

Lecture Notes in Physics

Jochen Greiner Hilmar W. Duerbeck
Roald E. Gershberg (Eds.)

Flares and Flashes

Proceedings,
Sonneberg,
Germany 1994



Springer

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Jochen Greiner Hilmar W. Duerbeck
Roald E. Gershberg (Eds.)

Flares and Flashes

Proceedings of IAU Colloquium No. 151
Held in Sonneberg, Germany,
5–9 December 1994



Springer

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Library of Congress Cataloging-in-Publication Data

IAU Colloquium (151 : 1994 : Sonneberg, Thuringia, Germany)

Flares and flashes : proceedings of the IAU Colloquium 151, held
in Sonneberg, Germany, 5-9 December 1994 / Jochen Greiner, Hilmar W.
Duerbeck, Roald Gershberg, eds.

p. cm. -- (Lecture notes in physics ; vol. 454)

Includes bibliographical references and index.

ISBN 3-540-60057-4 (alk. paper)

1. Solar flares--Congresses. 2. Stars--Congresses. 3. Cool
stars--Congresses. 4. Astrophysics--Congresses. I. Greiner,
Jochen, 1959- . II. Duerbeck, Hilmar W., 1948- .
III. Gershberg, Roald, 1933- . IV. Title. V. Series: Lecture
notes in physics ; 454.

QB526.F6I28 1994

523.7'5--dc20

95-21404

CIP

ISBN 3-540-60057-4 Springer-Verlag Berlin Heidelberg New York

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Printed in Germany

Typesetting: Camera-ready by the editors

SPIN: 10493051 55/3142-543210 - Printed on acid-free paper

Preface

The 151st Colloquium of the International Astronomical Union (IAU) was held in Sonneberg, Germany, from the 5th to the 9th December, 1994. With this Colloquium, the IAU has honoured G.A. Richter and W. Wenzel, two well-known Sonneberg astronomers. Both had their 65th birthdays in autumn 1994. This volume is dedicated to them for their outstanding contributions in the field of variable star research.

At the time of the Colloquium, Sonneberg Observatory was going to be closed within three weeks, and we originally had the hope that hosting a high-ranked international conference in Sonneberg would help in the fight for survival against the Thuringian Ministry for Science and Culture (as the main responsible authority). At the moment, this hope seems to have been fulfilled only partially.

This Colloquium was unique in trying to combine many different fields of current research under the aspect of rapid variability of astrophysical sources from radio up to gamma-ray wavelengths. This experiment proved to be very successful. Many discussions between the different groups and on the use of data collected in dedicated projects for different research projects took place. The principal focus of the Colloquium was the presentation and discussion of observational results, as well as their theoretical implications. The printed questions and answers and the edited roundtable discussion mirror only very imperfectly the lively discussions.

In these proceedings we attempted to group together similar issues sorted according to wavelength. However, many papers could have fit equally well in more than one section. The order in which the papers appear in these Proceedings is close, but not identical, to the order in which these talks were presented at the Colloquium. In addition to the papers printed in this volume we had the following additional presentations: by C. Kouveliotou on the *Temporal Properties of Gamma-Ray Bursts*, by F. Mahmoud on a *Renewed Brightness Decrease of the Flare Star V774 Her*, by F. Mirabel on *Relativistic Ejections from Gamma-Ray Transients*, by W.S. Paciesas on the *Monitoring of High-Energy Transients with BATSE*, by G.R. Ricker on *HETE*, and by R. Sunyaev on *Galactic Center Monitoring with Granat*.

Many persons and institutions helped to make the workshop a success.

This Colloquium would not have been possible without the dedication and vigor of the three most important members of the Local Organizing Committee, Angelika Wicklein and Bernd Fuhrmann from Sonneberg Observatory, and Beatrix Ott from the Astronomical Institute in Münster. We would like to thank them and the other staff members of Sonneberg Observatory very much for doing a very demanding job with great competence and providing at the same time a friendly atmosphere for the Colloquium.

We were fortunate to have received support for this Colloquium from a number of sources. We are very grateful to the Deutsche Forschungsgemeinschaft, which not only supported the Colloquium with a substantial grant, but in addition supplied travel grants for 19 astronomers from Eastern Europe. We thank the International Astronomical Union for its spiritual and financial support, which resulted in 18 additional grants for travel support. We also thank the International Science Foundation (New York), which financed the stay of three participants from Russia, Ukraine, and Usbekistan.

We thank the City authorities of Sonneberg for their permission to use the Assembly Hall of the Rathaus for our Conference. Professor Kippenhahn, who, in the 1940s, as a teenager gained his first exposure to astronomy at Sonneberg Observatory, gave a popular evening lecture on *The Life of the Stars* for the people of the city. In the free time, excursions to the cities of Coburg (visit to the Veste, organ concert in the St. Moriz church) and Lauscha (visit to the Glass Museum and a glassblower's workshop), and to the Sonneberg Toy Museum and Sonneberg Observatory took place.

We thank our colleagues A. Bruch, P.B. Byrne, D.H. Hartmann, R. Pallavicini, J. van Paradijs, and W.C. Seitter who served, on short notice, as 'referees' for some of the contributed papers.

Finally, we thank the Max-Planck-Institut für Extraterrestrische Physik and the Astronomisches Institut der Universität Münster for the excellent logistical support they supplied for the Organizers of this Colloquium.

The IAU Colloquium 151 presented the ideal opportunity to honour G.A. Richter and W. Wenzel, to whom this volume is gratefully dedicated.

München/Münster/Crimea
March 1995

J. Greiner
H.W. Duerbeck
R.E. Gershberg

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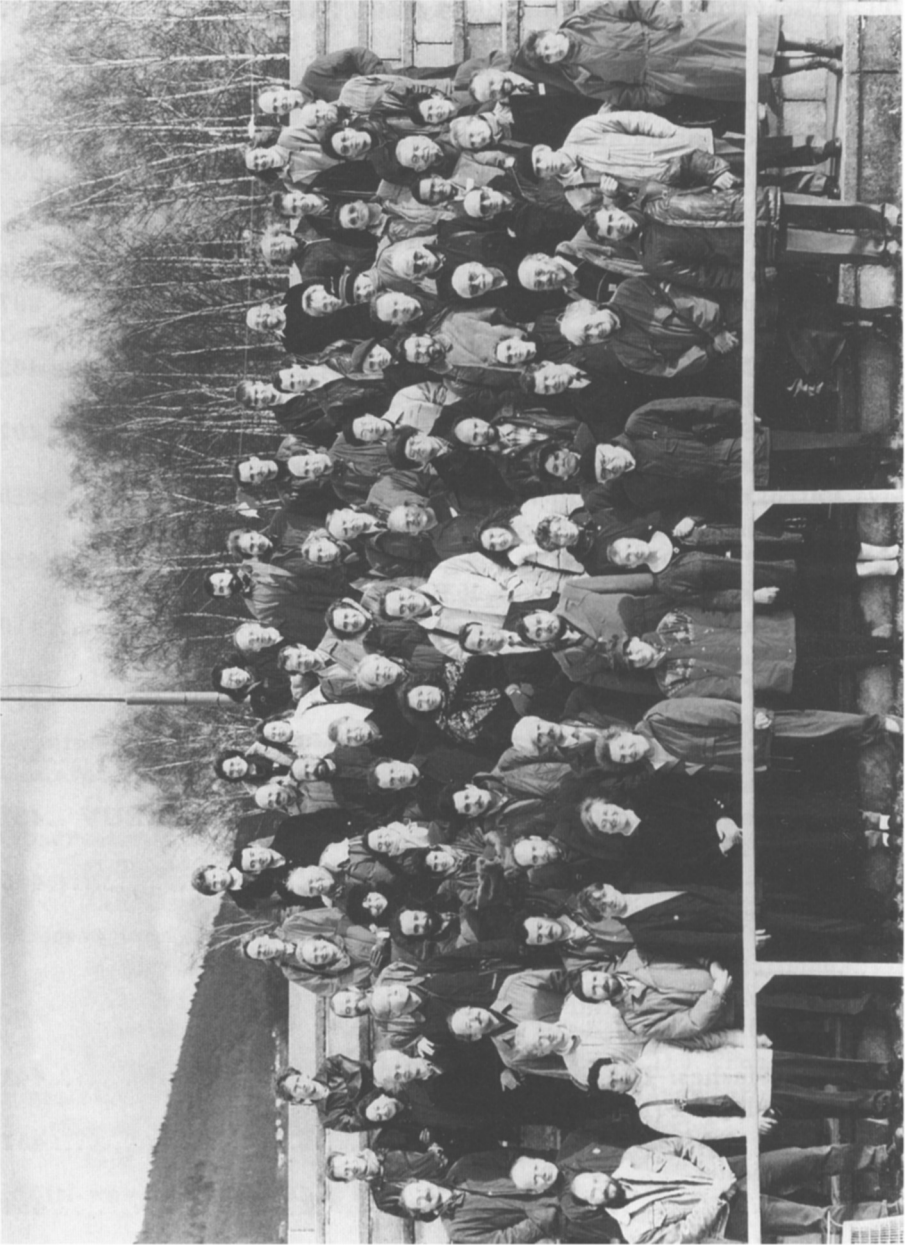
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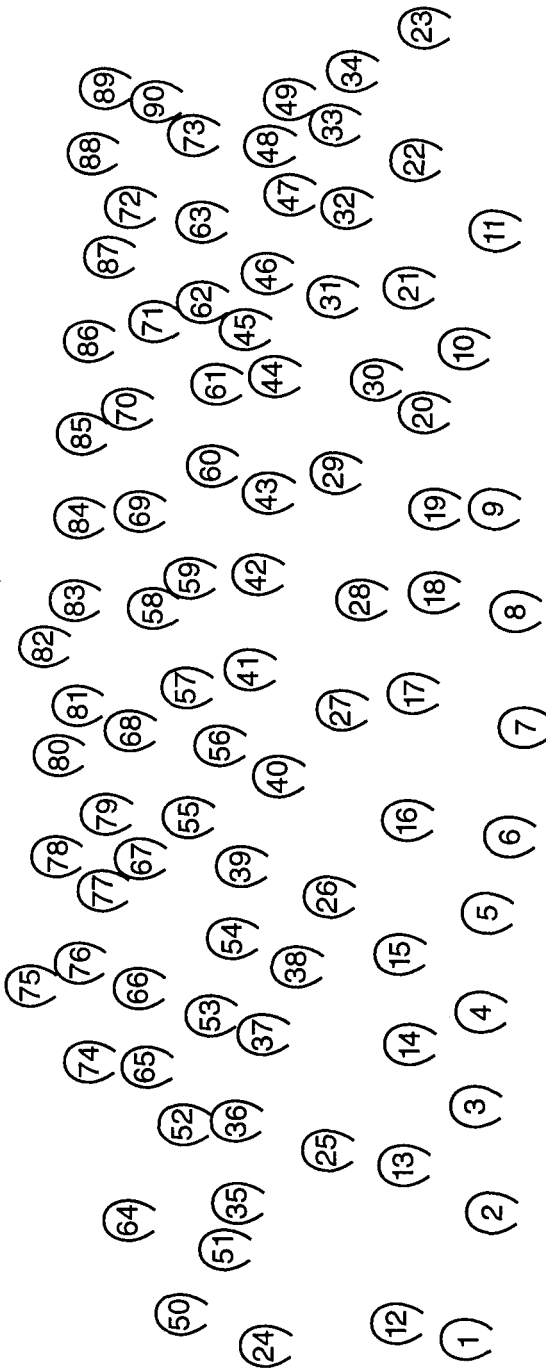
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| 12. Bräuer | 72. Schwarz | 87. Poveda |
| 13. Notni | 73. Wang | 88. la Dous |
| 14. Hojaev | 74. Larsson | 89. Greiner |
| 15. Yudin | 75. Ikhsanov | 90. Rößiger |
| | 46. Byrne | |
| | 47. Sanwal | |
| | 48. Mirzoyan | |
| | 49. Tsvetkova | |
| | 50. van der Klis | |
| | 51. Kouveliotou | |
| | 52. Kroll | |
| | 53. Pagano | |
| | 54. Umana | |
| | 55. Bruch | |
| | 56. Bowyer | |
| | 57. Ball | |
| | 58. Ottmann | |
| | 59. Stepanov | |
| | 60. Pan | |
| | 31. Shapiro | |
| | 32. Livshits | |
| | 33. Winterberg | |
| | 34. Vogt | |
| | 35. van Paradijs | |
| | 36. Drevins | |
| | 37. Trigilio | |
| | 38. Ventura | |
| | 39. Pallavicini | |
| | 40. Franciosini | |
| | 41. Minarini | |
| | 42. Stegert | |
| | 43. Gershberg | |
| | 44. Beskin | |
| | 45. Andronov | |

Opening Remarks

J. Greiner

Dear participants of IAU Colloquium 151,

On behalf of the Scientific Organizing Committee and the Local Organizing Committee I welcome you in Sonneberg. For the largest group among us with English as non-native language I have prepared a similar sentence in Russian: От имени научного и локального организационного комитета я сердечно приветствую вас – из бывшего Советского Союза – в Соннеберге, в бывшей Германской Демократической Республике.

In organising this colloquium, we violated every possible basic rule: If you want to attract people then

1. you must give them a fashionable place to come to
2. you must chose a time with nice weather
3. you must chose a location which is conveniently to reach.

The consequences for us were terrible – I had to answer about 300 e-mails during the last 6 weeks, and the Local Organizing Committee has had a similar load with FAXes. The consequences for you are also terrible: if you had already a quick look into the latest version of the programme, you probably did not found much similarities to the version you got with the third announcement. But despite all these circumstances we are 110 participants from 28 countries.

The reason for choosing this bad combination of time and location is twofold:

1. We are honouring with this Colloquium G.A. Richter and W. Wenzel, two well known Sonneberg astronomers. Both had their 65th birthdays a few weeks ago.
2. Sonneberg Observatory is going to be closed within three weeks, and we originally had the hope that hosting a high-ranked international conference in Sonneberg would help in the fight against the Thuringian ministry (as the main responsible authority).

We have specialists with us from many different fields of astrophysical research and working in all wavelengths from radio to GeV. Though every specialist group is probably undercritical in number (except the GRB “mafia”), we hope that the following 5 days will trigger extensive discussions between the various groups and across the wavelengths bands. With this I want to close my opening remarks. I wish you a pleasant stay in Sonneberg (regardless of the weather) and a lot of new insights, exciting ideas and suggestions for your future research.

Opening Remarks

R.E. Gershberg

Dear Colleagues:

On behalf of the Scientific Organizing Committee I should like to welcome all of you, to thank you for being here and to wish you a successful activity: interesting lectures, intriguing posters, exciting talks, pleasant meetings with old friends and new acquaintances.

I shall not attempt to tell you about the importance of stellar flares and flashes: since you are here, you know this excellently. Instead, I should like to propose an unorthodox but attractive idea.

As you know, if somebody takes photographs of distant galaxies, sometimes he or she finds a supernova explosion. In photographs of nearby galaxies one can detect more frequent nova explosions as well. However, this result is not the only unique possible view of the world. For instance, a frog sees only moving bodies and thus lives in a strange world that essentially differs from ours. Continuing this thought, let me imagine that we have an equipment to detect only time derivatives of radiation, independent on flux levels and on flux variations due to quantum statistics. In such a case the picture of the stellar world would change drastically: we should see not only supernova and nova explosions on a static background but a boiling ocean of stellar flares. They would occur due to the most numerous red dwarfs and other stars with solar-type activity, due to young T Tau stars, to old cataclysmic variables, and many others. I think that just as pictures of surrealistic painters say something about the inner state of the human soul, the proposed stellar picture from this hypothetical detector would manifest the essence of stars. So, let us study the stellar flares, the stellar souls.

Thank you.

Laudation

With this Colloquium 151, the IAU is honouring the work of the two Sonneberg astronomers G. Richter and W. Wenzel. Both have spent their entire scientific life in discovering and investigating variable stars of basically all classes. Due to the impact of their work over the last 4 decades, IAU Commission 27 was enthusiastic about our proposal for this Colloquium.

However, part of their work is also relevant to other branches in astronomy, mainly X-ray astronomy. Unfortunately, this is widely ignored outside the variable star community. Who of you, in the X-ray community, knows the following sources by their optical names: V818 Sco - the brightest soft X-ray source in the sky (Sco X-1), or V1357 Cyg (Cyg X-1), or V725 Tau (A0535+26)? There are over 70 X-ray sources which have been either discovered as variable stars before their X-ray discovery or extensively studied thereafter at Sonneberg Observatory. The most prominent example is HZ Her = Her X-1 which was discovered by Cuno Hoffmeister, the founder and first director of Sonneberg Observatory, in 1936 and then was extensively studied here. Only in 1972, Liller identified the *Uhuru* source Her X-1 with the variable HZ Her. Further examples are AM Her, TT Ari, MV Lyr, GK Per, V616 Mon, X Per etc. This is another reason for getting considerable support from IAU Commission 42 and 44.

Already this short listing of sources makes clear that we are meeting here at a historical place in honouring G.A. Richter and W. Wenzel. About 30% of all known variable stars have been discovered at Sonneberg Observatory, most of these by C. Hoffmeister. It was Hoffmeister's activity and the open-minded, scientific atmosphere at Sonneberg in the early fifties which formed two young astronomers - and not only these two - for their career to follow.

1 Wolfgang Wenzel

W. Wenzel worked at Sonneberg Observatory in 1948 for one year before he graduated at the University of Jena with his diploma in astronomy in 1954. In the same year he joined the scientific staff of the Observatory, thus having had his 40th anniversary of working for the Observatory earlier this year. During these early times he introduced modern photoelectric photometry in Sonneberg and began the systematic photoelectric monitoring of variable stars.

After two years of observing campaigns at Heidelberg Observatory between 1957–1959 he (together with W. Götz) used the Sonneberg Schmidt telescope with an objective prism to determine the spectral classes of hundreds of variables. In 1961 he earned his doctoral degree on the properties of irregular and low-luminosity variables.

He strongly supported simultaneous photoelectric and spectroscopic observations of variables, in particular after the installation of the 2m Schmidt telescope in Tautenburg. Due to his early success, in 1967 he officially became director of the department “Variable stars” of Sonneberg Observatory which was part of the Central Institute for Astrophysics in Potsdam at that time. However, this year also saw his last opportunity for a business travel to a non-socialist country, and also the political pressure on the founder and director of Sonneberg Observatory, Cuno Hoffmeister, grew more and more severe.

In the mid seventies W. Wenzel initiated first experiments on infrared observations of T Tauri stars. Despite several years of intensive instrument developments this research branch was stopped before routine operations abroad could start. Many of you probably know that W. Wenzel acted as vice president of commission 27 of the IAU between 1973–1976. However, when he was nominated for president in 1976, the directorate of the Central Institute for Astrophysics Potsdam forced him to decline. This political decision clearly marks a break in his international reputation in that it marks the beginning of avoiding abroad business travels at all.

Nevertheless, he remained an active astronomer all the time. He initiated one of the first multi-wavelength campaigns, today a nearly normal business for many of us. Without e-mail or FAX they succeeded in simultaneous optical observations at Sonneberg Observatory and several other optical observatories and EXOSAT X-ray observations of TT Ari. In general, long-term photometry and statistical investigations of eruptive variables became the main topic of W. Wenzel in the eighties.

In addition, he developed a strong interest in all new phenomena which could be targets for research at Sonneberg. One of the many examples are gamma-ray bursts (GRB). When I came to Sonneberg in February 1985 (nearly 10 years ago) to start searching for optical counterparts of GRBs, W. Wenzel had already investigated 5 GRB error boxes on about 3000 photographic plates. His enthusiasm and open minded character then started my personal collaboration with him. Recalling the many hours we spent together discussing scientific problems, I never will forget his ability of ironically questioning basic assumptions (“Oh, you know that there is a black hole in the Nova Muscae 1991 system?”) and to stimulate new developments.

On the political side things didn’t develop as smoothly. Because of his phantasy in finding ways to permanently by-pass official orders from the Central Astrophysical Institute in Potsdam he made enemies everywhere. It is one of the tragedies in his career that he always had to live with a security director which had the same authority and who even at the Observatory torpedoed many plans for enhanced independence from Potsdam, for more flexibility and improved



Gerold A. Richter



Wolfgang Wenzel

boundary conditions for scientific research. As a consequence of his strict character not to support any attempts to constrain the research conditions, W. Wenzel was forced to resign as a leader of the “Variable star” department in 1986. Officially he had to announce this fact as due to health problems. Given the fact that the responsible people are, at least partly, still in office, it is certainly time for rehabilitation.

Summarizing, W. Wenzel made a major contribution in the classification of variable stars, investigated the temporal behaviour of a huge number of variables and could clarify many of the interesting and widely known cases such as HZ Her, FG Sge, BO Cep etc. On a more local scale, he coordinated and headed a good deal of the scientific work at Sonneberg Observatory for more than 20 years. He also headed the bibliographical catalog of variable stars which now is a major contribution to the CDS Strasbourg. And last but not least, his willingness to educate and collaborate with amateurs has made Sonneberg Observatory also to a Mecca for (East-)German amateurs and guaranteed a lively use of the world’s second largest plate collection by them.

2 Gerold Richter

G.A. Richter studied physics at Leipzig and Jena University and started his astronomical career at Sonneberg Observatory in early 1957. He also spent some observing time in Heidelberg before he made the Sonneberg 40 cm astrograph his instrument. Over decades he photographically monitored the northern sky in the long-term project of the Sonneberg field patrol, deep exposures of 80 well defined fields on the sky with nowadays 400–1000 plates per field. This was the observational basis for his discoveries of several hundred new variable stars, and the investigation of the lightcurves of further hundreds of known variables for statistical purposes. This statistical analysis of the various classes of variables,

such as the frequency of variables of various classes in the solar neighbourhood and in our Galaxy, the question of population membership as well as the duration of variability states, allowed him to study the general structure of our Milky Way. With this result he earned his doctoral degree in 1966.

In the following years he continued this kind of investigation with the search for and spectroscopic investigation of UV excess objects at high galactic latitudes. For this, he several times went for observations to Zelenchukskaya and Tautenburg. In addition, G.A. Richter started to put emphasis also on extragalactic objects. He optically identified and investigated point-like radio sources. His investigations of the spiral structure of M31 led to the discovery of new OB associations and isolated OB stars.

In the eighties he concentrated on the study of many eruptive binary systems, in particular dwarf novae and recurrent novae. The main target of research was the determination of the cycle length of the outbursts. The statistical reduction of the huge observational material led to a widely used relation between outburst amplitude and cycle length, and served as an empirical basis for the understanding of the physics in cataclysmic variables.

Certainly all of you know the helium flash star FG Sge which was discovered as variable star in Sonneberg by Hoffmeister. But it was G.A. Richter who recognized the exceptional importance of this star for the theory of stellar evolution.

Summarizing, G.A. Richter did a huge work in investigating several 100 variable stars of all known classes. These were the basis for the far-reaching conclusions he could draw out of the statistical investigations of more than 1000 variable stars.

3 The future

One of the consequences of the German unification process in astronomy was the expiration of the contracts of all scientific personnel in December 1991. As the result of the evaluation process by predominantly West-German authorities, Tautenburg Observatory (which is about 100 km from Sonneberg) became the Thuringian State Observatory while Sonneberg was given a three year time limit for preparing either a new boost or the well ordered closure. To make it not too easy for Sonneberg Observatory, it was freed of all but two scientists at that time, among the fired people also G.A. Richter and W. Wenzel, who both were assessed to be old enough to retire. There are many voices in the air which claim that much of this never would have happened if W. Wenzel would still have been director in 1989/1990.

Fortunately, we could get funding for two small projects within a few months which allowed them to resume scientific work in the course of 1992. Due to mainly bureaucratic constraints the topics of these projects were devoted to correlative research to the ROSAT and GRO missions. It was extremely remarkable, how enthusiastic both started working on more or less completely new fields. This

is especially honourable, because both were forced to observe more or less passively how politicians and frustrated former collaborators started damaging the reputation of the Observatory.

Things became worse with time. At present - three weeks before time is up - politics seems to have won against science. The deterioration of intelligence is not confined to Thuringia, however. Prominent politicians in our federal government officially claim that "experts are making proposals, but politicians decide" (Schwaetzer). There is much truth in this sentence. According to this realization politics obviously consists of getting the right things written down, putting them aside, and acting according to the own clientele. In the present case, it seems to be even worse, developing as in the script of a usual western: *Give them a fair trial and hang them*. The verdict is established, also the perpetrator, only the corpse is still missing.

Who then is astonished that some of the persons affected regard all this as a calculated gambit. As a consequence you will not have the possibility to meet W. Wenzel. He is not in town this week.

I think that it will be according to the intention of G. Richter and W. Wenzel if I do not only close with best wishes for themselves but with best wishes for the Observatory to which they devoted their lives. So, let us hope together - and much more we cannot do anymore - that with the new Yhuringian government which formed last week and an unbiased new minister for science, research and culture also new decisions will be possible which eventually maintain scientific research at Sonneberg Observatory and which may allow G. Richter and W. Wenzel a dignified continuation of their scientific life.

December 5, 1994

Jochen Greiner