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THE GEORGE TELEKI MEMORIAL COLLOQUIUM

on

FUNDAMENTALS OF ASTROMETRY

*Proceedings of the 100th Colloquium
of the International Astronomical Union
Held in Beograd, Yugoslavia, September 8–11, 1987*

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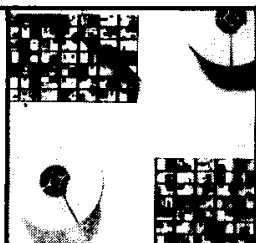
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PREFACE

The one hundredth Colloquium of the International Astronomical Union on the subject "Fundamentals of Astrometry", was held at Belgrade from 1987 Sep. 08 to Sep. 11. The site had been chosen so that the Colloquium might be a part of the festivities on the occasion of the centenary of the Belgrade Observatory. Unfortunately, the Scientific Organizing Committee lost its original chairman, Count Djordji Teleki, who died 1987 February 23 in the middle of the preparation for the colloquium, and Heinrich Eichhorn was appointed to chair the Scientific Organizing Committee. The participants voted to name the Colloquium the "George Teleki Memorial Colloquium on the Fundamentals of Astrometry", and this was approved by the Executive Committee of the IAU.

These proceedings contain papers on astrometric subjects, six of them invited reviews. All papers, including the latter, were sent to competent referees (not necessarily members of the SOC) and on their advice, the Editors rejected a fair percentage, because they strongly feel that a paper which does not meet the standards for publication in a journal should not be published in the proceedings of a meeting either. Yet, there is a significant difference between a research paper published in a journal and a paper published in conference proceedings. More than two years have passed between the time the Colloquium was held and the submission of the manuscript to the publisher. In many subspecialties of astronomy, particularly in the astrophysical area, such a delay would make many contributions obsolete. And if we pick up a thirty year old volume of one of the leading journals, how large a percentage of articles would we find which did, in hindsight, really advance our knowledge of the universe? And yet, it is remarkable that the papers in this volume have not lost any of their timeliness. While relative longevity may be a characteristic of papers on astrometry, it raises our hopes that this volume may retain its usefulness for some years to come.

Prof. B. D. Jovanović welcomed the 125 participants from 20 countries on behalf of the Union of Societies of Mathematicians, Physicists and Astronomers of Yugoslavia.

The Scientific Organizing Committee consisted of S. Debarbat, H. Eichhorn (Chairman), W. Fricke, N. Hu, J. A. Hughes, J. Kovalevsky, M. Miyamoto, C. A. Murray, F. Noel, I. Pakvor, Y. Réquième, A. R. Upgren, R. Wielen, Ya. S. Yatskiv and M. S. Zverev. I. Pakvor also chaired the Local Organizing Committee whose other members were Z. Knezevic, Z. Stancic, V. Protich-Benišek and A. Atanacković-Vukmanović. The sessions were chaired by (in this order) K. Aa. Strand, V. K. Abalakin, G. Westerhout, E. Hoeg, F. Chollet, W. Seitter, J.-C. Pecker, S.-h. Ye, C. Smith, W. F. van Altena, S. Tolchelnikova-Murri, J. D. Mulholland and M. Yoshizawa.

The editors extend special thanks to the secretaries, Mrs. Suzanna Hicks and Mrs. Debra A. Hunter, who typed all material which had not been submitted in photoready form, retyped a fair number of manuscripts and eased the task of the Editors in many other ways.

Venus Aeronomy

by **C. T. Russell**

Three decades of intense exploration by both Soviet and American Space Programs reveals Venus to differ greatly from the Earth in almost every respect, despite their similarity in size. Most important for the processes taking place in the upper atmosphere and ionosphere of Venus, i.e. the Aeronomy of Venus, is the fact that the planet has no intrinsic magnetic field. Consequently the solar wind interacts directly with the upper atmosphere and ionosphere.

This book collects for the first time the experience and knowledge accumulated from these investigations and provides the first detailed physical picture of the aeronomy of an unmagnetized planet.

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Evolution of Stars: The Photospheric Abundance Connection

Proceedings of the 145th Symposium of the International Astronomical Union held in Zlatni Pjasaci (Golden Sands), Bulgaria, August 27–31, 1990

edited by G. Michaud, A. Tutukov

INTERNATIONAL ASTRONOMICAL UNION SYMPOSIA 145

Modern astrophysics must answer two fundamental questions: why many stars have almost the same chemical composition as the Sun and why such a large fraction of them have peculiarities, very different from solar chemistry. The peculiarities become tracers of nuclear reactions and hydrodynamical processes going on inside individual stars. The book includes about forty review papers written by leading experts in the field. These reviews almost completely cover this topic of modern astrophysics.

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This book contains only the invited reviews held at the meeting.

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INTRODUCTION AND WELCOME

Heinrich Eichhorn
University of Florida

My dear colleagues,

I am very happy to welcome you, on behalf of the Scientific Organizing Committee, to this ancient and charming city. One of our reasons for coming here is to honor the Beograd Astronomska Opservatorija on its one hundredth anniversary. Before I formally open the 100th Colloquium of the IAU -- a jubilee of sorts in itself -- let me ask you to join me in a moment of silence in the memory of Count Djordji Teleki, who would have stood here in my place had a tragic fate not snatched him away in his prime. The executive Committee of the IAU has consented that we hold and name this meeting in his honor and I am sure you will join me in expressing to them our satisfaction at this step.

I should like to use the privilege of the chair to express some concerns. Many of us here, if not the majority, do astrometry -- the oldest branch of astronomy, the space science -- in the relatively protected environment of government-supported institutes. There, among our own, so to speak, we respect and support each other's efforts and our main worries are how to have our work supported by the bureaucrats who hold the purse strings. Those of us, however, who work at a university, must in addition, contend with those of our colleagues who -- mostly because lacking insight and information -- think that astrometry is no longer worth doing. I need not lecture you on the disastrous consequences when they succeed in convincing a dean, for example, that modern astronomy cannot be conducted but from space and that all ground-based work is obsolete, that the only problem worth pursuing is the question for the ultimate fate of the universe, that a progressive department must replace a retiring astrometrists with a theoretical astrophysicist who works on the "right" problems, whatever these may be in the eyes of those who dictate fashion to the rest of the astronomical community.

We, as astrometrists, have scored relatively recently with HIPPARCOS but, let's face it, we have an image problem. I would like to suggest a few things which might help.

Only very recently have we begun using principles other than the Earth's rotation -- which is all but uniform, when one investigates it closely -- or the optical imaging properties of a telescope for measuring the positions. No astrometric data that grace our catalogues have yet been obtained by measurements made outside the Earth's atmosphere. Instead of to an inertial reference frame, we still refer the stars' positions to one -- the Q systems -- which is fully determined by the Earth's solid body kinematics and orbital motion, thus loading ourselves down with really needless operations such as precession-nutation which are of more interest to geophysicists than to astronomers. And while we lecture the Rotarians at lunch (at least in the USA) on the virtues of the metric system, we return to our desks in the afternoons and reckon angles in a mixed hexadecimal-decimal system, and, if this alone were not ludicrous enough, use different basic units for longitude and latitude angles. "Because that's the way it has been done for many centuries" is the justification, even out of the mouths of those who -- justly -- point out that astrology has not changed its teachings for the last 3000 years and thus cannot

legitimately claim to be a science. Now that we have known Newtonian mechanics for three centuries, I doubt that anyone would introduce the ecliptic as an intrinsic element in defining our most frequently used coordinate system, had it not already been around for a millennium and a half when Newton proved the constancy of the angular momentum of closed mechanical systems.

We have been equally negligent in modifying our methods of data adjustment. There have been a number of significant advances in least-squares theory and alternatives to least squares have been developed. Every geodesist must in this day and age learn to master these before he graduates, but we treat, I daresay more often than not, our data as if the only use of the computer were the efficient and fast execution of basically the same procedures that were used thirty years ago when computers were accessible only to a few privileged members of our fraternity.

We all know that almost any significant new insight into the nature of the universe could not have been gained without essential input from the community of astrometrists. I suggest that we, as astrometrists, will retain our rightful place in the community of astronomers and astrophysicists only if we take our due support less for granted and become more innovative in the practice -- and the preaching -- of our craft. Not only must we maintain the old, but we must aggressively embrace and invent the new, and we must learn to recognize when the time has come for even the most beloved piece from our chest of tools, be it an instrument or a set of mathematical methods, to be moved from the observatory to the museum, no matter how well it may have served us in the years past, no matter how well we learned to use it and no matter how much we have become emotionally attached to it. Even the most comfortable old shoe can be repaired only so often.

When I assembled the program for this colloquium in memory of Count Teleki, I came across many titles that have renewed my confidence in the future of thoroughly modern astrometry. We must maintain this momentum and we shall prevail. Otherwise we will become just another example for a species that is an evolutionary dead end and can change its status in this world only in one way, namely by dying out.

Finally, I wish our several nations whom we represent here would take a good look at us. By no means do we all hold the same values or even the same opinions on matters in our subject, and sometimes the differences between our opinions as scholars are simply irreconcilable. But we sit peacefully together, we all not only respect each other but in spite of our unavoidable differences form a large fraternity of friendship that spans the whole globe, and we understand how each of us thinks. Though competition is sometimes fierce, it is almost never malignant. Only after the nations who inhabit this globe will get to know each other, understand each other and get along with each other as well as we astrometrists do (as one segment of the international community of scholars), will they be willing and able to force their governments and their military establishments to the decision that under no circumstances can war -- even covert in the form of support for terrorists -- be considered a viable alternative for the resolution of irreconcilable differences.

Thank you for your attention, and let's have a good colloquium.

MODERN PHOTOGRAPHIC CATALOG WORK :
ASPECTS OF OBSERVING TECHNIQUES AND REDUCTION METHODS

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ABSTRACT. The consequent application of present optical technology for the construction of substantially improved instrumentation in photographic astrometry and the application of rigorous reduction techniques provide all means for the construction of new, global position catalogs with a precision of a few 0.01 arcsec. At the same time the limiting magnitude of those catalogs can be extended to about 17 without decreasing positional accuracy. High speed measuring machines combined with real time reductions and storage on optical disks can handle the huge amount of information on a single plate. The throughout application of block adjustment reduction of global and hemisphere covering catalogs can provide a rigid stellar net which can be adjusted for the first time to a quasar based future reference frame directly. Instrumental requirements and optimal reduction techniques for achieving this goal are discussed.

1. INTRODUCTION

Photographic catalog work provides the optimal technique for a densification of the primary stellar reference frame of bright stars as given by the FK5 and IRS. Whereas wide field astrographs will bridge the interval from the 6th-8th magnitude stars of the IRS to about mag. 13-14, new types of large astrometric telescopes are needed to extend this net to about 17th or 18th magnitude thus reaching for the first time the future quasar based extragalactic reference frame without any further intermediate steps. In what follows, some essential aspects of photographic catalog technique which are crucial to achieve the highest quality will be discussed, a detailed review on particular catalogs and other aspects of catalog construction has been given elsewhere (de Vegt 1988).

2. ASTROMETRIC MAPPING PROCESS AND REDUCTION MODELS

In the formation of a high quality astrometric catalog, a number of effects contribute with different weights to the accuracy budget in a natural way. Some main effects will be addressed briefly, a more detailed

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