - \frac{1}{U^2}\right)$$

(3) The unit length of tube is preceded by a section between $x = -S$ and $x = 0$, which is filled with solution, the reservoir and the rest of the tube containing only solvent (Figure 1B). After some solvent has flowed in from the reservoir, the specimen occupies position $\overline{a\,x_2\,x_1\,b}$.

Here we have again, this time provided

$$U - 0.5\,S < 0.5 \leqq U,$$

$$e = 1 - \frac{1}{2\,U} \quad \text{and} \quad c = 1 - \frac{1}{4\,U^2}$$

For $U - 0.5\,S \geqq 0.5$:

$$\frac{x_2 - 1}{y_2} = \frac{x_2}{1}\,; \quad y_2 = 1 - \frac{1}{x_2}$$

$$\frac{x_1 - 1}{y_1} = \frac{x_1 + S}{1}\,; \quad y_1 = 1 - \frac{1}{x_2} - \frac{S}{x_2}$$

$$e = y_2 - y_1 = \frac{S}{x_2} = \frac{S}{2\,U}\,.$$

To obtain c, we need the rate of change of volume W of solution expelled in respect to U. This volume is represented by area $\overline{y_2\,x_2\,x_1\,y_1}$, equal to

$$(x_2 - 1)\,\frac{y_2}{2} - (x_1 - 1)\,\frac{y_1}{2}\,.$$

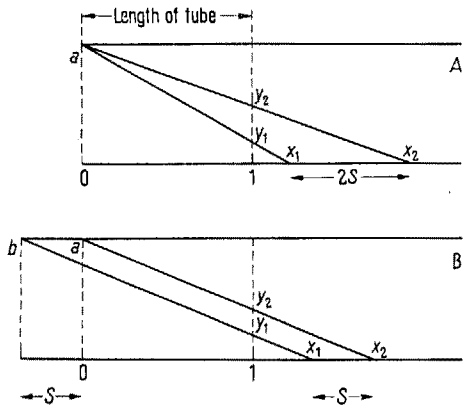

Fig. 1. Diagrams to illustrate flow of solution.

Substituting the above values for y_2 and y_1 and remembering that $x_2 = 2\,U_2 = 2\,U$, we finally obtain

$$W = S - \frac{S}{2\,U} - \frac{S^2}{4\,U}$$

$$c = \frac{d\,W}{d\,U} = \frac{S}{2\,U^2} + \frac{S^2}{4\,U^2} = \frac{S + 0.5\,S^2}{2\,U^2}$$

in which the term $0.5\,S^2$ can be neglected for small values of S.

The results are summarized in the Table.

		e static concentration	c flow concentration	c/e
I	$U \geqq 0.5$	$1 - \frac{1}{2\,U}$	$1 - \frac{1}{4\,U^2}$	$1 + \frac{1}{2\,U}$
II	$U - S \geqq 0.5$	$\frac{1}{2}\left(\frac{1}{U-S} - \frac{1}{U}\right)$	$\frac{1}{4}\left(\frac{1}{(U-S)^2} - \frac{1}{U^2}\right)$	$\frac{U - 0.5\,S}{U\,(U-S)}$
III	$U - 0.5\,S \geqq 0.5$	$\frac{S}{2\,U}$	$\frac{S + 0.5\,S^2}{2\,U^2}$	$\frac{1 + 0.5\,S}{U}$

Figure 2 shows the curves obtained when $S = \infty$ (case 1) and when $S = 0.1$ (cases 2 and 3). In these c is at first greater than e, then smaller. This is understandable, since the specimen first appears in the center of the tube, where the velocity is higher than the mean, and later moves as an annulus increasingly closer to the wall, where the velocity is zero.

The equations offered here permit the calculation of theoretical values with which experimental data can be compared. To take but one example: THOMAS et al.[4] have recently studied the flow of radioactive red cells in an

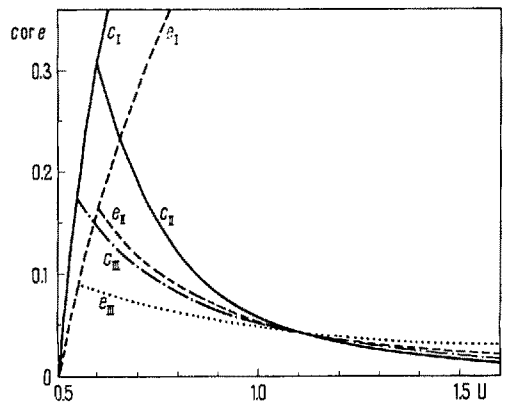

Fig. 2. Relations between static concentration e, flow concentration c and flow volume U, when solution specimen $S = \infty$ (case 1) and $S = 0.1$ (cases 2 and 3).

[4] H. W. THOMAS, R. J. FRENCH, A. C. GROOM, and S. ROWLANDS, Proc. of the 4th Internat. Congr. on Rheology, Brown University, Providence, R.I. (1963).

artificial capillary under near ideal conditions which correspond to our case 3, with $S \sim 0.13$. Comparison of their graph (their Figure 4, top) with the theoretical curve for e shows that the tagged cells do not increase in concentration as fast as expected, and later decrease more rapidly than expected. This suggests that the cells are subject to both a centrifugal displacement near the axis and a centripetal displacement at the wall, in agreement with evidence from other sources[5].

Résumé. On étudie une solution introduite dans un tuyau rempli de solvent et on distingue entre la concentration statique e et la concentration d'écoulement c du soluté. On présente un groupe d'équations s'appliquant à trois simples cas expérimentaux, qui donnent les relations de e et de c avec le volume de solution introduite et le volume d'écoulement total.

J. BOURDILLON

Division of Laboratories and Research, New York State Department of Health, Albany (New York USA), February 17, 1964.

[5] See in particular: M. TAYLOR, Austr. J. exp. Biol. Med. *33*, 1 (1955). – G. SEGRÉ and A. SILBERBERG, J. Fluid Mechanics *14*, 136 (1962). – G. BUGLIARELLO and J. W. HAYDEN, Science *138*, 981 (1962).

The Relationship Between Corticosterone Administration and Cholinesterase Activity in Rats

In an earlier paper[1], one of us proved that the administration of ACTH produced a highly significant increase in cholinesterase activity in normal subjects and also in asthmatic patients; more recently we have observed[2] that this stimulating effect of the corticosuprarenal hormone was also produced in rats which had received an injection of ACTH.

In order to find out whether the increased cholinesterase activity produced by ACTH is due to the direct action of this hormone or, more probably, its stimulating action on the suprarenal cortex, we administered corticosterone to laboratory rats. We chose this hormone because it is the principal corticosteroid produced by this animal.

For our present study we used female Wistar rats weighing 250 g. Blood was removed by puncture of the jugular vein on three successive occasions in the same animals: (a) under basic conditions, (b) after the intraperitoneal administration of a dose of 40γ of corticosterone diluted in a saline solution, (c) 9 days after the administration of the hormone.

Blood was extracted between 30 and 180 min following administration of corticosterone, and we allowed a period of seven days between the extraction under basic conditions and the next one.

Cholinesterase activity was determined in plasma, whole blood and blood cells using BIGGS et al.[3] colorimetric method.

Increased cholinesterase activity was found in all blood levels but was much more accentuated in the blood cells (a highly significant difference of $P < 0.001$) than in plasma ($P < 0.05$). The difference was intermediate in whole blood ($P < 0.01$). A similar variation was observed in normal subjects, asthmatic patients and rats injected with ACTH.

There was increased cholinesterase activity in blood cells and whole blood in all the animals studied, these acting as their own controls.

The third determination, carried out nine days after corticosterone administration, showed a decrease in whole blood and blood cell values, which almost reached those found before administration of the corticosuprarenal hormone.

It would appear, therefore, that corticosterone has a stimulating effect on cholinesterase activity in rats.

Résumé. Les auteurs ont déterminé chez des rats l'activité de la cholinestérase dans le plasma, le sang total et les cellules sanguines. Ils ont constaté par des statistiques qu'elle augmente de manière significative après l'administration de corticostérone.

J. R. VACCAREZZA and J. A. WILLSON

Instituto de Biología y Medicina Experimental, Obligado 2490, Buenos Aires (Argentine), and Laboratorio Central del Hospital Muñiz, March 10, 1964.

[1] J. R. VACCAREZZA and L. PELTZ, Presse Méd. *68*, 723 (1960).
[2] J. R. VACCAREZZA and J. A. WILLSON, Exper. *20*, 23 (1964).
[3] H. G. BIGGS, S. CAREY, and D. B. MORRINSON, Am. J. clin. Path. *30*, 181 (1958).

	Before corticosterone			After 40 γ of corticosterone			9 days after corticosterone		
	Plasma	Whole blood	Blood cells	Plasma	Whole blood	Blood cells	Plasma	Whole blood	Blood cells
Average U. Ch. activity	78	139	195	87	158	228	89	145	208
Standard deviation	±6.9	±9.7	±13.7	±11.6	±9.5	±17.5	±10.4	±15.0	±25.4
Standard error	±2.1	±3.1	± 4.3	± 3.7[a]	±3.0[b]	± 5.3[c]	± 3.3	± 4.7	± 8.0

[a] ($P < 0.05$). [b] ($P < 0.01$). [c] ($P < 0.001$).