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Biosensing for the 21st Century

Springer

109

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Dedicated to the 65th birthday of
Frieder W. Scheller

Preface

To detect, quantify, and model biologically significant molecules is getting more and more important in our everyday life, in medicine, industry, and environment.

When a group of enthusiasts like Frieder Scheller started more than 40 years ago to develop biosensors, they would not foresee that biosensors are now available in every drug store, that the human genome sequence is available on the Internet, that DNA tests help in forensic cases, that we can track down the path of our ancestors from Africa...

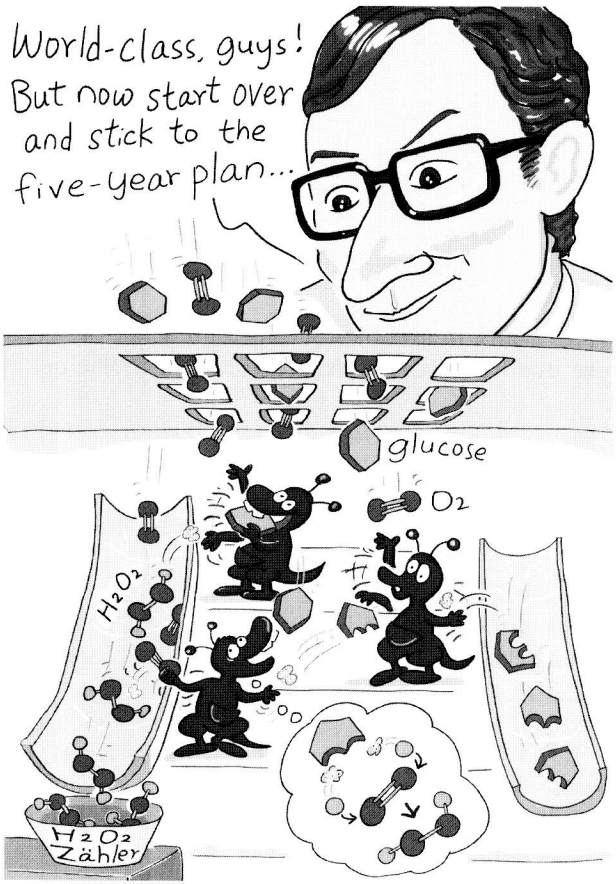
This all is bioanalytics in practice!

Frieder Scheller is one of the pioneers of this field. So, we did not hesitate for long when Thomas Scheper, the Series Editor, asked us to compile a monograph written by the leading specialist to honor his 65th birthday with a fresh insight into the ever expanding bioanalytical field. Thanks to all contributors and thanks to the staff at Springer Verlag: Birgit Kollmar-Thoni, Ulrike Kreusel and Dr. Marion Hertel for their help!

Even in the 21st century biosensors will continue to play an important role in bioanalytics. By definition biosensors are characterized by a rather close contact of the biocomponent for recognition and the transducing element. Thus, the development of biosensors is a highly interdisziplanary field. Future developments can be particularly seen in sensitivity enhancement down to the molecular level, switchability of the sensing device, miniaturization and integration into microsystems, incorporation of new transduction and characterization methods and the use of artificial recognition elements.

This book tries to cover recent developments in order to illustrate the potential of this rather fascinating area of science.

At the start of the book, you will find a chapter about the history of biosensors and Frieder Scheller's contribution. It gives you an impression what this restless, unselfish and creative scientist has done. To underline the basic biosensor idea we start here with a cartoon about Frieder Scheller's work:



"Aller guten Dinge sind drei" ("'all good things are 3", as Germans believe). They all may partly characterize Frieder:

Chance favors only the prepared mind.
(Louis Pasteur)

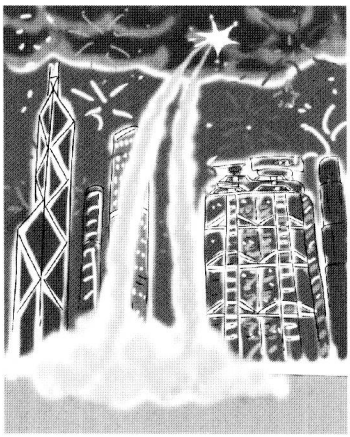
The important thing is to create.
Nothing else matters; creation is all.
(Pablo Picasso)

The only truth that gets through will be
what we force through:
the victory of reason will be
the victory of people
who are prepared to reason, nothing else.
(Bertolt Brecht)

What a long way biosensors have come in such a short time and how fast the time flies.

Now, the prepared mind, the creative, smooth fighter for reason, Frieder Scheller, turns 65 years young...

On behalf of the worldwide biosensor community:
Happy birthday, Frieder!! Here is a special Chinese Firework for your birthday!



Hong Kong and Wildau, August 2007

Reinhard Renneberg
Fred Lisdat

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Frieder Scheller and the Short History of Biosensors

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Abstract This is a first attempt at a brief sketch of the history of biosensors. It is far from complete and rather unsystematic. Many names are still missing, and we apologize for this. But the authors hope to have laid a humble cornerstone for a future "Complete History of Biosensors". We hope that many of our colleagues will contribute!

1 The Dawn of Biosensors

Without any doubt, Otto Warburg is the father of enzymatic analysis. His *optical test for the detection of NADH/NADPH* at 340 nm paved the way for the highly sensitive detection of dehydrogenases and their substrates in the mid-1930s. Hans-Ulrich Bergmeyer (Boehringer Mannheim) developed commercial optical enzyme tests based on Warburg's initial model.

The *father of biosensors* is Leland C. Clark, Jr. (Antioch College, Yellow Springs and the Children's Hospital in Cincinnati, Ohio, USA). He wanted to measure the reduction of oxygen with a platinum electrode to determine the oxygenation of blood. His first sensor failed because blood components were adsorbed on the electrode's surface, and this adsorption distorted the signal. Clark then had the ingenious idea of using the cellophane wrapper of a cigarette packet on his sensor. Only low molecular weight substances, mainly oxygen, could reach the electrode and be measured. The reduction current indicated the oxygen concentration, and so the Clark electrode was created. Today, Teflon is used as the membrane, and this sensor remains a key tool in medicine and environmental monitoring. To calibrate his sensor, Clark added an enzyme, glucose oxidase (GOD), to the solution. Clark then developed the sensor further by entrapping concentrated GOD with another