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Preface

A congress is a coming together. Like any 'happening', there is no accurate quantitative measurement for either its ingredients or its impact. If a congress is successful, one can choose to underline the depth and breadth of its planning, the diversity of its scope, the admixture of talented guests, the quality of presentation, the status of the science behind the presentation, the level of excellence in the particular scientific field, the interplay of personalities, the geographical setting, and even the weather. Judging from comments received, the III International Congress of Nephrology was a success. We hope that success is not measured merely by the 2134 scientists registered, the 624 abstracts submitted, or the 75 invited papers and 224 free communications presented. We hope that these tangible items are outweighed by the intangibles,—the new ideas appreciated, the constructive criticisms received, the new directions indicated, the new friendships created, and the old ones confirmed. The Congress served as a much needed worldwide inventory of the 'state of the art' of nephrology with its related basic and clinical components. It demonstrated the rapidity with which progress has been made in this remarkable new field of medicine.

In the beginning neither President BERLINER nor myself was in favor of publishing a Proceedings. The lead time for preparing presentations for international congresses is usually so long that publications are often dated or repetitious of already published work. In the end our minds were changed, as they should be, by the evidence at hand: the quality and breadth of the symposium presentations which represented a remarkable cross-section of the entire range of nephrology and the only currently available inventory of the field of nephrology as of 1966. The dramatic advances in dialysis and transplantation were matched by equally important additions in the basic fund of knowledge in related physiology, morphology, bacteriology, pharmacology, and immunology. The challenge of the kidney had obviously been a stimulating force in clinical investigation in the three years since Prague. So we have proceeded with these Proceedings which contain all but one of the invited presentations which comprised the symposia at the Congress. We have divided them into three volumes, roughly designated as Physiology; Morphology, Immunology, Urology; and Clinical Nephrology. Those who were not able to attend the Congress and who have special interests may obtain the material of their choice from the publisher. For those who registered for the Congress, we hope that these three volumes will recall the happy and fruitful days of September, 1966.

For their work and cooperation we wish to express our sincere gratitude to the individual volume editors, Drs. JOSEPH S. HANDLER, ROBERT H. HEPTINSTALL, and E. LOVELL BECKER, to our Congress Manager, Mrs. HELENA B. LEMP, and to our publisher. Most of all, we wish to thank the authors, who deserve the real credit for writing these Proceedings of the III International Congress of Nephrology.

GEORGE E. SCHREINER, M. D.
Secretary-General
Coordinating Editor

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Current Concepts in Renal Physiology

F. Morel

Département de Biologie, Commissariat à l'énergie atomique, Saclay

Mister Chairman, Ladies and Gentlemen,

I would like, first, to deeply thank the organizers of this third International Congress of Nephrology. I feel very honored of having been asked to give the introductory lecture. But this is a rather heavy task, and the only thing I can do, is to try to do my best.

A rapid survey of the program of the meeting clearly indicates how vast and diversified the areas covered by renal physiology have become. Under this title coesist various topics, for which the experimental methods, the language, even the aims, often have little in common.

On the other hand, a brief analysis of the biological and medical journals shows that the number of annual publications closely related to some aspect of renal physiology, amounts to thousands.

As things stand, what should be included in an introductory lecture such as this one? Should it be a record of the major contributions brought to renal physiology since the previous meeting? In order to establish such a record, one would need a knowledge that I in no way possess; and, more important, the result might prove to be a rather ill-assorted and tedious enumeration.

Therefore, I intend to limit myself to the analysis of some of the main trends prevailing today in renal physiology; at the same time, I would like to bring up a critical discussion of experimental methods used by many groups at the present time, with special reference to their possibilities as well as to their intrinsic limitations.

With a large oversimplification, one could say that the investigations dealing with kidney physiology can be divided into four groups, according to the degree of complexity of the system under observation: (1) biophysics of the epithelial cells; (2) physiology of the nephron; (3) function of the kidney as a whole; (4) homeostasis of the body fluids. This lecture will be limited to some aspects of the first three groups only.

(1) We are all acquainted with the brilliant successes obtained in biology during the last twenty years; while many major aspects of the molecular mechanisms which direct and control protein synthesis at the cellular level have been clarified, it should be noted, in contrast, how little our knowledge has progressed concerning another essential aspect of cellular biology, that is our knowledge of the selective permeability and the transport properties of membranes. The amount of experimental work already devoted to this field of cell physiology is enormous and there is no doubt that, due to their importance, the biophysics and the biochemistry of permeability and transport will undergo considerable expansion in the coming years. They concern renal physiology as well as nephrology directly, since the peculiar functions of the various tubular segments can be described as selective and specific reabsorptive or secretory processes involving practically all the compounds present in the glomerular filtrate.

As you are well aware, the permeability and transport properties of cell membranes are being studied vigourously in a number of especially suitable living systems, such as red blood cells, digestive mucosa, giant axon, skeletal muscle, skin or bladder of amphibians, and so on . . . Similar basic studies including biochemistry and biophysics, are also being carried out on the kidney cell itself, as a result of the development of appropriate procedures which either allow an experimental study of individual nephrons '*in situ*' (technics derived from micropuncture), or even allow the microperfusion of tubular segments in vitro.

The development of this kind of basic research as well as an understanding of the results in terms of biophysics have been greatly facilitated by the popularisation, in the world of biologists, of appropriate concepts of physical chemistry and thermodynamics. Thus, in order to define, recognize and distinguish net fluxes of substances resulting from processes of passive diffusion from those provoked by mechanisms of active transport, physiologists have made wide use of the TEORELL and USSING equation. As we all know, this equation, which was established some twenty years ago, links the ratio of the two unidirectional fluxes of a given ion to the elctro-chemical potential difference which exists for this ion between the two sides of the biological membrane. Unfortunately, in the case of the renal tubule, the systematic use of this criterion for judging the presence of active transport

Table I

I.	$\frac{f_{out}}{f_{in}} = \frac{a_f}{a_{pl}} e^{-zE_M F/RT}$
$\frac{f_{out}}{f_{in}} > \frac{a_f}{a_{pl}} e^{-zE_M F/RT}$	active reabsorption or solvent drag (passive)
$\frac{f_{out}}{f_{in}} < \frac{a_f}{a_{pl}} e^{-zE_M F/RT}$	active secretion or exchange diffusion (passive)
II. (a) If net tubular reabsorption	$(f_{out} > f_{in} ; \frac{f_{out}}{f_{in}} > 1)$
$\frac{RT}{zF} \log \frac{[F]}{[P]} - E_M > 0$	*compatible* with diffusion only
$\frac{RT}{zF} \log \frac{[F]}{[P]} - E_M < 0$	*incompatible* with diffusion only
(b) If net tubular excretion	$(f_{out} < f_{in} ; \frac{f_{out}}{f_{in}} < 1)$
$\frac{RT}{zF} \log \frac{[F]}{[P]} - E_M > 0$	*incompatible* with diffusion only
$\frac{RT}{zF} \log \frac{[F]}{[P]} - E_M < 0$	*compatible* with diffusion only

f_{out}: unidirectional flux through the tubular wall directed from the tubular fluid to the interstitual fluid.
f_{in}: unidirectional flux through the tubular wall directed from the interstitial fluid to the tubular fluid.
a_f, a_{pl}, [F], [P]: activities and concentrations of the ion in the tubular fluid and the blood plasma respectively.
E_M Electrical potential difference across the tubular wall.
For explanations, see text.

appears to be restricted by serious limitations of both a theoretical and experimental nature (Table I).

Even if we admit that all the parameters involved in the equation could be simultaneously measured with sufficient accuracy, a discrepancy between the data and the equation does not necessarily prove the existence of an active process of tubular reabsorption or secretion, since passive mechanisms other than simple diffusion may well change the data in either direction; a large net outflux of water, for example, may cause a drag effect of water on solutes, and result in an increased