

# Klaus Hierholzer (1929-2007) and his impact on our understanding of the renal effects of steroid hormones

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## ABSTRACT

Klaus Hierholzer (1929-2007) dissected various functions influenced by steroids in the distal tubule and showed that aldosterone in low doses reversed the sodium and potassium transport defect in adrenalectomized rats, through a rapid activation of Na<sup>+</sup>,K<sup>+</sup>-ATPase. Subsequent studies addressed the role of 11- $\beta$ -hydroxysteroid oxidoreductase (11-HSD) and showed that the undisturbed functioning of 11-HSD is a prerequisite for selective mineralocorticosteroid regulation of epithelial transport. Another set of original experiments showed that 11-HSD was equally important in the distal colon, thus establishing that the large intestine acts in parallel with the distal nephron. Hierholzer, born in Konstanz on June 8, 1929, was laureated in medicine on May 25, 1954. Subsequently he worked at the Department of Pharmacology of the University of Freiburg, Cornell University with J. F. Pitts, the Department of Medicine of the University of Frankfurt-am-Main, the University of Copenhagen with H. H. Ussing, and the Institute of Physiology of the Freie Universitaet in Berlin where he became full professor and head of the Institute of Clinical Physiology in 1968. He held that position until 1998. He died in Allensbach in the family house on February 27, 2007. Hierholzer was a member of the Naturforscher Leopoldina Academy and of many other scientific societies, including the Academy of Science and Technology in Berlin, and received various awards including an honorary professorship at the

University of Naples, the Bezold Medal, the Volhard Medal, the Schoeller/Junkman Award, and the Malpighi Medal (in memoriam). He published nearly 300 papers including various seminal books. Noteworthy also are his papers on the history of physiology of the kidney and acid-base balance. A total of 26 scientists who trained in his laboratory became professors.

**Key words:** *Function of kidney tubules, History of physiology, 11- $\beta$ -Hydroxysteroid oxidoreductase, Na-K-ATPase, Steroid hormones*

## THE KIDNEY AS TARGET: STEROID-DEPENDENT ELECTROLYTE AND WATER TRANSPORT

In the early micropuncture area of the 1960s and the 1970s, Klaus Hierholzer (Fig. 1) clearly established that in the distal tubule, different functions are influenced by adrenal steroids: the capacity to establish and maintain concentration gradients for sodium and potassium (regulated by mineralocorticosteroids) and the ability to sustain a state of low water permeability in the absence of antidiuretic hormones (regulated by glucocorticosteroids).



Fig. 1 - Klaus Hierholzer (1929-2007).

Acute administration of aldosterone in low doses reversed the sodium and potassium transport defects of adrenalectomized rats. Experiments with inhibitors of protein synthesis such as cycloheximide and actinomycin D provided the first evidence for the concept that protein synthesis is involved in the rapid activation of steroid-dependent Na,K-ATPase. The fact that inhibitors of protein synthesis specifically block the aldosterone-dependent fraction of sodium transport but leave intact the steroid-independent rate of sodium transport has been taken to be evidence that the stimulation of sodium transport by the hormone includes the formation of aldosterone-induced proteins which stimulate the antiluminal sodium pump and/or increase luminal sodium permeability. To further elucidate the action of aldosterone, measurements of membrane voltages and effective intracellular potassium concentration were performed. From the data it was concluded that in adrenal insufficiency, the peritubular Na/K exchange

pump, peritubular and transtubular membrane voltages, intracellular effective potassium concentration and the permeability of the luminal membrane for sodium and potassium were reduced. Acute application of aldosterone normalized active sodium extrusion across the peritubular membrane. In addition, the permeability of the luminal membrane for sodium and potassium was normalized. Importantly, both permeability effects of aldosterone were refractory to inhibitors of protein synthesis. Thus it must be concluded that the action of aldosterone on the biochemical sequences of events in active and passive transport is different, at least a dual effect of aldosterone is required. In contrast to the acute effects of aldosterone, after chronic administration (3 to 5 days) of the hormone, all measured electrical parameters and effective intracellular potassium concentration were normalized. Only after a few days is a new steady state of electrolyte excretion, permeability and pump activity reached and the normal concentration differences for electrolytes reestablished. An important defect which could be demonstrated in distal tubules of adrenalectomized rats is an increase of water permeability in the presence of transtubular osmotic gradients. This functional change could be reversed by adrenal steroids with predominant glucocorticoid activity. In addition to a possible steroid-dependent modulation of central antidiuretic hormone release, Hierholzer's group convincingly showed a direct effect of glucocorticosteroids on distal water permeability. This effect was not influenced by inhibitors of protein synthesis. In the rat, the impairment of water excretion capacity is at least in part the consequence of the observed changes in distal tubular water permeability. This view is supported by the observation of a typical delayed water excretion in adrenalectomized rats with hereditary diabetes insipidus.

### **The kidney as an endocrine organ and modulator of steroid molecules: the 11-HSD story**

Around 1980, Hierholzer postulated that the kidney, in addition to being a target organ for steroid hormones, has the capacity for biochemical regulation of steroid hormones similar to the pivotal role of the kidney in the metabolism of 25-hydroxyvitamin D<sub>3</sub> (25(OH)D<sub>3</sub>) to the biologically active metabolite. Using isolated perfused rat kidneys and kidney slices, he investigated the renal metabolism of corticosterone, and soon his laboratory was known worldwide as the most important place for in vitro studies of renal corticosteroid metabolism. The "Berlin 11-HSD story" started with the observation that 11-dehydrocorticosterone, the product of 11- $\beta$ -hydroxysteroid oxidoreductase (11-HSD), is

the major renal metabolite of corticosterone.

11-HSD inactivates glucocorticosteroids in steroid target cells. Hierholzer firmly established the concept that glucocorticosteroid inactivation, and hence the undisturbed function of 11-HSD, is a prerequisite of selective mineralocorticosteroid regulation of epithelial transport. This concept is of clinical importance. Inhibition of 11-HSD, which may occur in several pathophysiological conditions, leads to a mineralocorticosteroid excess syndrome because the relatively nonselective mineralocorticosteroid receptors are then occupied by glucocorticosteroids and inappropriately activated.

### THE LARGE INTESTINE ACTING IN PARALLEL WITH THE DISTAL NEPHRON

Hierholzer was attracted by the idea that corticosteroid-metabolizing enzymes may be functionally important in several target tissues besides the kidney. Nothing was more obvious than to test whether or not 11-HSD is included in the control of the cellular response to corticosteroid hormone signals in the "single ultra-large distal tubule," the distal colon. Here, Hierholzer and Fromm showed in Ussing chamber experiments that liquorice, an inhibitor of 11-HSD, turned a glucocorticoid by function into a mineralocorticoid and that 11-HSD inhibitors also prevent mineralocorticoid-inactive glucocorticoids from becoming active.

### BIOGRAPHY

Klaus Hierholzer was born in Konstanz (Germany) on June 8, 1929. His father, Erhard, was a veterinary physician. He studied medicine at the universities of Tübingen, Innsbruck and Freiburg where he passed the final examination on May 25, 1954, and defended his doctoral thesis on July 31 of the same year.

After completing his postdoctoral training, he became an assistant at the Department of Pharmacology of the University of Freiburg. Later he moved to New York to the Department of Physiology of Cornell University directed by J.F. Pitts, where he started his research in renal physiology. In the years he spent at Cornell, he published many seminal papers on acid-base regulation, diuretics, uric acid and potassium transport. On his return to Germany, he moved to the Department of Medicine of the University of Frankfurt-am-Main, where he worked for 4 years (1960-1964). During those years he was visiting scientist at the University of Copenhagen, where he worked with Dr. Erich Windhager, in the laboratory of Prof. H.H. Ussing.

During the years 1964-1967, he joined Karl J. Ullrich at the Department of Physiology of the Freie Universität Berlin, the

1949 founded university of West Berlin, as an associate professor of physiology. In the same university, he was full Professor of clinical physiology and chairman of the Institute of Clinical Physiology from 1968 to his retirement (1998). After retirement, he left Berlin for Allensbach where he lived in the family house on the shores of Lake Konstanz. There, he was continually exposed to the sight of 3 Roman Catholic Cathedrals, among the most magnificent north of the Alps.

However, Hierholzer's trainees did not like this decision; they had expected that he would spend the spring and summer in Allensbach and the fall/winter in Berlin, where the people who worked with him were still very active and successful. They thought and still think that this was not the best solution for a man with such an active life. However, he never agreed with them that, by secluding himself in such a small city, he limited the proper use of his cultural energy. However, he missed the sparkling Berlin atmosphere where he had realized all of his ambitions and where part of his family lived.

He passed away while sleeping, as he had always desired, on the night of February 24, 2007. He is survived by his wife, Christel, a physician specialist in occupational medicine, and by his children, Babette (a pianist living in New York), Andreas (an architect living in Berlin), Nicolas a physician-violinist presently a manuscript editor for Springer Verlag and Johannes, chairman of radiology at the Potsdam teaching hospital.

### Hierholzer throughout the world

Hierholzer was visiting professor of physiology and pathophysiology at various international institutions, including Cornell University, Yale University, The South Western Medical School of Dallas, the University of Santiago and the University Frederick II in Naples. In the last, he taught regular courses both at the Second Faculty of Medicine and in the Faculty of Veterinary Medicine. In 1998, on the occasion of the bicentennial of the Faculty of Veterinary Medicine of the University Frederick II in Naples, he was made an honorary doctor of Veterinary Medicine (Fig. 2).

He was a member of the council of the International Society of Nephrology during the years 1981-1993, president of the German Society of Nephrology (1978, 1982), president of the German Society of Physiology (1985), member of the Senate of the National Council for Research (Deutsche Forschungsgemeinschaft, DFG) from 1985 to 1991, and vice-president of the University of Berlin. He also served as a consultant for NASA, ESA, the Max Planck Institute for Biophysics at Frankfurt-am-Main, the Institute for Diagnostic Research of Berlin. Furthermore, he was also a member of the councils of the International Association for the History of Nephrology, of the Deutsche Akademie



**Fig. 2 - Klaus Hierholzer awarded title of Doctor Honoris Causa at the University Frederick II in Naples.**

der Naturforscher Leopoldina, the International Society of Pathophysiology and the Academy of Science and Technology of Berlin. For the last institution, he was the chairman of the study group on the Exodus of Scientists from Berlin during Nazism and promoted the publication of *Exodus von Wissenschaften aus Berlin* (De Gruyter, 1988; see Appendix).

He received the Schoeller/Junkman Award of the German Society of Endocrinology, the Bezold Medal from the Society of Pathophysiology and the Franz Volhard Medal of the German Society of Physiology.

He worked in the editorial committees of *Pflügers Archiv*, *Nephron*, *Kidney International*, the *European Journal of Clinical Investigation*, *Clinical Physiology and Biochemistry*, *Medizinische Klinik* and *Klinische Wochenschrift*.

Among his non-nephrological nonphysiological books, a special mention is deserved for the *Letters between Anton Dohrn and Emil Dubois-Reymond*, edited with Christine Groeben, and *Phasensprünge und Stetigkeit in der natürlichen und kulturellen Welt*, edited with H.G. Wittmann (Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1988; see Appendix).

### **CONTRIBUTIONS TO THE INTERNATIONAL ASSOCIATION FOR THE HISTORY OF NEPHROLOGY**

Hierholzer participated with great enthusiasm in the birth of the International Association for the History of Nephrology (IAHN). He was present at the founding conference

on October 28-30, 1993, in Naples-Montecassino where he joined the scientific council. On that occasion he lectured on “Carl Ludwig, Jacob Henk, Herman Helmholtz, Emil Dubois-Reymond and the Scientific Development of Nephrology in Germany,” a lecture that was published under that title in 1994 (1). In collaboration with Christel Hierholzer and Johannes Hierholzer, he also illustrated a paper on “Johann Lukas Schönlein and His Contributions to Nephrology and Medicine” (2).

At the second conference of the IAHN in Padua (October 4-7, 1998), he presented with Karl Julius Ullrich a significant and innovative paper on the “History of Renal Physiology in Germany During the 19<sup>th</sup> Century” (3). The paper is notable for the topic, its sources, method, accuracy, clarification of the links between scientists and ideas – that is the human component and the outcome in creativity. In it, we learn not only the who, where and why, but also the historical context (1793-1923), which extends from the birth of Johann Lukas Schönlein to the death of Wilhelm Conrad Röntgen. Ullrich and Hierholzer analyzed some 200 contributions starting with M. Jaffe from Königsberg (*On Indacan in Urine*) and ending with H. Koeppel from Giessen (*On Isotonia/Osmotic Pressure of saline*). The paper has a great appeal because of the careful analysis of scientists, laboratories, concepts and developments. For those who study the topic in the future, it will represent the *arkhē* (the source). A synopsis of the structure of the paper is given in Table I.

At the third Giovanni Alfonso Borelli Conference on Acid-Base Balance, on the island of Capri (1999), Hierholzer discussed a companion paper “Roots of Acid-Base Balance in Germany in the 19<sup>th</sup> and early 20<sup>th</sup> Century” (4), which was meant not to take a chauvinistic perspective ... but to stress that the field was nourished by many roots from various European countries such as Denmark (Copenhagen), Sweden (Stockholm, Uppsala), France (Paris), The Netherlands (Utrecht) and England (Oxford and Cambridge) to name the most important ones. It is impressive to realize how those centers cooperated with German scientists in Berlin, Leipzig, Heidelberg, Bonn, Strassburg and others like München, Göttingen, Vienna and Tübingen. (4)

Hierholzer’s analysis starts with Albert Magnus (ca. 1200-1280), who worked mainly in Cologne, who knew sulfuric acid and prepared nitric acid. It includes also references to Otto Tachenius from Westfalia, and gives attention to J.L. Glaubert (1603-1670) who worked in many German universities and concluded his academic career in Amsterdam, a scientist who provided the first demonstration that salts originate from the reaction of acid with bases. Hierholzer made a list of 50 scientists who had published acid-base experiments in *Archiv für experimentelle Pathologie und*

*Pharmakologie*, from 1875 to 1900. The paper makes appropriate reference to H.W. Nernst (1864-1941; Berlin) for his equation which connects voltage to ions, to Michaelis (1875-1849; Frankfurt, Berlin, Baltimore, New York) and to M.L. Menten (Berlin) for the Michaelis-Menten equation, to R.W.E. Bunsen (1811-1899; Heidelberg), L. Meyer (1830-1895; Heidelberg) and Carl Ludwig (1816-1895; mainly in Leipzig). In Ludwig's laboratory, August Krogh built a microtonometer which permitted the most reliable analyses of gas tensions. Magnus (1802-1870), trained in Stockholm and Paris and, working mainly in Berlin, developed an apparatus which allowed the first correct analysis of N<sub>2</sub>, O<sub>2</sub> and CO in blood collected anaerobically. A proper place is given to H. Helmoltz (1821-1894), F. Hoppe-Seyler (1825-1895), H. Geissler (1814-1879) and E. F. W. Pflügers (1828-1910; Bonn). It is really an exhaustive paper, which lists the relevant German scientists who made original contributions to the development of acid-base research (Tab. II).

The final sentence of the paper reads:

Thus later contributions to the field by H. Bartels' work on oxyhemoglobin dissociation curve, Bruno Ochwad's work in Pitts laboratory on the role of carbonic anhydrase and its inhibitors, Karl Heinz Gertz and Hans Loeschke's construction of a CO microelectrode which was used in an attempt to localize ventral medullary respiratory chemoreceptors, to the important description of Na<sup>+</sup>-H<sup>+</sup> exchange carriers in brush

membrane vesicles by Heini Murer, U. Hopfer and Rolf Kinne *will be left to the follow-up papers* [emphasis added] (4).

For those follow-up papers he had collected the material but did not have the energy, the will and the time for assembling them. He had outlined a program concerning the development of ideas, the creation of the new, the innovations – and not just a list of scientists. Note that he did not include in the list his masterpiece "Secretion of potassium and acidification in the collecting ducts of mammalian kidney" (5), a paper going back to his time in New York.

At the IAHN conference in Taormina (November 2001) Klaus and Johannes Hierholzer (6) discussed "The Discovery of Renal Contrast Media in Berlin." Again a powerful, meticulous analysis was made, this time of the early days of contrast agents and the contributions of Bintz, Rãth, Swick and Lichtenberg. At the end of that event, Hierholzer became an honorary member of the IAHN.

In Montecassino (April 2003), Hierholzer gave 2 presentations. One, an in memoriam address for Evamaria Kinne-Saffran (7), and the other titled "Forgotten Nephrologists: Leonard Turneysser and Herman Senator" (8).

Another important contribution he gave in a monograph on *Human Clinical Research: Ethics and Economics*, published by the Italian Institute for Philosophical Studies, which had 2 editions (1997 and 1998). He also discussed (9) the "Mutual Interaction Between Physiology and Clinical Research." He departed from *physis* and *logos*, outlined some contributions of physiology to clinical research and vice versa, illustrated the channelopathies and cell adhesion molecule-mediated syndromes, gave examples of clinical concepts which provided new bases for clinical syndromes and the other way round, and the need for animal experimentation but under the firm scrutiny of ethics committees.

Additional mention should also be made of other historical papers, and among them of paper no. 265 dedicated to the discovery of pulmonary circulation by Servet, a very convincing paper, where it is demonstrated that Servet was unique in one respect. Hierholzer analyzed Servet's *Christianismi restitutio* (Hagenau, 1552/53) and concluded: "We do know no other example, where a theological concept has led to a highly successful search into an anatomical and physiological problem." (10)

A particular mention is also deserved by a publication (no. 200 in the Appendix) coauthored by Klaus and Christel Hierholzer, and titled "J. S. Bach, 'Die Kunst der Fuge,' BWV 1080, Begleittext für Berliner Saxophon Quartett." This is an intriguing paper, which provides a demonstration of the musical and cultural background of the authors. In the article, the masterpiece, a late work by Bach, is presented in an uncommon form and with renewed charm. The article helps to catch the

## TABLE I

TOPICS COVERED BY ULLRICH AND HIERHOLZER IN THE HISTORY OF RENAL PHYSIOLOGY IN GERMANY DURING THE 19<sup>TH</sup> CENTURY (3)

Ia.	Analytical methods
Ib.	Experimental techniques
II.	Urinary composition and urinary excretion
III.	Renal physiology and pathophysiology
IIIa.	Structure/function relationship
IIIb.	Process of urine formation
IIIc.	Acid-base excretion
IIId.	Renal circulation
IIIe.	Extrarenal effects on renal function
IIIf.	Effects of drug and poisons
IIIg.	Diuresis/diuretics
IIIh.	Pathophysiology
IV.	Ureters and bladder
V.	Various additional topics of general importance

structure, the references, the sounds and the saxophones.

## HIERHOLZER IN ITALY

Hierholzer loved Italy and from his youth started visiting the country where lemons blossom. He gave many invited

lectures: at the Florence meeting of the International Society of Nephrology, where he gave 1 of 3 plenary lectures in the Church of Santa Croce; the third Taormina Course; the Cacchi and Ricci Memorial at Padua; the Borelli Conference; the Appeal for Clinical Research at the Philosophical Institute; a conference at the Department of Pediatrics in

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### TABLE II

ORIGINAL PAPERS RELEVANT FOR ACID-BASE RESEARCH PUBLISHED IN PFLÜGER'S ARCHIV FÜR DIE GESAMTE PHYSIOLOGIE DER MENSCHEN UND THIERE AND IN ARCHIV FÜR EXPERIMENTELLE PATHOLOGIE UND PHARMAKOLOGIE, FROM THE BEGINNING TO THE TURNING OF THE 19<sup>TH</sup> CENTURY (4)

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#### *Berlin*

Departments of Anatomy, Physiology, Pathology, Chemistry, and various University Clinics

L. Thurneysser	J. Müller	C. F.W. Ludwig	J. Henle
H. Helmoltz	E. Dubois-Reymond	E.F.W. Pflüger	
M. Rubne	W. Nernst	E. Fischer	R. Virchow
	H.W. Nernst	C.W. Hufeland	F. Haber
	F. v. Frerichs	O. Warburg	

#### *Leipzig*

Department of Physiology

C. Ludwig	Chr. Bohr	H.P. Bowditch
CG. Hüfner	J.P. Pawlow	M. Rubner
W. Rutherford	J. Setschenow	R. Tigerstedt
A. Schmidt		

#### *Heidelberg*

Departments of chemistry and physiology; Medical Clinic

C. Ludwig	L. Meyer	J. Henle
A. Kussmaul	H. Helmoltz	

#### *Bonn*

Department of Physiology

C.F. Nasse	J. Müller	N. Zuntz
E.F.W. Pflüger		

#### *Strassburg*

Department of Chemistry; Medical Clinic

F. Hoppe-Seyler	O. Schmiedberg	B. Naunyn
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Catania; a presentation at the European Master in Nephrology in Naples, etc. He achieved one of his most notable successes in Syracuse, where he went at the invitation of Dr. Tito Gianni, chairman of nephrology at Syracuse General Hospital. Dr. Gianni, Dr. Giuseppe Daidone (the present chairman of the renal unit) as well as Dr. Ida Camera were wonderful hosts. Klaus gave a splendid presentation, and the audience, made up of young physicians and all of the chairmen of nephrology from the whole of Sicily, were enthusiastic about his talk. He spent 3 days there, visited the Cathedral of Noto, before its collapse and rebuilding, and from morning to night revisited memories of the past. He went up and down Dionysius Street and the caves having in mind 2 ideas: (i) why Plato came here twice and was sold as a slave, and (ii) how it came that modern science started here with Archimedes, the man who did not utilize the shoulders of previous giants in science - the man who did everything on his own, without mentors, without predecessors.

The answer to the first question was that Plato was arrogant in thinking himself capable of teaching democracy to a tyrant like Dionysius. Concerning the Principle of Archimedes, Castello Eurialo, blossoming of asphodels (the plants of Pliny the Elder), it is the best to understand that dividing basic science from application and technology is a false approach.

Hierholzer had an interest in Etruscan history. He was really a scientist in that field. Once he went with Eknoyan and De Santo to visit Paestum (the ancient Posidonia). At the sight of the Tomb of the Diver, one of the greatest examples of Etruscan art, he was really happy. He lived every detail of the museum and of the Temples.

In February 2006, he was invited to Naples without any duties to perform, just to make a cultural trip. The fellows of the postgraduate school of nephrology took care of him and took him again to see Pompeii, Paestum, the Archeological and the Capodimonte museums, innumerable churches, the Hill of Vesuvius, Sorrento, Trajan's Arch of Peace (the last remaining) and the Theater in Beneventum. They were even able to persuade him into one of the museums for contemporary art, an art which he hated and used to argue "I have not studied enough to understand."

### THE LINK WITH KARL JULIUS ULLRICH

Hierholzer had great esteem and fondness for Karl Julius Ullrich (Fig. 3). He used to say that Ullrich was a brilliant, honest man, a sound scientist of international reputation, a scientist never asking for powers, a man without jealousy, capable of giving great inspirations, and generous with anyone having an intelligent idea or question. Hierholzer



**Fig. 3 - Karl Julius Ullrich.**

respected him and talked with him till his end. In his last few years, he was deeply moved whenever referring to the fact that the great director of the Max Planck Institute for Biophysics in Frankfurt-am-Main, when his wife Marga became disabled, had learned to assist her with great capability and love. He also used to mention that another man who had influenced him (J.F. Pitts), for many years had assisted with competence and love his disabled wife. The same appreciation he had for Mrs. Greger. This is very revealing of his views on those who are disabled and those who suffer.

### FAMILY LIFE

Of course, Klaus loved his children and was proud of their success. He adored his daughter-in-law Heike. He was fascinated by the talent of Stephan Offerman, Nicolas' husband, a molecular pharmacologist now on his way to the Max Planck Institute of Bad Nauheim, and was pleased by the strength of their relationship. Probably he never told Johannes how much he appreciated his capability to be straightforward, direct, centered on his goals, capable of taking a leadership role in the field of radiology, a never-ending field, as he used to say. His link with Babette, the pianist, was very strong, the strongest among his children. Once he was asked, "How it is with the pianist daughter? How you can adapt to a girl with her brain in the Heavens." The answer was: "well, it is nearly optimal. The love grows and grows, there is no discussion, no reason for discussion, you just can't give suggestions, you are incompetent, un-

able to help even in difficult times. You just love.” Klaus also had a warm relationship with Michael Simpler, Babette’s husband. He used to say that physicians, philosophers and architects are the professionals who care for men. So he was fascinated by the job of Andreas, his son the architect, who works in Berlin in the field of solar energy.

Hierholzer had difficulties in manifesting his feelings; he was shy, timid. About the man and his emotional links, a lot can be learned from his obituary in honor of Evamaria Kinne-Saffran, the closing paper in the Cassino Proceedings (7). That concise paper in 4 columns, just gives an idea of Klaus’ heart and his feelings about the people he appreciated and loved.

Christel Hierholzer, a lovely wife, respected Klaus’ collaborators. She invited them regularly and took care that they felt well. She did not rank them by their achievements in science or their position in the academy, she just loved them because they were Klaus’ crew. Christel, a sweet strong lady with many interests and capabilities, on the occasions of Klaus’ 67<sup>th</sup> and 70<sup>th</sup> birthdays took the microphone and

talked with irony about the academy, the mentors, the pupils and of course of Klaus, and also about what she properly identified as the “vices” the pupils induce in their mentors when they always say yes to them.

### SCIENTISTS TRAINED BY HIERHOLZER

Hierholzer trained a total of 20 scientists who successfully became involved in the academy (Tab. III), these spans the time from Michael Wiederholt (his first trainee; Fig. 4), to Michael Fromm (Fig. 5), his successor at the Campus Benjamin Franklin, Charité, in Berlin.

### Hierholzer’s papers and books at the Italian Institute for Philosophical Studies

Hierholzer papers and books are in Naples, where they will be part of the Archives for the History of Medicine at the Italian Institute for Philosophical Studies, to be preserved

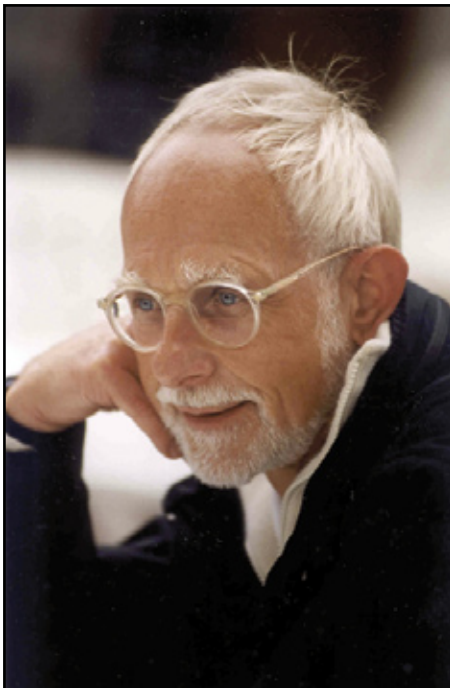
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**TABLE III**  
SCIENTISTS WHO TRAINED WITH HIERHOLZER

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1. Claus Behn, Professor of Physiology, University of Valparaiso, Chile
  2. Giancarlo Biamino, Professor of Angiology, University of Leipzig, Germany
  3. Natale G. De Santo, Professor of Nephrology and Pediatric Nephrology, University Federico II and Second University of Naples, Italy
  4. Hans Ebel, Professor of Clinical Physiology, Freie Universität Berlin, Germany
  5. Joachim Erich, Professor of Pediatrics, University of Hannover, Germany
  6. Michael Fromm, Professor of Clinical Physiology, Charité Berlin, Germany
  7. Alfred Gitter, Professor of Medical Engineering, University of Applied Sciences, Jena, Germany
  8. Heinz Gögelein, Professor of cardiology, University of Frankfurt, Germany
  9. Lutz L. Hansen, Professor of Ophthalmology, University of Freiburg, Germany
  10. Ulrich Hegel, Professor of Clinical Physiology, Freie Universität Berlin, Germany
  11. Horst Helbig, Professor of Ophthalmology, University of Regensburg, Germany
  12. Thomas Jentsch, Professor of Physiology and Pathology of Ion Transport, Max-Delbrück Center, Berlin-Buch, Germany
  13. Christoph Korbmacher, Professor of Physiology, University of Erlangen, Germany
  14. Emirene Mendonca Lima Verde, Medical Director, Centro de doencas renais e hipertensao arterial, Fortaleza, Brazil
  15. Roland Müller-Suur, Professor of Clinical Physiology, Stockholm, Sweden
  16. Thomas Poralla, Professor of Gastroenterology, St. Joseph-Hospital, Berlin, Germany
  17. Jörg-Dieter Schulzke, Professor of General Medicine and Pathophysiology of Enteral Nutrition, Charité Berlin, Germany
  18. Hilmar Stolte, Professor of Nephrology, University of Hannover, Germany
  19. Olaf Strauß, Professor of Experimental Ophthalmology, University of Regensburg, Germany
  20. Michael Wiederholt, Professor of Clinical Physiology and Physician in Chief at the Clinic Center, Freie Universität Berlin, Germany
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**Fig. 4 - Michael Wiederholt.**



**Fig. 5 - Michael Fromm.**

for the centuries to come among the papers of those who have lectured in that institution.

### ABOUT ULTIMATE/PENULTIMATE THINGS

Once Klaus visited the Hermitage of Camaldoli in the hills outside Naples, where a group of hermits of great culture, many of them from abroad, live in solitude and prayer. He asked if there was a possibility of being a guest there on his next visit. Permission was granted, and he gained admission to the convent and even, after a few days, to the *clausura*. He spent some hours every evening with the monks. He was assigned a place at their Spartan wooden desk. The hermits were very happy to have him with them.

Once he drove De Santo to the cemetery of the convent, an event that has already been described (11) in a book dedicated to the activities of those in the Department of Clinical Physiology at the Free University in Berlin:

He has made friends with all the hermits, and habitually dines with them in the evening, often sharing a bottle of sparkling Gragnano with them. When De Santo visit him at the hermitage, he always found an excuse to visit the chapel-cum-cemetery, where the hermits are buried. Simple crosses carved out of lime-stones, names and dates worn away by the ravages of time remain as witnesses to their earthly pilgrimages. I believe that as we go amid those walls

Klaus wants to tell me that the continuity and transmissibility of things that really continue have no need of dates, of noble family names, or of high offices held. Father Gabriel, Father Ignatius, Father ... are all there to remind us that they prayed all their lives for others, but asked for nothing for themselves, not even to be remembered. (11)

### SPECIAL BIRTHDAYS

On celebrating his 67<sup>th</sup> birthday at the closing of his academic career, it was Karl Julius Ullrich who undertook to present Hierholzer's biography. The list of speakers included many kidney celebrities such as Seldin and Windhager (Fig. 6).

In celebrating his 70<sup>th</sup> birthday, it was again a great event at the Benjamin Franklin Hospital in Berlin. There were, among others, Michael Wiederholt, Rolf Kinne with Evamaria Kinne-Saffran, Karl and Marga Ullrich, Eberhard Frömter, Michael Fromm, Erich Windhager and Donald W. Seldin (Fig. 6), as well as various historians and many, many colleagues and fellows.

At his 75<sup>th</sup> birthday celebration, there were no speakers, but the whole family was there at the lake house, and Klaus privileged the grandchildren. He was moved and silent. The next morning, he asked De Santo to go out for a walk on the shores of the lake. Klaus for the first time had a few questions, and he listened for most of the time.

De Santo recalls: "When in 2003 George Steiner finally



Fig. 6 - Windhager, Hierholzer, Seldin (left to right).

published his Norton Lectures at Harvard University (12), I bought the book for Hierholzer in the United States. Two weeks later I received a fax where he had underlined excerpts from pages 6 and 55.”

Page 6, line 10: the text reads, “we cannot perform certain triple-stopped *fermata* which Paganini refused to teach”. Hierholzer’s comment: “Great sin”!

Page 6, lines 14-24: the text reads, “Obviously, the arts and acts of teaching are, in the proper sense of that abused term, dialectical. The master learns from the disciple and is modified by this interrelation in what becomes, ideally, a process of exchange. Donation becomes reciprocal, as in the labyrinths of love. ‘I am most I when I am you’ as Paul Celan put it. Masters repudiate disciples finding them unworthy or disloyal. The disciple, in turn feels that he has outgrown his Master, that he must relinquish his Master in order to become himself (Wittgenstein will enjoin him to do so)”.

Hierholzer’s comment: “great!”

Page 55 refers to Canto XV of the *Inferno* when Dante visits Brunetto Latini, *lo mio maestro*, and approaches him politely and with deference calling him *Ser* and *Siete voi*. For it was from him that he received the quintessential lesson:

*Ad ora ad ora*

*M’insegnavate come l’uom s’eterna*

Supreme simplicity is untranslatable. Seven words in which Dante compacts and defines *paideia* (education). In which

he tells us what the purpose is of true teaching and what is the aim of art, of philosophy, and of speculative thought. For all time. The crux is *s’eterna*. Eliot Norton translates this line as “you taught me how man makes himself eternal.” This is indeed the standard rendition. But, it misses the trust; the unfolding of the original French allows the verb *s’eterniser*. Great teaching, the education of the human spirit toward aesthetic, philosophic and intellectual pursuits, “eternalizes” not only the individual but mankind. Fortunate is the disciple whose Master has given to mortality its sense. But vainglory will be out of place.”

Hierholzer’s comment: “Our sins: our incapacity to translate great ideas into practice.”

“I phoned back to Klaus and discussed his idea of ‘translation into practice.’ We discussed with the open minds and hearts of people, university and contexts. But, because of his death, it will remain a secret.” Klaus died during sleep, as always desired. Klaus *sit tibi laevis terra*.

Conflict of interest statement: None declared.

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## APPENDIX - LIST OF PUBLICATIONS BY HIERHOLZER

1. Hierholzer K. Klinische Erfahrungen mit dem differenzierten Schuppentest zur Blasensprungsdiagnose [doctoral dissertation Medicine]. Freiburg; 1953.
2. Hierholzer K, Fröhner K, Schleier S. Ein neuer Blasengeber für das Bubble-Flow-Meter. *Pflügers Arch.* 1957;264:94-96.
3. Janssen S, Aschoff J, Baumgartner G, et al. Vergleich und Kritik verschiedener Durchblutungs-Methoden. *Pflügers Arch.* 1957;264:198-216.
4. Grupp G, Hierholzer K. Der O<sub>2</sub>-Verbrauch von Nierengewebe verschiedener Zonen. *Zschr Biol.* 1957;109:197-202.
5. Hierholzer K. Indirekte calorimetrische Messungen an der Niere. *Arch Exp Path Pharm.* 1957;232:255.
6. Hierholzer K, Noetzel H, Schmidt L. Vergleichende toxikologische Untersuchung von Triphenylphosphat und Trikresylphosphat. *Arzneim-Forsch.* 1957;7:585-588.
7. Grupp G, Hierholzer K, Söling HD, Janssen S. Die Beziehungen zwischen Durchblutung und Sauerstoffverbrauch bzw. arterio-venöser Sauerstoffdifferenz in der Hundeniere. *Pflügers Arch.* 1958;267:401-413.
8. Pitts RF, Gurd RS, Kessler RH, Hierholzer K. Localization of acidification of urine, potassium and ammonia secretion and phosphate reabsorption in the nephron of the dog. *Am J Physiol.* 1958;194:125-134.
9. Kessler RH, Hierholzer K, Gurd RS, Pitts RF. Localization of diuretic action of chlormerodrin in the nephron of the dog. *Am J Physiol.* 1958;194:540-546.
10. Hierholzer K, Pitts RF, Gurd RS, Kessler RH. Effects of acetazolamide and chlorothiazide on distal tubular processes in nephron of the dog. Philadelphia: Vortrag vor der Am Physiol Gesellschaft; 1958. *Fed Proc.* 1958;17:70.
11. Hierholzer K, Gurd RS, Kessler RH, Pitts RF. Site of reabsorption of sulfate in the nephron of the dog. Vortrag vor der Am Physiol Soc. 1959. *The Physiologist.* 1958;1:37.
12. Grupp G, Heimpel H, Hierholzer K. Über die Autoregulation der Nierendurchblutung. *Pflügers Arch.* 1959;269:149-156.
13. Grupp G, Heimpel H, Hierholzer K, Janssen S. Die Wirkung der Carotissinus-Entlastung auf die Wärmebildung und die Kreislaufdynamik der Niere. *Arch Int Pharmacodyn Ther.* 1959;122:85-93.
14. Kessler RH, Hierholzer K, Gurd RS, Pitts RF. Localization of action of chlorothiazide in the nephron of the dog. *Am J Physiol.* 1959;196:1346-1351.
15. Kessler RH, Hierholzer K, Gurd RS. Localization of urate transport in the nephron of mongrel and Dalmatian dog kidney. *Am J Physiol.* 1959;197:601-603.
16. Hierholzer K, Cade R, Gurd RS, Kessler RH, Pitts RF. Stop-flow analysis of renal reabsorption and excretion of sulfate in the dog. *Am J Physiol.* 1960;198:833-837.
17. Hierholzer K. The secretion of potassium in Golden Hamsters. Chicago: Vortrag vor der Am Physiol Society; 1960. *Fed Proc.* 1960;19:365.
18. Hierholzer K. Secretion of potassium and acidification in collecting ducts of mammalian kidney. *Am J Physiol.* 1961;201:318-324.
19. Hierholzer K. Über die Lokalisation des Kaliumtransportes in der Niere. *Klin Wschr.* 1961;39:773-778.
20. Cade R, Shalhoub RJ, Hierholzer K. pCO<sub>2</sub> in regulating ammonia excretion by renal tubules of dogs. *Am J Physiol.* 1961;200:881-884.
21. Hierholzer K. Kalium- und Wasserstoffionen-Transport in der Niere. Vortrag Medizinische Gesellschaft Frankfurt/Main *Klin Wschr.* 1963;41:462.
22. Schoeppe W, Kaul A, Koch KM, Hierholzer K. Beeinflussung der Kaliumverteilung des gesunden Menschen durch ein Saliureticum. *Klin Wschr.* 1963;41:463.
23. Frey J, Hierholzer K. Nephropathien in der Schwangerschaft. *Internist.* 1963;4:161-168.
24. Hierholzer K, Windhager E. Transtubuläre Potentialdifferenzen und intratubuläre Natrium-Konzentrationen in der Niere adrenaletomierter Ratten. *Pflügers Arch.* 1964;279:R26.
25. Hierholzer K. Über die diuretische Wirkung des Adrenostatikums Methopyrapon. *Dtsch Med Wschr.* 1964;1.Teil:89:1124-1127. 2.Teil:89:1167-1173.
26. Hierholzer K. Mechanismus und Lokalisation des renalen Kalium- und Wasserstoffionentransportes. Vortrag auf dem Elektrolytsymposium in Kassel 1964. *Melsunger Med.* 1964;38:1-16.
27. Kaul A, Schoeppe W, Koch KM, Hierholzer K. Gammaskopmetrische und flammen photometrische Untersuchungen über Kaliumgehalt und Kaliumverteilung im Menschen. *Biophysik.* 1964;2:87-104.
28. Hierholzer K. Analyse der Natrium-Transportstörung in der Niere adrenaletomierter Ratten. Untersuchungen am Einzel-nephron [habilitation thesis]. Berlin; 1964.
29. Wiederholt M, Hierholzer K, Rumrich G, Holzgreve H. Transtubuläre Na-Ströme im proximalen und distalen Tubulus adrenaletomierter Ratten. *Pflügers Arch.* 1964;281:R95.
30. Hierholzer K. Transtubulärer Elektrolyttransport. Referat 3. Symp. Ges. f. Nephrologie, Berlin, 1964. In: Normale und pathologische Funktionen des Nierentubulus. Berlin: Huber-Verlag; 1965.
31. Thoenes W, Hierholzer K. Intravitalfixierung von Harnkanälchen an der Rattenniere. Vortrag 3. Symp. Ges. f. Nephrologie, Berlin 1964. In: Normale und pathologische Funktionen des Nierentubulus. Berlin: Huber-Verlag; 1965.
32. Hierholzer K, Wiederholt M, Holzgreve H, Giebisch G, Klose RM, Windhager EE. Micropuncture study of renal transtubular concentration gradients of sodium and potassium in adrenaletomized rats. *Pflügers Arch.* 1965;285:193-210.
33. Schoeppe W, Koch KM, Kaul A, Hierholzer K. Untersuchungen über die Kaliumverteilung und Bestimmung des Gesamtkörperkaliumsdurch Messung von K40. In: Hoffmann G, Keiderling W, eds. *Radio-Isotope in der Endokrinologie.* Stuttgart: Schattauer Verlag; 1965:417-422.
34. Wiederholt M, Hierholzer K, Brecht JP. Die Wirkung von Aldos-

- terone und Cortison auf den tubulären Na-Transport adrenaletomierter Ratten. *Pflügers Arch.* 1965;283:R71.
35. Hierholzer K, Wiederholt M, Stolte H. Der Einfluß hypertoner NaCl-Infusionen auf die renale Na-Resorption intakter und adrenaletomierter Ratten. *Pflügers Arch.* 1965;283:R71.
  36. Thoenes W, Hierholzer K, Wiederholt M. Gezielte Fixierung von Nierentubuli in vivo durch Mikroperfusion zur licht- und elektronen-mikroskopischen Untersuchung. *Klin.[AUTHORS: please spell out this journal name in full.]* 1965;43:794-795.
  37. Stolte H, Wiederholt M, Hierholzer K. Resorptionshemmung im proximalen Konvolut der Säugetiere nach Adrenaletomie und ihre Beeinflussung durch Steroidhormone. IV. Symp d. Gesellschaft für Nephrologie. In: Aktuelle Probleme der Nephrologie. Berlin, Heidelberg, New York: Springer Verlag;1966:521-530.
  38. Hierholzer K. Sodium transport in the kidney of adrenalectomized rats. Second International Congress on Hormonal Steroids. *Excerpta Medica Int Congr Ser.* 1966;111:183.
  - 38a. Wiederholt M, Stolte H, Hierholzer K. Micropuncture study of the effects of corticosteroids on sodium reabsorption in adrenalectomized rats. Second International Congress on Hormonal Steroids. *Excerpta Medica Int Cong Ser.* 1966;111.
  39. Wiederholt M, Hierholzer K, Windhager EE, Giebisch G. Einflußunterschiedlicher Perfusionsraten auf die proximale Flüssigkeitsre-sorption (Mikroperfusionsuntersuchungen an der Rattenniere). *Pflügers Arch.* 1966;289:R68.
  40. Hierholzer K, Wiederholt M, Stolte H. Hemmung der Natriumresorption im proximalen und distalen Konvolut adrenaletomierter Ratten. *Pflügers Arch.* 1966;291:43-62.
  41. Wiederholt M, Stolte H, Brecht JP, Hierholzer K. Mikropunktionsuntersuchungen über den Einfluß von Aldosteron, Cortison und Dexamethason auf die renale Natriumresorption adrenaletomierter Ratten. *Pflügers Arch.* 1966;292:316-333.
  42. Hierholzer K, Wiederholt M, Stolte H. Effects of corticosteroids on renal Na reabsorption and water permeability of tubular epithelium in adrenalectomized rats. Third International Congress of Nephrology, 1966:210.
  43. Hierholzer K. Renaler Salzverlust nach Nebennierenausfall. Experimentelle Untersuchungen. Vortrag vor: Berliner Med Gesellschaft am 9.3.1966, Verh. Berliner Med Ges. 1966;1:4.
  44. Ullrich KJ, Hierholzer K. Physiologie der Niere. In: Sarre H, ed. Nieren-krankheiten. 3rd ed. Thieme Verlag;Stuttgart 1967.
  45. Wiederholt M, Hierholzer K, Windhager EE, Giebisch G. Micropuncture study of fluid reabsorption in proximal tubules of rat kidneys. *Am J Physiol.* 1967;213:809-818.
  46. Hierholzer K, Brecht JP, Stolte H, Wiederholt M. Die Filtrationspermeabilität corticaler Nephronsegmente und ihre Beeinflussung durch Adrenaletomie und Glucocorticoide. *Pflügers Arch.* 1967;297:R56.
  47. Hierholzer K, Wiederholt M, Brecht JP, Stolte H. Effects of various corticosteroids on renal electrolyte and fluid reabsorption in adrenalectomized rats. Fourth conference of European Comparative Endocrinology, Karlsbad. 1967:31.
  48. Wiederholt M, Hierholzer K. The effect of actinomycin D on transepithelial sodium transport. In : Peters G, ed. V Symp. der Ges. für Nephrologie, Lausanne. Berlin, Heidelberg, New York: Springer Verlag;1967:203-209.
  49. Stolte H, Brecht JP, Wiederholt M, Hierholzer K. Einfluss von Adrenaletomie und Glucocorticoiden auf die Wasserpermeabilität corticaler Nephronabschnitte der Rattenniere. *Pflügers Arch.* 1968;299:99-127.
  50. Ebel H, De Santo NG, Hierholzer K. Besteht eine Korrelation zwischen Membran-ATPase und steroidabhängiger Na-Resorption in der Rattenniere? *Pflügers Arch.* 1968;300:28.
  51. Hierholzer K. Klinisch wichtige Aspekte moderner Auffassungen der Nierenphysiologie. *Dtsch Med J.* 1968;19:657-663.
  52. Wiederholt M, Hierholzer K, Senft G, Herken H. Lokalisation der natriuretischen Wirkung von 6-Aminonicotinamid in der Rattenniere. *Naunyn Schmiedebergs Arch Pharmacol Exp Path.* 1968;261:143-151.
  53. Wiederholt M, Langer KH, Thoenes W, Hierholzer K. Funktionelle und morphologische Untersuchungen am proximalen und distalen Konvolut der Rattenniere zur Methode der gespaltenen Ölsäure (split-oil droplet method). *Pflügers Arch.* 1968;303:166-191.
  54. Hierholzer K, Wiederholt M, Gertz KH. Fluid and sodium reabsorption out of proximal surface tubules of the rat kidney as measured by single nephron shrinkage. *Proc Int Union Physiol Sci.* 1968;7:192.
  55. Hierholzer K, Ebel H. Beeinflussung des renalen K<sup>+</sup> und Na<sup>+</sup>-Transportes durch Nebennierenrindensteroiden. In: Aktuelle Probleme des Elektrolyt- und Wasserhaushaltes. VI. Symposium der Gesellschaft für Nephrologie, Wien, 23-25 September, 1968. 1968:223-241.
  56. Hierholzer K. Die chronische und die terminale Niereninsuffizienz, Pathophysiologie. *Berl Med Ges.* 1/1968, *Dtsch Med J.* 1968;19:110-120.
  57. De Santo NG, Ebel H, Hierholzer K. Assenza di correlazione diretta tra trasporto steroidodipendente di sodio e Mg<sup>++</sup>Na<sup>+</sup>K<sup>+</sup>-ATPasine membrane cellulari di rene di ratto. IX Congresso Nazionale della Società Italiana di Nefrologia, Fiuggi, 1968. *Minerva Nefrologica.* 1968;16:235-239.
  58. Hierholzer K. Intrarenale Wirkung von Steroidhormonen auf den Natriumtransport. *Int Symp Feldafing*, 1968. In: Thureau K, Jahrmärker H, eds. Renal transport and diuretics. Berlin, Heidelberg, New York: Springer Verlag; 1969:153-171.
  59. Hierholzer K, Ullrich KJ. Grundzüge der Nierenphysiologie. In: Herken H, ed. *Handb. d. exp. Pharmakologie.* Berlin, Heidelberg, New York: Springer Verlag. 1969;24:1-61.
  60. Hierholzer K, Wiederholt M, Stolte H, Brecht JP. Hemmung der Natriumresorption in der Niere adrenaletomierter Ratten. In: Respe G, ed. *Advances in the biosciences: I Schering symposium on endocrinology.* Pergamon Press, Vieweg; 1969:40-47.
  61. Hierholzer K. Physiologie tubulärer Transportvorgänge. In: Krick F, Leppla W, Urban U, eds. *Klinische Pharmakologie der Diuretika.* München: Schwarzenberg Verlag; 1969:24-36.
  62. Hierholzer K, Stolte H. The proximal and distal tubular action of adrenal steroids on Na reabsorption. *Nephron.*

- 1969; 6:188-204.
63. Baldamus CA, Hierholzer K, Rumrich G, et al. Natriumtransport in den proximalen Tubuli und den Sammelrohren bei Variation der Natriumkonzentration im umgebenden Interstitium. *Pflügers Arch.* 1969;310:354-368.
64. Stolte H, Wiederholt M, Fuchs G, Hierholzer K. Time course of development of transtubular sodium concentration differences in proximal surface tubules of the rat kidney. *Pflügers Arch.* 1969;313:252-270.
65. De Santo NG, Natzschka JC, Hierholzer K. The pathogenesis of bilirubin nephropathy: Micropuncture experiments in rats with congenital hyperbilirubinaemia (Gunn Strain). *Proc Eur Soc Paediatr Nephrol.* 1970;25-26.
66. Schurek HJ, Lohfert H, Hierholzer K. Na-Reabsorption in der isoliertperfundierten Rattenniere (Abhängigkeit von Substratangebot und Na-Load). *Pflügers Arch.* 1970;319:R85.
67. Hierholzer K. Natrium- und Flüssigkeitsresorption in der Säugetiermamiere unter verschiedenen experimentellen Bedingungen. Vortrag Nephrologischer Arbeitskreis Heidelberg. *Klin Wschr.* 1970;48:1198-1199.
68. De Santo NG, Ebel H, Hierholzer K.  $Mg^{++}Na^{+}K^{+}$ -ATPase in cellular membranes of the rat kidney: effect of aldosterone, cortisone and aldosterone inhibitors. *Minerva Nefrologica.* 1970;17:100-104.
69. Ebel H, DeSanto NG, Hierholzer K. Plasma cell membranes of the rat kidney: Part I: purification and properties of the outer cell membrane ATPase. *Pflügers Arch.* 1971;324:1-25.
70. De Santo NG, Ebel H, Hierholzer K. Plasma cell membranes of the rat kidney: Part II: ATPase activities in adrenalectomized rats with and without steroid hormone substitution. *Pflügers Arch.* 1971;324:26-42.
71. Hierholzer K, Hegel U. Die osmotische Diurese. *Medizinische Klinik* 66. Jhrg. 1971;8:255-264
72. Lohfert H, Lichtenstein I, Butz M, Hierholzer K. Continuous measurement of renal intratubular pressures with a combined pressure transducer micropfusion system. *Pflügers Arch.* 1971;327:191-202.
73. Butz M, Lohfert H, Hierholzer K. Pressure-flow characteristics of renal tubules as recorded with a combined pressure transducer micropfusion system. *Proceedings of the International Union of Physiological Sciences, XXV International Congress, Munich.* 1971;9:93.
74. De Santo NG, Natzschka JC, Lichtenstein I, Ebel H, Hierholzer K. Studi di micropuntura renale nella nefropatia bilirubinica. *Minerva Nefrologica.* 1971;18:159-161.
75. Hierholzer K, Butz M, Baethke R. Evaluation of measurement of reduced glomerular filtration rate in the severely diseased kidney. In: Kluthe R, Berlyne G, Burton B, eds. *Uremia: an international conference on pathogenesis, diagnosis and therapy.* Stuttgart: Georg Thieme Verlag; 1972:98-108.
76. Hierholzer K, Butz M. Evaluation of single nephron filtration rate (SNGFR) using two different micropuncture techniques. In: Wirz M, Spinelli F, eds. *International symposium on renal handling of sodium, Brestenberg,* 1971. Basel: Karger; 1972:33-42.
77. Hierholzer K, Froese P. Optimale Therapie mit Diuretika. *Dtsch Med J.* 1972;23:85-92.
78. Hierholzer K, Butz M, Muller-Suur R, Lichtenstein I. Pressure measurements in proximal surface tubules of the rat-single nephron filtration rate and tubuloglomerular feedback. *Yale J Biol Med.* 1972;45:224-232.
79. Hierholzer K. Regulation der Homöostase. XX Internat. Fortbildungskongreß der Bundesärztekammer in Davos und Bad Gastein, 12-15 March 1972.
80. M, Müller-Suur R, Lichtenstein I, Hierholzer K. Tubuloglomerular feedback in the rat kidney demonstrated with a micropfusion pressure recording System. Fifth international congress of nephrology, Mexico, 1972. 138.
81. Hierholzer K, Butz M, Müller-Suur R, Lichtenstein I. Single nephron filtration and recording of intratubular pressure [abstract of plenary session and symposia]. Fifth international congress of nephrology, Mexico, 1972. Basel: Karger . 1972;2:141-143.
82. Hierholzer K, Hegel U, DeSanto NG. Mannit als osmotisches Diuretikum. In: Kessel M, ed. *Anwendung hoher Furosemiddosen in der Klinik.* Berlin: Medicus Verlag; 1973:1-10.
83. Hierholzer K, Lange S. The effects of adrenal steroids on renal function. In: Thurau K, ed.. *MTP international review of science, kidney and urinary tract physiology.* Butterworths University Park Press; London 1974:273-319.
84. Lange S, Hegel U, Hierholzer K. Die Wirkung von Aldosteron auf den transepithelialen Salztransport und ihre Untersuchung mit elektrophysiologischen Methoden. *Med Klinik.* 1974;37:1478-1488.
85. Hierholzer K, Müller-Suur R, Gutsche HU, Butz M, Lichtenstein I. Filtration in surface glomeruli as regulated by flow rate through the Loop of Henle. *Pflügers Arch.* 1974;352:315-337.
86. Hierholzer K, Kokko J. Contribution of solvent drag to Na-reabsorption in isolated proximal convoluted tubules (PTC). *Proceedings of the International Union of Physiological Sciences, New Delhi.* 1974;9:11.
87. Gutsche HU, Müller-Suur R, Lichtenstein I, Hierholzer K. Tubuloglomerular feedback in the kidney of adrenalectomized rats. *Proceedings of the International Union of Physiological Sciences, New Delhi.* 1974;9:124.
88. Müller-Suur R, Gutsche HU, Samwer KF, Lichtenstein I, Hierholzer K. Tubuloglomerular feedback in clamped and unclamped kidneys of Goldblatt-hypertensive rats. *Proceedings of the International Union of Physiological Sciences, New Delhi.* 1974;9:124.
89. Schurek HJ, Brecht JP, Lohfert H, Hierholzer K. The basic requirements for the function of the isolated cell free perfused rat kidney. *Pflügers Arch.* 1975;354:349-365.
90. Gutsche HU, Müller-Suur R, Hegel U, Hierholzer K, Lüderitz S. A new method for intratubular blockade in micropuncture experiments. *Pflügers Arch.* 1975;354:197-202.
91. Hierholzer K. Clearance determinations: remarks of the chairman. In: Winkel K, Blaufox MD, Funck-Brentano JI, eds. *Radio-nuclides of nephrology, Proceedings third international symposium,*

- sium, Berlin, 1974. Stuttgart: Georg Thieme Verlag; 1975:282.
92. Hierholzer K: Regulation des Elektrolythaushaltes durch Membrantransport. Verhandlungen der Deutschen Gesellschaft für innere Medizin. München: JF Bergmann. 1975;81:738-754.
  93. Gutsche HU, Müller-Suur R, Hierholzer K. Direct evaluation of diluting capacity of ascending limbs in vivo. Sixth international congress of nephrology, Florence, 1975:44.
  94. Müller-Suur R, Gutsche HU, Samwer KF, et al. Tubuloglomerular feed-back in rat kidneys of different renin contents. Pflügers Arch. 1975;359:33-56.
  95. Gutsche HU, Müller-Suur R, Hierholzer K. The effect of volume expansion on the diluting capacity of ascending limbs (AL) of Henle's loop in vivo. Pflügers Arch. 1975;359(Suppl):R122.
  96. Hierholzer K. Homeostasis of body composition. Ninth world congress of anatomy and clinical pathology, Sydney, Oct. 1975. Excerpta Medica. 1975;369:6-7.
  97. Hierholzer K, Müller-Suur R, Gutsche HU, et al. Feedback regulation of single nephron filtration rate (SNGFR) in mammalian renal surface tubules: measurements of early proximal flow rate and of stop flow pressure. Ninth world congress of anatomy and clinical pathology, Sydney, Oct. 1975. Excerpta Medica. 1975;369:73.
  98. Hierholzer K. Recent advances in renal physiology. Proceedings of the sixth international congress of nephrology, Florence, 1975. Basel: Karger; 1976:19-37.
  99. Ullrich KJ, Hierholzer K. Physiologie der Niere. In: Sarre H, ed. Nierenkrankheiten. 4<sup>th</sup> ed Stuttgart: Georg Thieme Verlag ; 1976.
  100. Hierholzer K, Wiederholt M. Some aspects of distal tubular solute and water transport. Kidney Int. 1976;9:198-213.
  101. Hierholzer K. Renal effects of corticosteroids. International workshop on basic aspects of epithelial transport mechanism of adaption, Centro Latino Americano Ciencias Biologicas, Caracas, July, 1976.
  102. Hierholzer K. Der Hypothalamus als endokrines Organ. In: Gauer, Kramer, Jung, eds Physiologie des Menschen. Bd. 18: Endokrinologie I. München: Urban & Schwarzenberg; 1977:57-85.
  103. Hierholzer K. Die Adenohypophyse. In: Gauer, Kramer, Jung, eds. Physiologie des Menschen. Bd. 18: Endokrinologie I. München: Urban & Schwarzenberg; 1977:87-164.
  104. Hierholzer K. Das Hypothalamus-Neurohypophysen-System. In: Gauer, Kramer, Jung, eds. Physiologie des Menschen. Bd. 18: Endokrinologie I. München: Urban & Schwarzenberg; 1977:165-204.
  105. Hierholzer K. Die Nebennierenrinde. In: Gauer, Kramer, Jung, eds. Physiologie des Menschen. Bd. 19: Endokrinologie II. München: Urban & Schwarzenberg; 1977:1-63.
  106. Hierholzer K. Das Renin-Angiotensin-Aldosteronsystem. In: Gauer, Kramer, Jung, eds. Physiologie des Menschen. Bd. 20: Endokrinologie III. München: Urban & Schwarzenberg; 1977:219-261.
  107. Hierholzer K. Prostaglandine. In: Gauer, Kramer, Jung, eds. Physiologie des Menschen. Bd. 20: Endokrinologie III. München: Urban & Schwarzenberg; 1977:263-282.
  108. Hierholzer K. Hormonale Regulation der Nierenfunktion. Nephrologisches Seminar, Heidelberg, 2-5 February 1977.
  109. Hierholzer K, Kleinschmidt J. Renale Wirkungen von Diuretika. Berliner Seminar 1, Physiologische und pharmakologische Grundlagen der Therapie (Herzglykoside,  $\beta$ -Rezeptorenblocker, Diuretika). Erlangen: Verlag Dr. Med D. Straube; 1977:67-86.
  110. Hierholzer K, Mendonca Lima Verde E, Siebe H. The role of corticosteroids in regulation of renal homeostatic mechanisms. Alfred Benzon Symposium XI, osmotic and volume regulation, Copenhagen, Munksgaard. 1978:163-186.
  111. Hierholzer K, Kleinschmidt J. Proximal fluid reabsorption in presence and absence of angiotensin II. Niere und Nierenhormone-Symposium, Sofia, 1-2 June. 1978:39.
  112. Hierholzer K. Modes of action of diuretics. Heidelberg Seminar in Nephrology, 1978. In: Contributions to nephrology, pathophysiological problems in clinical nephrology. Basel: S. Karger. 1978;14:111-117.
  113. Hierholzer K, Ulmrich W. Renale Wirkungen von Diuretika. 3. Arztl. Fortbildungstagung: Diuretische Therapie, Viersen, Therapiewoche. 1980;30:2678-2692.
  114. Hierholzer K, Kawamura S, Seldin DW, Kokko JP, Jacobson HR. Reflection coefficients of various substrates across superficial and juxtamedullary proximal convoluted segments of rabbit nephrons. Miner Electrolyte Metab. 1980;3:172-180.
  115. Gutsche HU, Müller-Suur R, Samwer KF, Beer G, Hierholzer K. Tubuloglomerular feedback control in kidneys of adrenalectomized rats. Pflügers Arch. 1980;386:11-19.
  116. Gutsche HU, Müller-Suur R, Hegel U, Hierholzer K. Electrical conductivity of tubular fluid of the rat nephron. Pflügers Arch. 1980;383:113-121.
  117. Hierholzer K. Saluretics and potassium balance: protective effect of amiloride [abstract]. Fifteenth international congress medicine, 18-22 August 1980, Hamburg, 1980.
  118. Hierholzer K. Kidney and endocrinium [abstract]. X Congresso Brasileiro de Nefrologia, Fortaleza-Ceara, Brasilien, 1980.
  119. Hierholzer K. Renal acid excretion under the influence of corticosteroids [abstract]. X Congresso Brasileiro de Nefrologia, Fortaleza-Ceara, Brasilien, 1980.
  120. Hierholzer K, Tsiakiras D, Schöneshöfer M, Siebe H, Weskamp P. Renal handling of hormones In: Greger R, Lang F, Silbernagl S, eds. Renal transport of organic substances. Berlin, Heidelberg, New York: Springer Verlag; 1981:278-289.
  121. Tsiakiras D, Siebe H, Weskamp P, Hierholzer K. Metabolic conversion of  $^3\text{H}$  corticosterone (CS) by the isolated perfused rat kidney. Pflügers Arch. 1981;389:R42.
  122. Hierholzer K, Tsiakiras D, Siebe H, Weskamp P, Schöneshöfer M. Polar metabolites of corticosterone (CS) formed, released and excreted by isolated perfused rat kidney [abstract]. Eighth international congress of nephrology, Athens, 1981.
  123. Hierholzer K, Lichtenstein I, Siebe H, Tsiakiras D, Witt I. In vitro conversion of corticosterone (B) by rat renal tissue. In: Morel F, ed. Biochemistry of kidney functions. INSERM Symp. 21. 1982:233-240.

124. Tsiakiras D, Hoyer GA, Hierholzer K. Identification of structure of corticosterone metabolites formed by the isolated perfused rat kidney in vitro. *Pflügers Arch.* 1982;392:R12.
125. Hierholzer K. Site and mechanism of actions of diuretics. Lectures by visitors from abroad (Shanghai). 1982;2:37-38.
126. Hierholzer K. Renal metabolism of corticosteroids and other hormones. Lectures by visitors from abroad (Shanghai). 1982;2:38-39.
127. Hierholzer K. Value and necessity of animal research in nephrology. *Exp Biol Med.* 1982;7:88-101.
128. Hierholzer K, Lichtenstein I, Siebe H, Tsiakiras D, Witt I. Renal metabolism of corticosteroid hormones. *Klin Wschr.* 1982;60:1127-1135.
129. Tsiakiras D, Hoyer GA, Siebe H, Hierholzer K. Renal metabolism of corticosterone (B) in vitro [abstract]. Frühjahrstagung d. Dt. Pharmakol. Gesellschaft und Dt. Physiol. Gesellschaft, Mainz. *Naunyn-Schmiedeberg's Arch Pharmacol.* 1983;322(Suppl):R58.
130. Hierholzer K, Schöneshöfer M, Siebe H, Tsiakiras D, Weskamp P. Corticosteroid metabolism in isolated rat kidney in vitro: Formation of lipid soluble metabolites from corticosterone (B) in renal tissue from male rats. *Pflügers Arch.* 1984;400:363-371.
131. Siebe H, Tsiakiras D, Hierholzer K. Corticosteroid metabolism in isolated rat kidney in vitro: Part II: sex dependency of metabolism and formation of 11-dehydrocorticosterone. *Pflügers Arch.* 1984;400:372-376.
132. Hoyer GA, Tsiakiras D, Siebe H, Hierholzer K. Corticosteroid metabolism in isolated rat kidney in vitro: Part II: structure analysis of lipid soluble metabolites of corticosterone. *Pflügers Arch.* 1984;400:377-380.
133. Hierholzer K, Siebe H, Kobayashi N. In vitro formation of renal metabolites of corticosterone. Studies with filtering and non-filtering isolated kidneys and subcellular fragments. Sat. symposium of the ninth international congress of nephrology, San Diego, June 11-16, 1984.
134. Hierholzer K. Renaler Stoffwechsel von Corticosteroiden. Vortrag vorder Leopoldina am 21.2.1984. *Leopoldina (R3).* 1984;30:111-112.
135. Kobayashi N; Schulz W, Hierholzer K. Subcellular localization of renal metabolism of corticosterone (B) in vitro. *Pflügers Arch.* 1984;402(Suppl):R5.
136. L'Allemand D, Siebe H, Vecsei P, Hierholzer K. Conversion of aldosterone (Aldo) into less polar metabolite(s) in rat renal tissue [abstract]. *Pflügers Arch.* 1985;403(Suppl):R18.
137. Schulz W, Kobayashi N, Hierholzer K. Metabolism of corticosterone (B) in microsomal and nuclear fractions of male rat renal cortex [abstract]. *Pflügers Arch.* 1985;403(Suppl):R18.
138. Hierholzer K, Kobayashi NI, Siebe H, Schulz W. Renal corticosteroid (CS) metabolism [abstract]. *Primo Congresso Nazionale, Soc Ital Nefrol Ped, Napoli, 14-15 May 1985.*
139. Hierholzer K. Wasser- und Elektrolythaushalt. In: Encke, Heberer, Hernandez-Richter, Kummerle, Schildberg, Witte, eds. *Chirurgische Intensivmedizin.* München: Urban & Schwarzenberg; 1985:3-8.
140. Hierholzer K. Sodium reabsorption in the distal tubular system. In: Seldin D W, Giebisch G, eds. *The kidney: physiology and pathophysiology.* New York: Raven Press; 1985;1063-1096.
141. Hierholzer K, Kobayashi NI, Siebe H, Schulz W. Subcellular localization of renal metabolism of corticosterone (B): in vitro studies with rat kidney cortex [abstract]. First annual meeting of American Society of Renal Biochemistry and Metabolism, Cancun, Mexico, 1985. 1985:16.
142. Chao HP, Schulz W, Siebe H, Lichtenstein I, Hierholzer K. Quantitative comparison of renal and hepatic corticosterone metabolism in vitro [abstract]. *Pflügers Arch.* 1985;405:R35.
143. Chao HP. Vergleich des Corticosteron metabolismus von Nieren- und Lebergewebe der Ratte in vitro [inaugural dissertation]. *Med Fachbereiche der Freien Universität Berlin, 1985.*
144. Groeben C, Hierholzer K. Emil du Bois-Reymond - Anton Dohrn, Briefwechesel. Berlin: Springer; 1985.
145. Verowski A. Corticosteronmetabolismus in der Glandula submandibularis der Ratte in vitro [inaugural dissertation]. *ZahnMed Fachbereich der Freien Universität Berlin, 1985.*
146. Verowski A, Siebe H, Hierholzer K. Metabolism of corticosterone (B) in the submandibular gland of male and female rats. Presented at the 63rd meeting of the German Physiological Society. 1986.
147. Sabatini S, Myer M, Luong K, Hierholzer K. Effect of renal glucocorticoid metabolites on membrane transport [abstract]. *Kidney Int.* 1986;29:358.
148. Tarlowski L. Biologische Aktivitäten der renalen Metabolite von Corticosteron [inaugural dissertation]. *Medizinischen Fachbereiche der Freien Universität Berlin, 1986.*
149. Schulz W, Kobayashi N, Siebe H, Hierholzer K. 11 $\beta$ -Hydroxysteroid-dehydrogenase activities in subcellular fractions of rat renal cortex [Abstract]. *Renal Physiol.* 1986;9:78.
150. Schulz W, Kobayashi N, Hierholzer K. Comparison of renal and hepatic 11 $\beta$ -hydroxysteroid dehydrogenase of male rats. 17th FEBS meeting, Berlin (West), *Biol. Chem Hoppe-Seyler.* 1986;367(Suppl):271.
151. Hierholzer K. Diuretika als spezifische Elektrolyttransport-Inhibitoren (SETI). In: Diuretika H, Knauf E, Mutschier E., eds. München: Urban & Schwarzenberg; 1986:169-172.
152. Schulz W, Siebe H, Hierholzer K. 11 $\beta$ -Hydroxysteroid dehydrogenase (11-HSD) – its function in renal corticosteroid metabolism [abstract]. Eighth international symposium on biochemical aspects of kidney function, Dubrovnik. *J Clin Biol Chem.* 1986;24:693.
153. Hierholzer K. Physiological methods for the study of epithelial membranes. Bericht der Chinesischen Ärzetagung vom 25-27 September 1986 in Wuhan (PR China), 1986.
154. Schulz W, Kobayashi N, Siebe H, Hierholzer K. 11 $\beta$ -Hydroxysteroid dehydrogenase (11-HSD) – its function in renal corticosteroid metabolism. In: Kovacevic Z, Guder W, de Gruyter W, eds. *Molecular nephrology.* Berlin, New York: 1987:361-367.
155. Kobayashi N, Schulz W, Hierholzer K. Corticosteroid metabolism in rat kidney in vitro: Part IV: subcellular sites of

- 11-hydroxysteroid dehydrogenase activity. *Pflügers Arch.* 1987;408:46-53.
156. Hierholzer K, Fromm M. Wasser- und Elektrolythaushalt Physiologie der Niere. In: Wittke G, ed. *Lehrbuch der Veterinär-Physiologie*, Scheunert/Trautmann. Berlin: Verlag Paul Parey; 1987:359-436.
157. Spieth A, Hierholzer K. Longitudinal heterogeneity of renal corticosterone metabolism in mouse nephron [abstract]. *Pflügers Arch.* 1987;408(Suppl 1):R42.
158. Schulz W, Kobayashi N, Siebe H, Hierholzer K. Studies on renal metabolism of corticosterone. *Miner Electrolyte Metab.* 1987;13:355.
159. Hierholzer K. Arbeitsgruppe "Exodus von Wissenschaften aus Berlin" Bericht. *Jahrbuch, Akademie der Wissenschaften zu Berlin*, 1987. Berlin, New York: de Gruyter Verlag; 1988:110-113.
160. Schulz W, Spieth A, Hierholzer K. Renal handling of corticosteroids: localization of 11 $\beta$ -hydroxysteroid-dehydrogenase (11-HSD) within the nephron. *Acta Endocrinol.* 1988;114:35.
161. L'Allemand D, Siebe H, Tsiakiras D, Hoyer GA, Vecsei P, Hierholzer K. Aldosterone metabolism in rat renal tissue in vitro: formation of lipid soluble metabolites. *Pflügers Arch.* 1988;411:529-539.
162. Schöneshofer M, Bannermerschult R, Schulz W, Hierholzer K. Profiling of peptide fragments occurring during insulin catabolism in human erythrocytes. *J Clin Chem Clin Bio Chem.* 1988;26:324.
163. Schulz W, Korbmacher C, Lichtenstein I, Siebe H, Hierholzer K. Identification of multiple forms of renal 11 $\beta$ -hydroxysteroid dehydrogenase (11-HSD) [abstract]. *Acta Physiol Pharmacol Bulg.* 1988;14(Suppl 1):76.
164. Hierholzer K, Wittmann HG, eds. *Phasensprünge und Stetigkeit in der natürlichen und kulturellen Welt. Wissenschaftskonferenz in Berlin, 8-10 Oktober 1987, Reichstagsgebäude.* Stuttgart: Wissenschaftliche Verlagsgesellschaft; 1988.
165. Fromm M, Marhefka A, Schulzke JD, Hegel U, Hierholzer K. Action of aldosterone, corticosterone, and their locally formed metabolites on amiloride-sensitive sodium transport in rat rectum in vitro [abstract]. *Pflügers Arch.* 1988;411:R76.
166. Marhefka A, Gross U, Hierholzer K. Segmental heterogeneity of corticosterone transformation along the intestinal tract: in vitro studies with rat tissue [abstract]. *Pflügers Arch.* 1988;411:R106.
167. Hierholzer K, Winau R, Hubenstorf M. Bericht der Arbeitsgruppe "Exodus von Wissenschaften aus Berlin". *Jahrbuch, Akademie der Wissenschaften zu Berlin* 1988, Berlin, New York: de Gruyter Verlag; 1989:432-446.
168. Hartseil A, Hierholzer K, Kurtzman NA, Sabatini S. Corticosterone metabolism in toad bladder in vitro. *The American Society of Nephrology. Kidney Int.* 1989;35:312.
169. Botzen H. Aldosteron- und Corticosteronmetabolismus in der Glandula mandibularis von Ratte, Schwein und Rind in vitro [inaugural dissertation]. *Fachbereiches Veterinärmedizin der Freien Universität Berlin*, 1989.
170. Korbmacher C, Schulz W, Kijinig M, Siebe H, Lichtenstein I, Hierholzer K. Renal epithelial cell lines (BSC-1, MDCK, LLC-PK1) express 11 $\beta$ -hydroxysteroid dehydrogenase activity. *Biochim Biophys Acta.* 1989;1010:311-317.
171. Schulz W, Lichtenstein I, Siebe H, Hierholzer K. Isoelectric focusing analysis of detergent extracted renal 11 $\beta$ -hydroxysteroid dehydrogenase. *J Steroid Biochem.* 1989;32:581-590.
172. Schulz W. *Untersuchungen über die renale 11 $\beta$ -hydroxysteroid-dehydrogenase (E.C.1.1.1.146) [inaugural dissertation]. Fachbereiches Chemie der Freien Universität Berlin*, 1989.
173. Castello R, Schwarting R, Müller C, Hierholzer K, Lichtenstein I. Immunohistochemical localization of 11-hydroxysteroid dehydrogenase in rat kidney with a monoclonal antibody. *Renal Physiol Biochem.* 1989;12:320-327.
174. Fromm M, Schulzke JD, Hegel U, Hierholzer K. Mineralocorticoid activity of nine in vitro added corticosteroids in rat rectal colon. *Proc Int Union Physiol Sci.* 1989;31:151-152.
175. Fromm M, Schulzke JD, Hegel U, Hierholzer K. Relative potency of nine corticosteroids added in vitro in the induction of electrogenic Na<sup>+</sup> transport in dietetically untreated rat rectal colon. *Z Gastroenterologie.* 1989;5:292.
176. Hubenstorf M, Hierholzer K, Winau R. Exodus of sciences from Berlin, 1920-1950 [abstract]. *Int Union Hist and Philosoph Sci. (IU HPS/DHS)*, Hamburg, München, 1989.
177. Hierholzer K, Winau R, Fischer W. Bericht der Arbeitsgruppe "Exodus von Wissenschaften aus Berlin." *Jahrbuch, Akademie der Wissenschaften zu Berlin*, 1989. Berlin New York: de Gruyter Verlag; 1990:283-293.
178. Hierholzer K, Castello R, Kobayashi N, Fromm M. Sites and significance of renal corticosteroid metabolism. In: *The frontiers of nephrology.* London: Elsevier Science; 1990:67-76.
179. Fromm M, Schulzke JD, Kreusel KM, et al. Receptor versus enzyme mediated specificity of mineralocorticoid action (Na<sup>+</sup> transport) in rat rectal colon in vitro. *Pflügers Arch.* 1990;415(Suppl):R35.
180. Blum S, Buhler H, Lichtenstein I, Novak A, Siebe H, Hierholzer K. Oxidative and reductive activity of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) obtained from human placenta. *Pflügers Arch.* 1990;415(Suppl):R119.
181. Hierholzer K, Siebe H, Fromm M. Inhibition of 11 $\beta$ -hydroxysteroid dehydrogenase and its effect on epithelial sodium transport. *Kidney Int.* 1990;38:673-678.
182. Fromm M, Schulzke JD, Hierholzer K. Role of local 11-hydroxysteroid dehydrogenase in mediating mineralocorticoid action in rat rectal colon: effect of liquorice. *Z Gastroenterologie.* 1990;28:420-421.
183. Bühler H, Kobayashi N, Lichtenstein I, Perschel FH, Siebe H, Hierholzer K. Reversible inhibition of renal 11-hydroxysteroid dehydrogenase (11-HSD) by steroids, structure function relationship [Abstract]. *Nieren- und Hochdruckkrankheiten.* 1990;9:374.
184. Perschel FH, Bühler H, Siebe H, Lichtenstein I, Hierholzer K. Bile acids as endogenous inhibitors of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) [abstract]. *Nieren- und Hochdruck-*



- krankheiten. 1990;9:406.
185. Perschel FH, Bühler H, Siebe H, Lichtenstein I, Hierholzer K. Sind Gallensäuren als endogene Hemmer der 11 $\beta$ -Hydroxysteroid-Dehydrogenase (11 $\beta$ -HSD) wirksam? [Abstract]. *Z Gastroenterologie*. 1990;28:717-718.
  186. Hierholzer K, Bühler H, Perschel FH. Target cell metabolism of corticosteroids mediating antisteroid effects. Eleventh international congress of nephrology, symposium on molecular actions of diuretics, Tokyo, July 15-20, 1990. In: Hatano M, ed. *Nephrology*. Tokyo: Springer Verlag; 1991:1122-1135.
  187. Hierholzer K. Was ist und wie fördert man Forschung in der Medizin. Wissenschaftswoche, Universitätsklinikum Steglitz, 10.12.1990. In: *Forschungsprojekte am Klinikum Steglitz, V.i.S.d.P.: Forschungskommission des Universitätsklinikums Steglitz, Hausdruckerei des UKS*. 1991:4-9.
  188. Bühler H, Lichtenstein I, Perschel FH, Siebe H, Wang D, Hierholzer K. Modulation of 11 $\beta$ -hydroxysteroid dehydrogenase by endogenous and exogenous inhibitors, apparent mineralocorticoid excess: in vivo and in vitro. *Wissenschaftswoche, Universitätsklinikum Steglitz, 10.12.1990*. In: *Forschungsprojekte am Klinikum Steglitz, V.i.S.d.P.: Forschungskommission des Universitätsklinikums Steglitz, Hausdruckerei des UKS*. 1991:123-126.
  189. Hierholzer K, Schmidt RF, eds. *Pathophysiologie des Menschen*. Weinheim: VCH Verlagsgesellschaft, edition Medizin VCH; 1991.
  190. Hierholzer K, Ritz E. Nieren und ableitende Harnwege. In: Hierholzer K, Schmidt RF, eds. *Pathophysiologie des Menschen*. Weinheim: VCH Verlagsgesellschaft. Herausgeber, edition Medizin VCH. 1991;10:10-16.
  191. Hierholzer K, Fromm M, Ebel H. Elektrolyt- und Wasserhaushalt. In: Hierholzer K, Schmidt RF, eds. *Pathophysiologie des Menschen*. Weinheim: VCH Verlagsgesellschaft. Herausgeber, edition Medizin VCH. 1991;10:10-16.
  192. Hierholzer K, Perschel FH. Ormoni e Rene [Hormones and kidney]. In: De Santo NG, Capasso G, eds. *Nefrologia Pediatrica*. Bios, Cosenza. 1991;3:49-77.
  193. Bühler H, Lichtenstein I, Perschel FH, Siebe H, Hierholzer K. Ketoconazole inhibits rat and human hepatic 11-hydroxysteroid dehydrogenase (11-HSD) [abstract]. *Deutsche Physiologische Gesellschaft, 69<sup>th</sup> Meeting, Freiburg*. *Pflügers Arch*. 1991;418(Suppl):R118.
  194. Perschel FH, Bühler H, Hierholzer K. 11-Dehydrogenase (11-HSD): key enzyme modulating mineralocorticoid effects mediated by glucocorticosteroids. *International Congress Pathophysiology. Abstract Proc Int Soc Pathophysiol*. 1991;1:205-206.
  195. Perschel FH, Bühler H, Hierholzer K. Bile acids and their amides inhibit 11 $\beta$ -hydroxysteroid dehydrogenase obtained from rat kidney. *Pflügers Arch*. 1991;418:538-543.
  196. Hierholzer K, Bühler H, Perschel FH, Fromm M. Target organ metabolism of corticosteroids: studies on 11 $\beta$ -hydroxysteroid dehydrogenase. In: Bonvalet JP, Farman N, Lombes M, Rafestin N, Oblin ME, eds. *Aldosterone fundamental aspects*. Paris London: Colloques INSERM, John Libbey Eurotext. 1991;215:97-107.
  197. Ullrich KJ, Rumrich G, Papavassiliou F, Hierholzer K. Contraluminal p-aminohippurate transport in the proximal tubule of the rat kidney: Part: VIII: transport of corticosteroids. *Pflügers Arch*. 1991;418:371-382.
  198. Fromm M, Epple HJ, Schulzke JD, Hierholzer K. Dose-response of aldosterone and ten other corticosteroids on electrogenic Na<sup>+</sup> transport in rat rectal colon in vitro. In: Bonvalet JP, Farman N, Lombès M, Rafestin N, Oblin ME, eds. *Aldosterone fundamental aspects*. Paris London: Colloques INSERM, John Libbey Eurotext. 1991;215:334.
  199. Hierholzer K. Schlussworte zu Verhandlungen der Gesellschaft Deutscher Naturforscher und Ärzte, 116. Versammlung - 22-25 September 1990 - Berlin. *Materie und Prozesse. Vom Elementaren zum Komplexen*. Stuttgart: Gerok W. Wissenschaftliche Verlagsgesellschaft. 1991:443-449.
  200. Hierholzer K, Hierholzer C. J.S. Bach, "Die Kunst der Fuge", BWV1080, Begleittext für Berliner Saxophon Quartett. Osnabrück: Classic Produktion, CD 2 cpo. 999 058-2, 1991.
  201. Bühler H, Perschel FH, Hierholzer K. Inhibition of rat 11-hydroxysteroid dehydrogenase by steroidal compounds and triterpenoids; structure-function relationship *Biochim Biophys Acta*. 1992;1075:206-212.
  202. Kapturczak M, Bühler H, Lichtenstein I, Hierholzer K. Isoforms of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) activity along the mouse nephron. *Wissenschaftswoche im Universitätsklinikum Steglitz vom 9-13.12.1991*. In: *Forschungsprojekte am Klinikum Steglitz, V.i.S.d.P.: Forschungskommission des Universitätsklinikums Steglitz, Hausdruckerei des UKS*. 1992:212-214.
  203. Bühler H, Lichtenstein I, Siebe H, Hierholzer K. The antifungal drug ketoconazole interferes with renal and hepatic glucocorticosteroid metabolism. *Wissenschaftswoche im Universitätsklinikum Steglitz vom 9-13.12.1991*. In: *Forschungsprojekte am Klinikum Steglitz, V.i.S.d.P.: Forschungskommission des Universitätsklinikums Steglitz, Hausdruckerei des UKS*. 1992:197-199.
  204. Perschel FH, Siebe H, Hierholzer K. Inhibition of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) by atypical bile acids occurring in liver and biliary disease. *Wissenschaftswoche im Universitätsklinikum Steglitz vom 9-13.12.1991*. In: *Forschungsprojekte am Klinikum Steglitz, V.i.S.d.P.: Forschungskommission des Universitätsklinikums Steglitz, Hausdruckerei des UKS*. 1992:224-226.
  205. Siebe H, Wang D, Bühler H., Lichtenstein I, Hierholzer K. Dexamethasone is metabolized by rat renal microsomes [abstract]. *Seventh European colloquium on renal physiology, Naples, Castel dell'Ovo, June 13-16, 1992*. *Renal Physiol Biochem*. 1992;210:179.
  206. Bühler H, Lichtenstein I, Siebe H, Hierholzer K. The activity of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) is influenced by mediators of the cAMP-pathway [abstract]. *Seventh European colloquium on renal physiology, Naples, Castel dell'Ovo, June 13-16, 1992*. *Renal Physiol Biochem*. 1992;204:155.

207. Hierholzer K. Claude Bernard: portrait. In: *Forschung und Medizin, Botschaften*. Schering AG. 1992;1:99-105.
208. Hierholzer K, Hegel U. Der direkte Weg zum Kern. Steroidhormonedringen in die Zielzellen ein. In: *Forschung und Medizin, Botschaften*. Schering AG. 1992;1:29-38.
209. Hierholzer K, Winau R. Pioneer nephrologists of Berlin. *Am J Nephrol*. 1992;12:442-450.
210. Castello R. Immunhistochemische Lokalisation von 11 $\beta$ -Hydroxysteroid-Dehydrogenase in der Rattenniere mit einem monoklonalen Anti-körper [inaugural dissertation]. Med Fachbereiche der Freien Universität Berlin. 1992.
211. Blum S, Bühler H, Lichtenstein I, Siebe H, Hierholzer K. Characterization of placental 11 $\beta$ -hydroxysteroid dehydrogenase, the main enzyme of glucocorticosteroid metabolism. In: 3. Wissenschaftswoche Universitätsklinikum Steglitz der Freien Universität Berlin, 7-11 Dezember. 1992:272-273.
212. Bühler H, Agrawal R, Lichtenstein I, Siebe H, Wang D, Hierholzer K. 11 $\beta$ -Hydroxysteroid dehydrogenase (11 $\beta$ -HSD) activity is influenced by mediators of the cAMP-pathway. In: 3. Wissenschaftswoche im Universitätsklinikum Steglitz der Freien Universität Berlin, 7-11 Dezember. 1992:282-283.
213. Buchen St, Oelkers W, Krainj, Schöneshöfer M, Siebe H, Hierholzer K. Die Rolle von 11-Hydroxysteroid-Dehydrogenasen in der Verstärkung des Mineralocorticoid-Effektes von 9-alpha-fluoridiertem Cortisol. In: 3. Wissenschaftswoche im Universitätsklinikum Steglitz der Freien Universität Berlin, 7-11 Dezember. 1992:280-281.
214. Siebe H, Baude G, Lichtenstein I, et al. Metabolism of the synthetic glucocorticosteroid dexamethasone: in vitro studies with rat enzyme. In: 3. Wissenschaftswoche im Universitätsklinikum Steglitz der Freien Universität Berlin, 7-11 Dezember. 1992:350-351.
215. Agrawal R. Ist eine 6 $\beta$ -Hydroxylase in der Säugetiemiere nachweisbar? In vitro-Untersuchungen an Nieren von Ratten und Menschen [inaugural dissertation]. Med Fachbereiche der Freien Universität Berlin. 1992:
216. Kapturczak M, Bühler H, Lichtenstein I, Hierholzer K. Isoforms of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) activity along the mouse nephron. *Pflügers Arch*. 1992;420:R73.
217. Siebe H, Baude G, Lichtenstein I, et al. Metabolism of dexamethasone: sites and activity in mammalian tissues. *Renal Physiol Biochem*. 1993;16:79-88.
218. Hierholzer K, Agrawal R. Physiologie und Pathophysiologie der Nieren und ableitenden Harnwege. Vortrag Bundesapothekerkammer, 23. Internationale Pharmazeutische Fortbildungswoche Davos vom 17-23.1.1993. Davos: PZ Pharmazeutische Zeitung; 1993:6-18.
219. Wang D, Lichtenstein I, Siebe H, Bühler H, Hierholzer K. Co-substrate preference of 11 $\beta$ -hydroxysteroid dehydrogenase. Organ specificity of the enzyme system. 72. Tagung der Deutschen Physiologischen Gesellschaft, München. *Pflügers Arch*. 1993;422(Suppl):R88.
220. Blum S, Bühler H, Lichtenstein I, Siebe H, Hierholzer K. Characterization of human placental 11 $\beta$ -hydroxysteroid dehydrogenase, a main enzyme of glucocorticosteroid metabolism. 72. Tagung der Deutschen Physiologischen Gesellschaft, München. *Pflügers Arch*. 1993;422(Suppl):R88.
221. Bühler H, Lichtenstein I, Siebe H, Hierholzer K. Enhancement of intracellular cAMP-levels reduces the oxidative activity of 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) in HT29 human-colon-carcinoma-cells. 72. Tagung der Deutschen Physiologischen Gesellschaft, München. *Pflügers Arch*. 1993;422(Suppl):R86.
222. Bühler H, Hierholzer K. The intracellular glucocorticoid metabolism by 11 $\beta$ -hydroxysteroid dehydrogenase (11 $\beta$ -HSD) is under functional control of the second messenger cAMP. Twelfth international congress of nephrology, Jerusalem, Israel, June 13-18. 1993:591.
223. Wang D, Lichtenstein I, Siebe H, Hierholzer K. Isoforms of 11 $\beta$ -hydroxysteroid-dehydrogenase along the rat intestinal tract. In: 4. Wissenschaftswoche Universitätsklinikum Steglitz der Freien Universität Berlin, vom 9-10.12.1993, Jahrbuch. 1993:106-107.
224. Lichtenstein I, Siebe H, Hierholzer K. Apparent heterogeneity of 11 $\beta$ -hydroxysteroid oxidoreductase (11 $\beta$ -HSOR) obtained from rat renal tissue. In: 4. Wissenschaftswoche Universitätsklinikum Steglitz der Freien Universität Berlin, vom 9-10.12.1993, Jahrbuch. 1993:124-125.
225. Hierholzer K. Vorwort. In: *Exodus der Wissenschaften aus Berlin. Fragestellungen - Ergebnisse - Desiderate. Entwicklungen vor und nach 1933*. (Tagung 1991) [Arbeitsgruppe Exodus der Wissenschaften aus Berlin]. Fischer W, Hierholzer K, Hubenstorf M, Walther P, Winau R, eds. Forschungsbericht 7, Akademie der Wissenschaften zu Berlin. Berlin, New York: De Gruyter Verlag; 1993:1-3.
226. Bühler H, Hierholzer K. The intracellular glucocorticoid metabolism by 11 $\beta$ -hydroxysteroid dehydrogenase in MDCK cells is enhanced by preincubation with dexamethasone. XXIV Kongress der Gesellschaft für Nephrologie, 1993, Hamburg. *Nieren U. Hochdruckkrankheiten*. 1993;10:33.
227. Fischer W, Hierholzer K, Hubenstorf M, Walther P, Winau R. Exodus der Wissenschaften aus Berlin. Fragestellungen - Ergebnisse - Desiderate. Entwicklungen vor und nach 1933. Forschungsbericht 7, Akademie der Wissenschaften zu Berlin. Berlin, New York: De Gruyter Verlag; 1993.
228. Sabatini S, Hartseil A, Meyer M, Kurtzman NA, Hierholzer K. Corticosterone metabolism and membrane transport. *Miner Electrolyte Metab*. 1993;19:343-350.
229. Hierholzer K. Vorwort. In: Gross P, Richter D, Robertson GL, eds. *Vasopressin*. Fourth international vasopressin conference, Berlin. Paris: John Libbey Eurotext; 1993.
230. Kapturczak M. Heterogenität der 11 $\beta$ -Hydroxysteroid-Dehydrogenase-Aktivität entlang des Nephrons von Ratte und Maus [inaugural dissertation]. Med Fachbereiche der Freien Universität Berlin. 1994.
231. Hierholzer J, Hierholzer C, Hierholzer K. Johann Lukas Schönlein and his contribution to nephrology and medicine. *Am J Nephrol*. 1994;14:467-472.

232. Hierholzer K. Carl Ludwig, Jacob Henle, Hermann Helmholtz, Emil Dubois-Reymond and the scientific development of nephrology in Germany. *Am J Nephrol.* 1994;14:344-354.
233. Hierholzer K. Adrenal steroids metabolism and the kidney. Third Taormina Course on Nephrology. Consolo F, Bellinghieri G, Savica V, eds. Editoriale Bios; Cosenza. 1994.
234. Hierholzer K, Agrawal R, Lichtenstein I, Siebe H. Heterogenous distribution of 11 $\beta$ -hydroxysteroid-oxidoreductase (11 $\beta$ -HSOR) in the mammalian body and differential inhibition by endogenous and exogenous inhibitors. In: 5. Wissenschaftswoche Universitätsklinikum Benjamin Franklin der Freien Universität Berlin, vom 5-9.12.1994, Jahrbuch. 1994:86-87.
235. Hierholzer K, Wlodyga F. Was ist und zu welchem Zweck existiert das Klinikum Steglitz. In: Festschrift 25 Jahre Universitätsklinikum Steglitz. Klinikumsvorstand Universitätsklinikum Steglitz der Freien Universität Berlin. Berlin: Ruksaldruck; 1994:55-59.
236. Hierholzer K, Fromm M. Barrier function of 11 $\beta$ -hydroxysteroid-oxidoreductase catalysed corticosteroid metabolism. Steglitzer geburtshilflich perinatologisches Kolloquium, 7-8 Oktober. 1994:11.
237. Bühler H, Perschel FH, Fitzner R, Hierholzer K. Endogenous inhibitors of 11 $\beta$ -OHS: existence and possible significance. *Steroids.* 1994;59:131-135.
238. Hierholzer K, Fromm M. Epithelien. In: Schmidt RF, Thews G, eds. *Physiologie des Menschen.* 26. Aufl. 1995;34:719-736.
239. Fromm M, Hierholzer K. Funktionen der Niere. In: Schmidt RF, Thews G, eds. *Physiologie des Menschen.* 26. Aufl. 1995;35:737-776.
240. Hierholzer K, Fromm M. Wasser- und Elektrolythaushalt. In: Schmidt RF, Thews G, eds. *Physiologie des Menschen.* 26. Aufl. 1995;36:778-791.
241. Wang D. Die Lokalisation des 11 $\beta$ -Hydroxysteroid Oxidoreductase systems in verschiedenen Organen von Mensch und Ratte [Inaugural dissertation]. Med Fachbereiche der Freien Universität Berlin. 1995.
242. Matejevic D, Lichtenstein I, Siebe H, et al. 11 $\beta$ -Hydroxysteroid-oxidoreductase (11 $\beta$ -HSOR, E.C.1.1.1.146) in human placenta of normal and in pre-eclamptic (PE-) pregnancies [abstract]. European Branch International Society for the Study of Hypertension in Pregnancy. Int. Congress 20-22 July 1995. Groningen: JSSHP; 1995.
243. Matejevic D, Lichtenstein I, Siebe H, Schuster C, Graf R, Hierholzer K. Further studies on placental 11 $\beta$ -hydroxysteroid-oxidoreductase in mice after application of a synthetic glucocorticoid. Sixth meeting of the European Placenta Group, joint meeting with the Rochester Trophoblast Conference (EPG), 20-23 September 1995, Spaloumont, Belgien. *Placenta.* 1995;6:A47.
244. Hierholzer K, Stahl K, Lichtenstein I, Schwartz-Porsche D. 11 $\beta$ -HSOR (E.C.1.1.1.146) a special "transport inhibitor" [abstract]. Symposium "Transport of Organic Anions and Cations across Cell Membranes," 17-19 November 1995, Göttingen Biological Chemistry - Hoppe-Seyler; 1995.
245. Stahl K, Lichtenstein I, Siebe H, Schwartz-Porsche D, Hierholzer K. Different mammals exhibit isoenzymes of 11 $\beta$ -hydroxysteroid oxidoreductase In: 6. Wissenschaftswoche Universitätsklinikum Benjamin Franklin der Freien Universität Berlin, vom 1-15.12.1995, Jahrbuch. 1995:400-401.
246. Hierholzer K, Bühler H. Metabolism of cortical hormones and their general mode of action. In: Greger R, Windhorst U, eds. *Comprehensive human physiology: from cellular mechanism to integration.* Chapter 20. Berlin, Heidelberg, New York: Springer; 1996:403-429.
247. Finke R, Hierholzer K, Schleusener H. The thyroid gland: thyroid hormones, their origin and their mechanism of action. In: Greger R, Windhorst U, eds. *Comprehensive human physiology: from cellular mechanism to integration.* Chapter 22 Berlin, Heidelberg, New York: Springer; 1996: 451-472.
248. Hierholzer K, Lichtenstein I, Siebe H. Does corticosteroid metabolism in target organs affect the cardiovascular system? *Journal of the Autonomic Nervous System.* 1996;57:188-192.
249. Stahl, K, Lichtenstein I, Siebe H, Hierholzer K. Interaction of 11 $\beta$ -hydroxysteroid-oxidoreductase in different organs of various mammalian species. Hypertension: Causes and Consequences of Renal Injury. Satellite symposium to the 13th international congress of nephrology, July 7-8th, 1995, Barcelona. *Kidney Int.* 1996;49(Suppl):S156-S159.
250. Hierholzer K, Wiederholt M, Hegel U, Ebel H, Fromm M. 25 (+1) Jahre Klinische Physiologie. Institutsbericht 1969-1995 Wissenschaftliche Druckerei-Buchbinderei des Universitätsklinikums Benjamin Franklin der Freien Universität Berlin. 1996.
251. Stahl K, Agrawal R, Lichtenstein I, Siebe H, Hierholzer K. Interference of plant extracts with 11 $\beta$ -hydroxysteroid oxidoreductase (A potential pathophysiological cause of hypertension) [abstract]. *NephroPharmacology* 96, June 27-29, 1996, Berlin Buch. 1996.
252. Hierholzer K, Stahl K, Lichtenstein I, Agrawal R, Siebe H. Inhibitors of 11 $\beta$ -hydroxysteroid-oxidoreductase (E.C. 1.1.1.146) – Research Project. 1997.
253. Hierholzer K, Hierholzer J. Renal imaging techniques. *Am J Nephrol.* 1997;17:369-381.
254. Agrawal R, Lichtenstein I, Siebe H., Hierholzer K. In vitro 6 $\beta$ -hydroxylation of progesterone in human renal tissue. *Wien Klin Wschr.* 1997;109:493-496.
255. Hierholzer K, Finke R. Myxedema. *Kidney Int.* 1997;51(Suppl59):S82-S89.
256. Hierholzer K. Mutual interaction between physiology and clinical research. In: De Santo NG, Eknoyan G, eds. *Human clinical research: ethics and economics.* Naples: Istituto Italiano per gli Studi Filosofici; 1997:65-88.
257. Hierholzer K, Wittman HG, eds. Phasensprünge und Stetigkeit in der natürlichen und kulturell Welt. Wissenschaftskonferenz in Berlin, 8-10 October, Reichstagsgebäude. Wissenschaftliche Verlagsgesellschaft, Stuttgart. 1998;S:311.
258. Parthier B, Hierholzer K. Laudatio für WD Keidel zum 80. Geburtstag. *Deutsche Akademie d. Naturforscher Leopoldina, Jahrbuch.* 1997;3:59-61.
259. Ullrich KJ, Hierholzer K. Video legacy of the International So-

- ciety of Nephrology [video film]. Bruxelles, Int. Soc. Nephrol. 8 September 1998.
260. Hierholzer K. Metabolismo dei corticosteroidi a livello degli organibersaglio, un nuovo principio di regolazione. In: I 200 anni della Facoltà di Medicina Veterinaria, Università degli Studi di Napoli Federico II. 1998:71-76. [Honorary degree of Veterinary Medicine]
261. Hierholzer K, Ullrich KJ. History of renal physiology in Germany during the 19th century. In: Eknoyan G, Antonello A, De Santo NG, Calò L, Massry S, eds. History of nephrology 3. Am J Nephrol. 1998;19:243-256.
262. Hierholzer K, Ritz E. Recipient of the Franz Volhard Medal, Freiburg, 1999. Laudatio. Kidney Blood Press Res. 1999;22:184-186.
263. Hierholzer K. Roots of acid-base balance in Germany in the 19th and early 20th century. In: De Santo NG, ed. Acid-base balance, from bench to bed-side. Third Borelli conference, Capri, Istituto Italiano per gli Studi Filosofici. 1999:15-25.
264. Hierholzer K. Berliner Nephrologen, 1850-1933. In: Proceedings of the 12<sup>th</sup> Berliner dialysis seminar, Berlin, 3-4 December. 1999:19-27.
265. Hierholzer K. Michael Servet and the pulmonary circulation. Proceedings of the meeting in Cosenza, Second Telesio conference on edema, Bios, Cosenza. 2000:241-251.
266. Fromm M, Hierholzer K. Niere. In: von Engelhardt W, Breves G, eds. Physiologie der Haustiere. Stuttgart: Enke im Hippokrates Verlag; 2000:254-287.
267. Hierholzer K, Kirsch AK. Institute stellen sich vor: Die Physiologie an der Freien Universität Berlin. Physiologie. 2000;15:22-28.
268. Hierholzer K, Hierholzer J. The discovery of renal contrast media in Berlin. Am J Nephrol. 2002;22:295-299.
269. Hierholzer K, Hierholzer J. The discovery of renal contrast media in Berlin. In: Eknoyan G, De Santo NG, Shasha SM, Bellinghieri G, Savica V, Massry SG, eds. History of nephrology. Am J Nephrol. 2002; 22:295-303.
270. Hierholzer K, Fromm M. Elementi di Fisiologia renale. In: De Santo NG, Camussi G, Darmiento M, eds: Malattie dell'apparato urinario. Bios, Cosenza. 2003:3-44.
271. Hierholzer K, Hierholzer J. Forgotten nephrologists: Leonard Thurneysser and Hermann Senator. J Nephrol. 2003;16:760-765.
272. Hierholzer K. Evamaria Kinne-Saffran (1941-2002). Am J Nephrol. 2004;17:633-634.
273. Hierholzer K, Hierolzer J. Forgotten nephrologists: Leonard Thurneysser and Hermann Senator. In: De Santo NG, Iorio L, Marketos S, Massry SG, Eknoyan G, eds. The history of nephrology. Milan: Wichtig; 2004:22-27.
274. Hierholzer K. Evamaria Kinne-Saffran (1941-2002). In: De Santo NG, Iorio L, Marketos S, Massry SG, Eknoyan G, eds. The history of nephrology. Milan: Wichtig; 2004:217-218.

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## REFERENCES

- Hierholzer K. Carl Ludwig, Jacob Henle, Hermann Helmholtz, Emil Dubois-Reymond and the scientific development of nephrology in Germany. Am J Nephrol. 1994;14:344-354.
- Hierholzer K, Hierholzer C, Hierholzer J. Johann Lukas Schönlein and his contributions to nephrology and medicine. Am J Nephrol. 1994;14:467-472.
- Ullrich KJ, Hierholzer K. History of renal physiology in Germany during the 19th century. Am J Nephrol. 1999;19:243-256.
- Hierholzer K. Roots of acid-base balance in Germany in the 19th and early 20th century. In: De Santo NG, ed. Acid-base balance. Naples: Istituto Italiano per gli Studi Filosofici; 1999:15-28.
- Hierholzer K. Secretion of potassium and acidification in the collecting ducts of mammalian kidney. Am J Physiol. 1961;201:318-324.
- Hierholzer K, Hierholzer J. The discovery of renal contrast media in Berlin. Am J Nephrol. 2002;22:295-299.
- Hierholzer K. Evamaria Kine-Saffran (1941-2002). J Nephrol. 2004;17:633-634.
- Hierholzer K, Hierholzer J. Forgotten nephrologists: Leonard Thurneysser and Hermann Senator. J Nephrol. 2003;16:760-765.
- Hierholzer K. Mutual Interaction between physiology and clinical research. In: De Santo NG, Eknoyan G, Capasso G, Marotta P, eds. Human clinical research: ethics and economics. Naples: Istituto Italiano per gli Studi Filosofici; 1997-1998:65-89.
- Hierholzer K. Michael Servet and the pulmonary circulation. Proceedings of Meeting in Cosenza, Second Telesio Conference on Edema, in Bios, Cosenza. 2000;241-251.
- De Santo NG. My years with Klaus Hierholzer. In: Hierholzer K, Hegel U, Ebel H, Fromm M; 25 + 1 Jahre Klinische Physiologie. Institut Berichte 1969-1995. Berlin: Wissenschaftliche Druckerei/Buchbinderei des Universitätsklinikum Benjamin Franklin der Freien Universität Berlin; 1996.
- Steiner G. Lessons of the masters. Cambridge, Harvard Academic Press; 2003.

Received: 6 October, 2008

Accepted: 30 June, 2009

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