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50 YEARS OF RESEARCH AT THE BELGIAN INSTITUTE FOR SPACE AERONOMY

FOREWORD

This book was written on the occasion of the 50th anniversary of the Belgisch Instituut voor Ruimte-Aeronomie - Institut d'Aéronomie Spatiale de Belgique (BIRA-IASB). It is intended to present a large part of the scientific studies carried out during 50 years at BIRA-IASB. This is neither an exhaustive activity report nor a scientific textbook on aeronomy.

The addressed topics illustrate the historical evolution of scientific researches in the field of aeronomy since its infancy, in the sixties. Only a minority of topics is not reported.

Special thanks go to all external authors:
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Their affiliation is mentioned explicitly in the book. All other authors and contributors are from BIRA-IASB or have been working there until their retirement. The authors are responsible for the content of their chapters and sections..

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PREFACE

Dirk Frimout

Space Shuttle launch (credit: NASA)

At the time when the Belgian Institute for Space Aeronomy was created, aeronomy was a science relatively unknown to the general public. The term aeronomy was first introduced in 1946 by Professor Sydney Chapman, assigned in 1953 as President of the Special Committee for the International Geophysical Year (IGY) in 1957-58, who defined it as *the science of the upper region of the atmosphere, where dissociation and ionization are important*. Most fittingly, it is during the IGY that the space age begins with the launch of the first artificial satellite, Sputnik, by the USSR.

Located next to the Royal Observatory and the Royal Meteorological Institute in Uccle the Belgian Institute for Space Aeronomy was created in 1964 under the initiative of Professor Baron Marcel Nicolet with the full support of King Baudouin. Professor Nicolet was an internationally well-known scientist of the Meteorological Institute, who in 1953 was assigned as Secretary-General of the IGY and whose achievements in scientific research and administration earned him honors such as the Guggenheim prize.

Professor Nicolet became the first director of the Belgian Institute for Space Aeronomy. The Institute commenced its activities on the 1st of January 1965, provisionally in a building of the Meteorological Institute, but later on it moved into its own buildings. Following the IGY, Professor Nicolet had been able to gather around him a young, ambitious team of collaborators and the closest formed the first core of the scientific personnel. Building on his international experience, he insisted that the Institute be multidisciplinary, meaning, composed of a strong theoretical division, that worked closely together with an experimental group, with the support of a technical division. This approach enabled the Institute to make use of the new space age technologies to perform in situ measurements in the high atmosphere.

As a young engineer, I started my career in this newly created institute. Also to me, aeronomy was an unknown science. All I knew was that it studied the higher atmosphere and that space experiments would be required to fulfill this task. That aspect of the job was very attractive to me. The young Institute started with plenty of ambition, but with a limited budget. Under the leadership of Dr. Baron Marcel Ackerman, we built instruments to perform space experiments, but with our lack of experience and money, we could not make use of sounding rockets or satellites, that had become the international standard at that time. Fortunately, because of the international relations of Prof. Nicolet and Dr. Ackerman and their contacts with the CNES in France, we could perform experiments with stratospheric balloons. These balloons, with a volume of up to 300 000 m^3, could carry a payload weighing up to 300 kg to an altitude of 40 km where it could perform measurements in the stratosphere during several hours. Stratospheric balloons were called the "satellites of the poor" but they fitted very well our research which focused on the stratosphere. Our experimental research concerned a priori the study of the ozone layer and the ultraviolet light of the Sun, both not measurable with Earth-based experiments.

In 1970, the scientific emphasis moved worldwide to the problem of global pollution in the stratosphere, especially the chlorofluorocarbons and nitric oxides. This was partly triggered by an economic interest as big airplane producers like Aérospatiale in France and Boeing in USA, planned the construction of supersonic airplanes, intended to fly in the stratosphere. People were afraid that soon a large flotilla of supersonic airplanes, such as the Concorde, would fly daily over the ocean between Europe and America and that the exhaust of nitric oxides would attack the ozone layer. This would have a major impact on our atmosphere. With the experience of stratospheric balloons, the Belgian Institute for Space Aeronomy was in a good position to perform the required measurements and so, the Institute added the measurement of vertical profiles of a number of important minor constituents by absorption measurements in the near infrared part of the spectrum to its experimental program. A close collaboration was started with ONERA in France, who had developed an instrument, specially adapted for this purpose: the Grille Spectrometer. With this instrument, vertical profiles of several minor constituents could be measured at different latitudes. This allowed us to acquire quite some data, important for verification of the mathematical models developed by the theoreticians in the Institute. All these results contributed to the study of the greenhouse effect and the global warming of the Earth. The arrival of the Space Shuttle allowed for the first time to perform global measurements, and hence, the Grille Spectrometer was proposed to fly on the joint NASA-ESA mission Spacelab 1.

Dirk Frimout presenting the mockup of the Space Shuttle and Spacelab in the cargo bay.

Dirk Frimout during the Atlas 1 mission.

In collaboration with CNRS in France, the Belgian Institute for Space Aeronomy had also developed two other instruments, SOLSPEC and ALAE, both of which performed measurements of the Sun, and that were selected for the Spacelab 1 mission as well. In this way, the Institute was involved in three experiments on the Spacelab 1 flight in November 1983. They all were successful and brought a quantity of good data for the modelling of the stratosphere. All three experiments flew a second time on the ATLAS 1 mission in 1992. I was proud to have these experiments on board and to be able to control their good functioning during the flight.

Since then, the Belgian Institute for Space Aeronomy has evolved and has become more and more international. Many new groups were created within the Institute and have contributed to its international recognition. The activities and the research results related to the magnetosphere and plasma physics, to mass spectrometry, to planetary atmospheres and to so many other subjects, are all discussed in this publication.

The success behind this young institute is due to many factors, first of all the well-chosen multidisciplinary composition of the team of scientists, technicians and support teams, all delivering high-quality work. From the beginning, there was contact and collaboration with leading institutes from all over the world. The Institute got involved in and contributed to many international projects. It was a homogeneous team of young scientists with an experienced leadership and most of all with the necessary commitment and sense of adventure. This policy continued with the new generation of young scientists that took the torch from the first generation. The research has extended towards the atmospheres of the planets Mars and Venus. There are continuously new challenges, which will always attract young scientists.

I personally have many reasons to thank the Belgian Institute for Space Aeronomy. Specifically, I had the opportunity to expand my talents, which included preparing a doctoral thesis and spending a postdoctoral year at the University of Colorado in the United States. For many years, I was lucky to work in a highly qualified team of scientists, with dedicated technicians and with good administrative support. Together we got to know the sweetness of success during the launch campaigns, but also the deceptions of failures.

The Belgian Institute for Space Aeronomy was also my springboard to space. Thanks to their support, I got the unique opportunity to become a candidate to participate in the ATLAS 1 mission, and this support never ceased. Even when I left the Institute, I still felt closely linked to it. I continued to follow their successes. I still admire their creativity, their dedication and their scientific performances. I know that I can always count on their expertise when I need information. On the occasion of this 50th anniversary, I want to thank them all for the help they have given. Congratulations to the young, dynamic team that is taking care of the continuity and future of the Institute.

Dirk Frimout working in the upper deck of the Shuttle during the ATLAS 1 mission.

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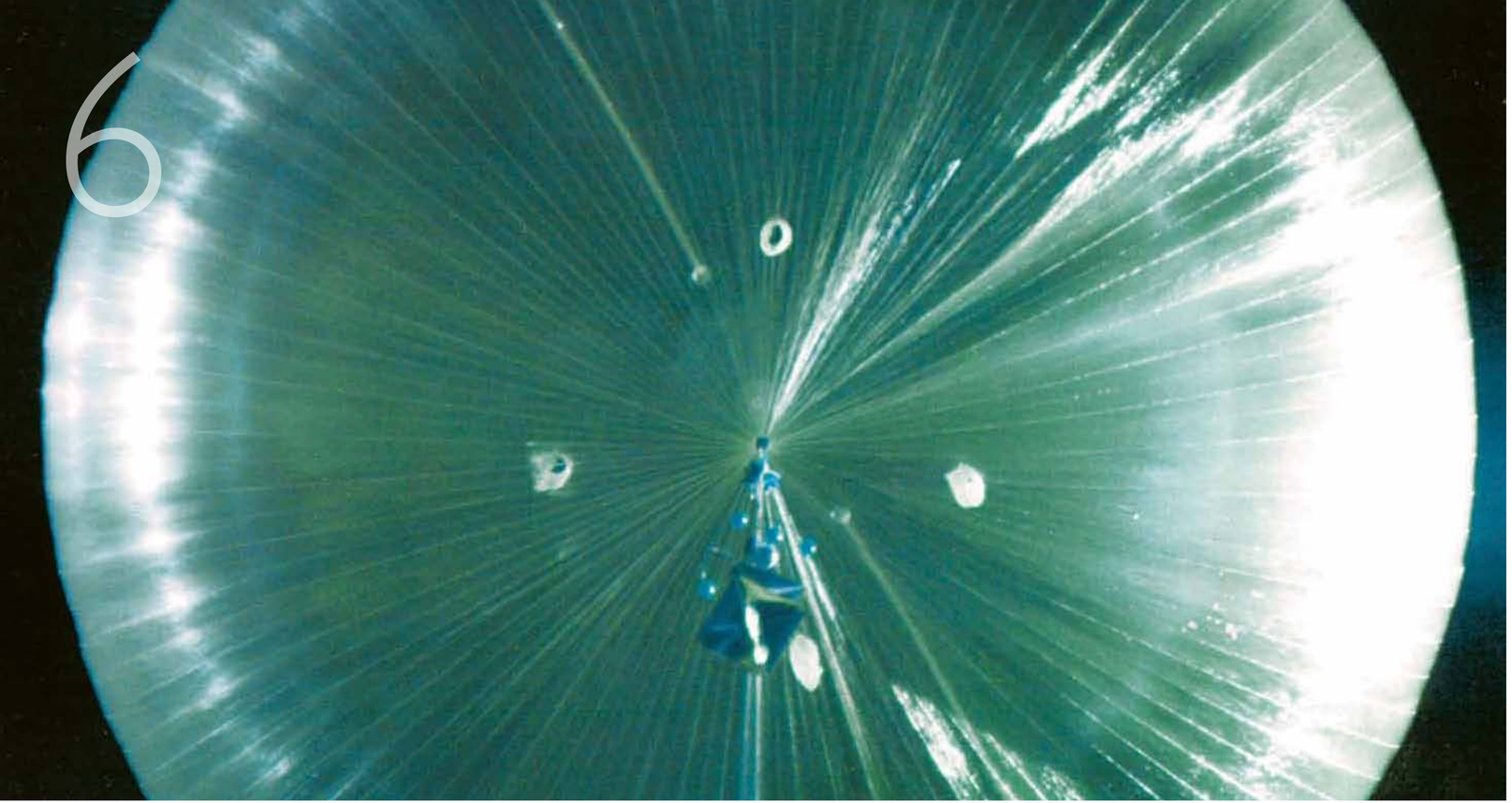
"If we long for our planet to be important, there is something we can do about it.
We make our world significant by the courage of our questions and the depth of our answers"

(Carl Sagan)

SPACE AERONOMY: A HISTORICAL INTRODUCTION

Paul C. Simon



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Christ Amelinck and Paul C. Simon

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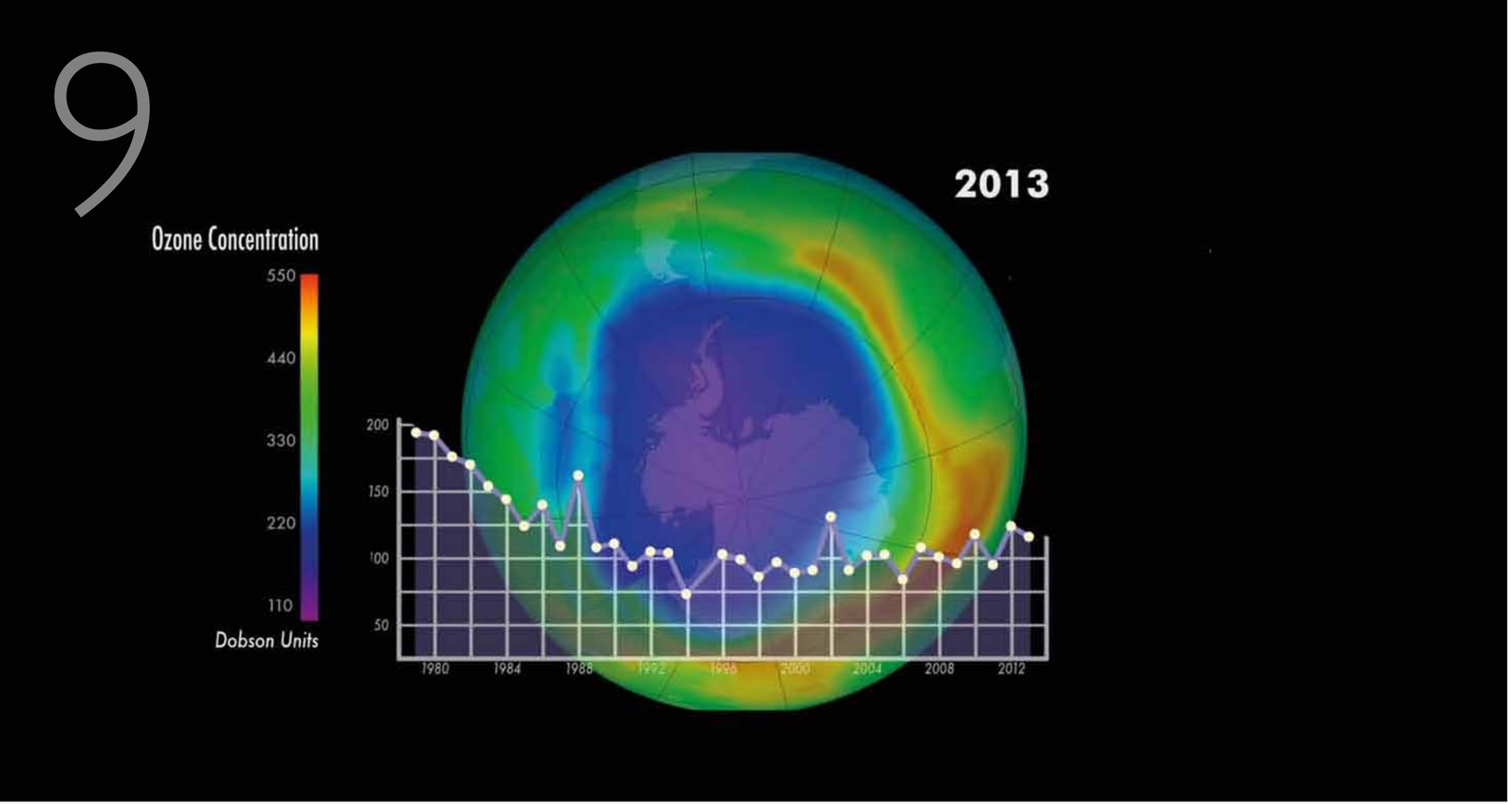

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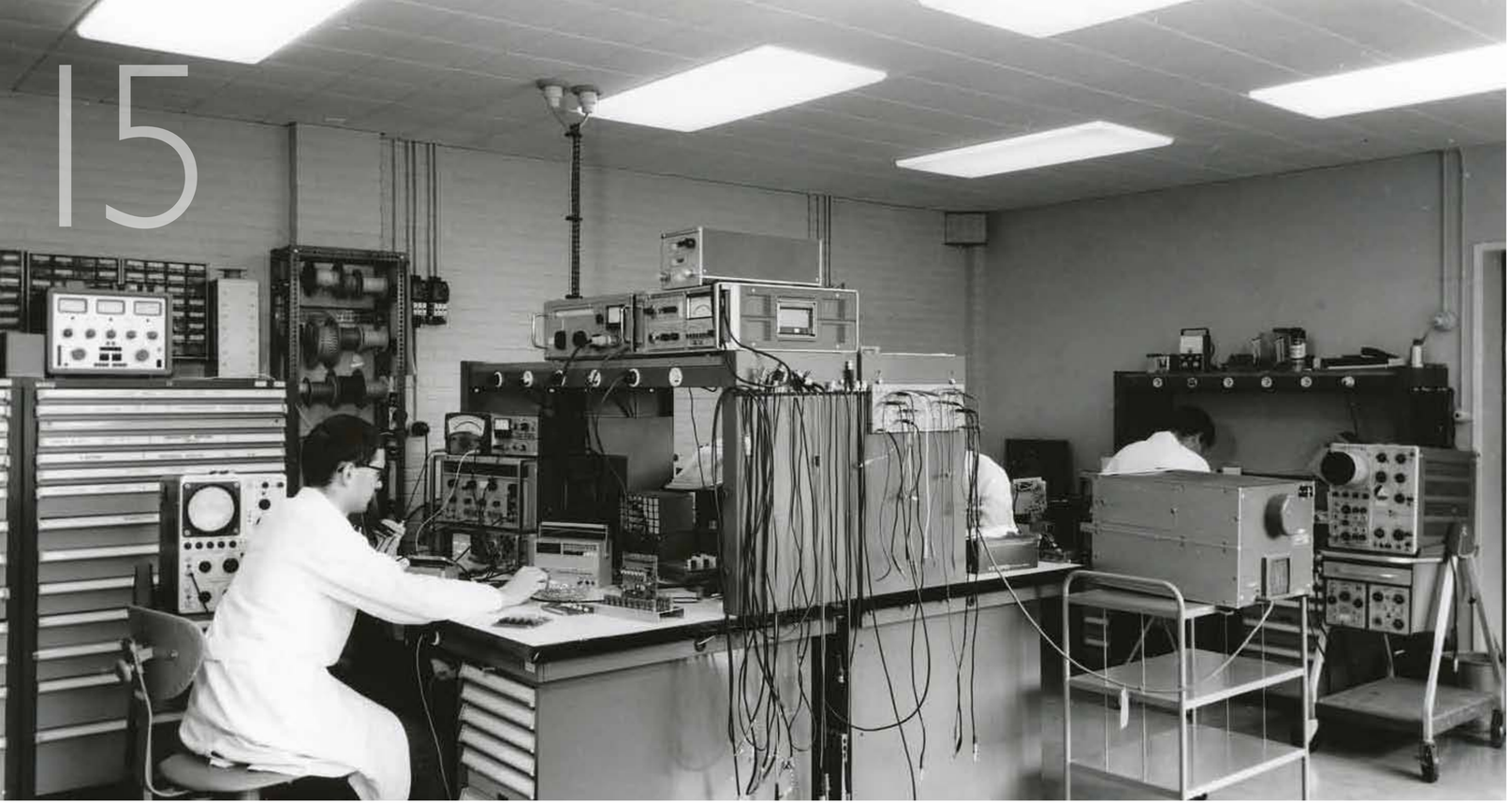

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TECHNICAL SUPPORT AND EXPERTISE

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Science is moving from one astonishment to another. Aristoteles