

Sixty Years in Solar Physics

Zdeněk Švestka

Received: 15 October 2010 / Accepted: 15 October 2010 / Published online: 25 November 2010
© Springer Science+Business Media B.V. 2010

Abstract I recount my career in solar physics beginning at Ondřejov Observatory in 1948 and ending with my ~30 year stay at the Laboratory of Space Research in Utrecht.

1. Origins of an Astronomer

It was in the fourth class of the gymnasium when our classmate Strnad took myself and Jiří Bouška to a meeting of the Czech Astronomical Society of which he was a member. The meeting took place at the People's Observatory on the Petřín Hill in Prague and it had a heavy impact on both of us. While Strnad later disappeared having other interests, both Jiří and I became since that time deeply interested in astronomy. Bouška got later the position of an assistant at the Observatory of the Charles University in Prague, and after the war I began to study the subject of astronomy at the same university.

But before that, during the war, I had to work in a factory in the outskirts of Prague, where the trip by tram took three quarters of an hour. As we worked ten hours a day, there was practically no time left in the evenings for astronomical observations. Besides this my father didn't like my evening activities and was worried that I had not enough night rest after my duties during the day. Nevertheless despite my father's misgivings I spent the evenings as much as possible at a window with a binocular and later with a five-inch telescope, which I borrowed from the University Observatory, where it was lying unused. With this borrowed telescope I made some observations of long-periodic variables of the Mira type during this period.

As there was no open position for an astronomer in Czechoslovakia at that time, I didn't suppose that I might have astronomy as my profession, but only as a hobby. Therefore I studied as the main subjects mathematics and physics, with the intention to become a teacher of these topics at a secondary school (gymnasium). The main astronomical lectures were

Z. Švestka is retired.

Z. Švestka (✉)
Laboratory of Space Research, Utrecht, The Netherlands
e-mail: zdeneksv@xs4all.nl

Figure 1 František Link, Zdeněk Švestka's Doctoral Thesis Advisor and Director of Ondřejov Observatory from 1948 – 1953, during a COSPAR meeting in Tokyo in 1968.



delivered by Professor Heinrich and they concerned only celestial mechanics that was very far from my interests. However, I was already a member of the Czech Astronomical Society in Prague and of its section for astronomical computations, which was headed by Dr. Link (Figure 1), who was also my teacher of physics at the gymnasium. He also gave some astronomical lectures which I attended, and those concerned studies of the upper atmosphere using optical phenomena, like the changing colors of the Moon during lunar eclipses, due to variations of the paths of light through the Earth's atmosphere. At that time these analyses were quite interesting, but they lost much of their significance as soon as the atmosphere began to be studied by rockets and from satellites. I finished my studies at the Charles University in 1948.

2. Ondřejov Years

In the year 1948 Dr. Link was appointed temporary director of the Astronomical Observatory at Ondřejov (Figure 2), some 40 km from Prague, and offered me in the same year, after I finished my studies at the university, a position there. This position was actually for a gardener but, of course, I did not take care of the extensive park around the institute, but continued in my astronomical studies, usually sitting at the terrace of the observatory, drinking coffee and smoking. Not very healthy, and the garden suffered. In the evenings I made some observations, mainly again of long-periodic variable stars of the Mira type. These observations were then regularly published in an astronomical circular – actually my first publications, but my name was not there. And besides other duties at the observatory I started to work on the thesis for my doctorate degree from Charles University which I received in 1949. The title of Dr. was granted based on my thesis: “Study of the Earth Shadow near its Center”. My advisor was Dr. Link.

At the end of 1949 Dr. Link made an arrangement with the army – convincing them that observations of the ionosphere were important for them – and this arrangement provided some money so that I could become a fully paid astronomical assistant and more young people could be hired. We had to measure every hour at night the height of the ionosphere, running through frequencies on a radio, but this gave us enough free time to make astronomical observations in between. Thus it was Dr. Link who actually made from me a professional astronomer – without him I would be teaching at a secondary school.

In 1953 there was established in our country the Academy of Sciences with the seat in Prague to which all scientific institutes, including our Observatory, belonged. Ondřejov got



Figure 2 Aerial view of Ondřejov Observatory.

a new director based in Prague, Dr. Šternberk, who was there (in Prague) for many years before as the head of the department in charge of measuring time. This department was already for many years closely connected with the Observatory at Ondřejov. Dr. Link stayed in Ondřejov and led then the department of the study of the high atmosphere.

I continued my work in Ondřejov and during the following years I made two new theses for two new titles which our country has taken from the Soviet nomenclature. With the thesis “Physical Conditions in Chromospheric Flares” I received the title CSc (in the year 1956) and ten years later I got the title DSc for the thesis “Spectral Analysis of Chromospheric Flares”. Both theses were based already on my own scientific results. The title CSc was about equal to our earlier title of doctor while DSc was a much higher degree for already experienced scientists or professors at a university. I got both these titles at our newly born Academy of Sciences. In 1965 I also became “docent” (Assistant Professor) at the Charles University, but – with the exception of one term when I substituted for the full professor who was then on his sabbatical – I was giving only specialized lectures, no regular courses. I was very much interested in the stellar universe and in planetary nebulae in particular, but the equipment needed for any useful study in this field was not available at the Ondřejov Observatory and would cost a lot of money. Therefore, from the possibilities which were available I chose to study the Sun.

At Ondřejov I became (in 1956) the first head of the newly-established Solar Department of the Astronomical Institute and helped to build in 1959 a multi-camera solar spectrograph which, at that time, became a unique instrument for studying solar flares. Its construction was due, in particular, to two members of the department, Milan Blaha and Boris Valníček. Boris is an excellent instrumentalist and Milan an outstanding interpreter. We got some very good spectra of flares and could draw from them very interesting conclusions about the flare structures. Josip Kleczek also used this instrument for studies of the spectra of prominences.

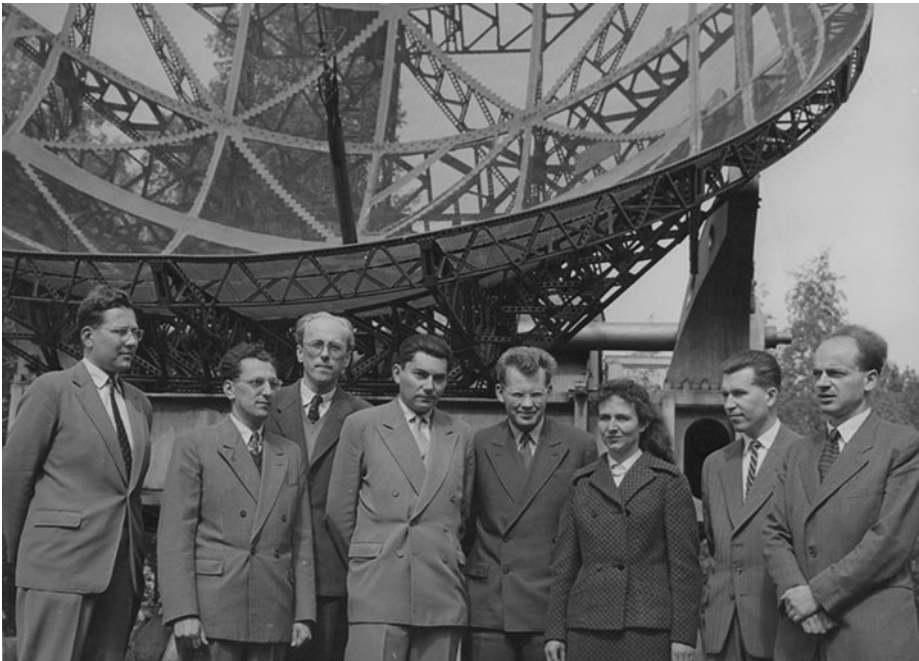


Figure 3 Ondřejov solar group on the occasion of receiving a state award in Prague, 1962. Left to right: Vaclav Bumba, Milos Kopecký, Vojtech Letfus, Zdeněk Švestka, Boris Valníček, Lida Fritzová-Švestková, Milan Blaha, and Ladislav Křivský.

For these studies the Solar Department was awarded in 1962 a Czechoslovak State Prize for scientific achievement in the study of solar flares. This prize was given to a collective of nine scientists, including myself as the group leader (Figure 3).

For 14 years I was the head of the solar department at the Ondřejov Observatory (Švestka, 1970a). When the department was established in 1956, its only equipment consisted of an old-fashioned spectroheliograph of the Hale type and a radio telescope observing the Sun on one single frequency. When I left in 1970, it was one of the best-equipped solar observatories in Europe.

The department became well-known throughout the world for its scientific contributions and it was equipped with modern instrumentation including a solar spectrographic laboratory, a flare spectrograph, a radio spectrograph, a magnetograph, and a prominence coronagraph-spectrometer. Our flare spectrograph was the first of its kind in the world and, without our knowledge, was copied with all details at the Purple Mountain Observatory near Nanking. A copy of our radio spectrograph was built for the observatory in Irkutsk. We also started cooperation in space experiments, first with France, which, however, met with some political obstacles, and later with the USSR.

The majority of our results during this time was published in our *Bulletin of the Astronomical Institutes of Czechoslovakia*. Besides this I wrote the book “Astronomical and Astrophysical Dictionary” with J. Kleczek, “Interstellar Matter” with V. Vanýsek, “The Sun and its Influences at the Earth” with F. Link, and I myself wrote the book “Stellar Atmospheres”. All these books were written in Czech.

Our results in the study of flares and the solar activity in general with the new spectrograph were so good that the President of the IAU Commission 10 for Solar Activity, Prof.

Figure 4 Andrei B. Severny, Director of the Crimean Astrophysical Observatory from 1952–1987 and Vice-President of the IAU from 1964–1970.



Severny from the Crimean Observatory (Figure 4), asked me – as the head of the solar group at Ondřejov – to become his Vice-President. Thus, after his term ended, I became automatically president of Commission 10 for the period 1964–1970.

During that time I visited the Dutch Observatory in Utrecht and, in a discussion with Kees de Jager (1996), I fully agreed with his suggestion to start a journal which would publish only solar studies. He had at that time very good contacts with the Dutch publisher Anton Reidel in Dordrecht, who already published another journal which de Jager edited, the “*Space Science Reviews*”, and who also strongly supported this proposal. Thus in the year 1966 we founded and started the journal “*Solar Physics*” where also this article is published. We believed that the studies of the Sun needed a special journal, because in other astronomical journals papers concerning the Sun were always at the end of the issues which made them somehow inconspicuous. Some people, like Jean-Claude Pecker (1999) were against it because, as they said, it detached the studies of the Sun from other astronomical topics but, according to my opinion, that was not as bad as it might have been perhaps suspected at that time. I hope that even Jean-Claude now agrees with that.

3. Noordwijk to Utrecht

In 1970 I was offered a one year stay in the European Space Research and Technology Centre (ESTEC) at Noordwijk in the Netherlands. I went there with my family with the exception of my oldest son from my first marriage who lived at that time with my mother in Prague and just started studies at the university. Towards the end of our planned stay in Holland ESTEC offered to extend my employment there to two years, but that implied that I had to stay permanently abroad, because I had permission to stay abroad for one year only. As a consequence of it I had to leave Noordwijk, because I became then some sort of an obstacle for the collaboration of ESA with the Soviets.

Nevertheless, ESA still very kindly continued to pay my salary. I went to the Fraunhofer Institute in Freiburg in Germany, which I had visited several times before for shorter periods of time and where I was already involved in some programs organized by Professor

Figure 5 Zdeněk Švestka and Anton Bruzek in Bruzek's flat in Freiburg in the early 1970s. Bruzek's landmark (Bruzek, 1964) paper on two-ribbon flares and loop prominence systems provided the observational underpinning for the standard Carmichael/Sturrock/Hirayama/Kopp and Pneuman (CSHKP) model of eruptive flares (Švestka and Cliver, 1992; Sturrock, 1992).



Figure 6 Zdeněk Švestka with Anton Bruzek and Vaclav Bumba in Hong Kong, 1968.



Kiepenheuer. There we became good friends with the family of Anton Bruzek (Figure 5) with whom I made a very interesting trip in 1968 through southern Asia after a conference on solar flares in Tokyo. As I was the organizer of that conference, the trip was some sort of a reward for my work when preparing it and Bruzek and Bumba decided to join me (Figure 6).

Out of all the places where we lived during our life we liked most the village Buchholz, near Freiburg. It is a very interesting part of Germany, which is very close to the borders with France and Switzerland and you can already feel their influences on the “German” style of life. However, the local people around Freiburg very often use dialects which one hardly can understand. When we first came there, our small children learned very fast the Black Forest dialect from the local kids, but we were completely unable to understand what they were saying. It was somewhat embarrassing to see how easily the children communicated with the local people, while we did not understand almost a single word.

As a citizen of a country which was not member of the European Community, I could not get a permanent position in Germany, because that required a complicated bureaucratic procedure which would have taken a very long time. Therefore, in 1974 I left Germany with my family and we moved to the USA, where I worked in the scientific laboratory of the company American Science and Engineering (AS&E) in Cambridge, Massachusetts. That was an exciting time for solar physics as *Skylab* had been launched in 1973 and AS&E had an experiment on it: the S054 X-ray telescope, led by Dr. G. Vaiana. We bought a house in Framingham near Boston.

It was during this period (1975) that I completed my book “Solar Flares” (Švestka, 1976; cited more than 460 times to date (NASA ADS)). In my opinion it was just a very good time to write about this phenomenon, because at that time quite new material about the origin and processes in flares became available thanks to new equipments for their observations. I had always good possibilities to get the newest data, starting with our new flare-spectrograph at Ondřejov and later being employed in institutions which were supporting programs in space research. I had also no problems with publishing this book because our Dutch publisher Reidel had also an office in the United States and knew me well as “*Solar Physics*” editor. He published not only the Journal and this book, but also many proceedings where I participated as a co-editor.

However, slightly less than three years after I arrived there, AS&E, which mainly produced X-ray checking counters for airports, closed its scientific research department and I had to go back to Europe where Kees de Jager offered me kindly a position at the Laboratory for Space Research in Utrecht. Since that time we have been living in Bunschoten, a little town some 40 km from Utrecht.

The Laboratory for Space Research had no ground-based observatory, but had some experiments on satellites and space probes. Thus I could continue my studies of the Sun in X-rays. For that research I needed closer contacts with the US. Therefore, I used the possibility to become a non-salaried research physicist at the University of California in San Diego which was offered to me at the beginning of the year 1979. A short time later, NASA supported my proposal “Analysis of Soft X-Ray Data (S-054 Experiment)”. In the same way more of the proposals in which I participated were later supported through the University and I stayed there usually twice a year for several weeks. After a few years, however, this became somewhat inconvenient. Later, because of the length of my stay abroad I liked to take with me my wife. But then all the expenses combined with these trips were so high that I had actually no real income. At that time NASA had financial problems and my money came, besides from the NSF, mainly from the Air Force (through the USCD). After the onset of the war with Iraq it became difficult for me to get new contracts. At that time the Air Force became less interested in the space between the Earth and the Sun but more in regions much nearer to the Earth’s surface. Nevertheless I succeeded to get a few new contracts till the end of the 1990s. Then my work in America ended, but my successful and fruitful collaboration with San Diego, primarily with Bernie Jackson and Paul Hick, lasted for 23 years.

As editor of an international journal I had very good contacts with scientists throughout the world. Members of the Editorial Board came from Argentina, Australia, Brazil, Canada, China, Czech Republic, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Switzerland, Russia, United Kingdom, and USA. I was also a member of several international organizations and I traveled a lot.

I had some very good students at Utrecht, but according to the rules valid in Holland at that time, I could not have any of them as my assistants for more than three years. The reason was to make free place for newly coming students. And as it was at that time almost impossible to get a job in our field, I lost the assistants then completely, with the only exception of Paul Hick, for whom I succeeded to get a post at the University of California at

San Diego, where I had still reasonably good contacts after having worked there for a long time before.

My frequent moves from one place to another caused no problems for me, because my work was everywhere essentially the same, but my family did not like it much. My wife was not too happy in the States, where some habits differ strongly from those in Europe, and our two children had no real home, they did not know where they belong. Only, when we came in 1989 for the first time to Prague after living in different countries for twenty years they realized that they were Czechs. They enjoyed that all the people around were speaking the same language which we used all the years at home, they participated at the Prague castle at the elections of Havel as president and took part on some other celebrations that happened in Prague at that time. Our son, who was a doctor of artificial intelligence at the University of Utrecht, also liked to wander in the Tatra mountains in Slovakia, but unfortunately died there in 1999, when he, tired after a tour in Siberia, underestimated the mountain dangers and fell down when climbing one of the highest peaks there.

The Dutch people are very kind to newcomers, so that it is easier and much more pleasant for us to live in the Netherlands than in some other European countries, where foreigners remain just foreigners for a long time. Our neighbors here in Bunschoten are from Portugal, behind them again live Netherlanders, but on their other side are people from Surinam – the earlier colony of Netherlands in South America. And on the other side of us lives a Dutch lady with her husband from Scotland.

We were considering several times whether we should return home, to Prague, but even after the communist rule disappeared, we found the life there still very different from the life in the western democratic countries – forty years of communism a short time after the Second World War cannot be so soon “normalized”. I also traveled a lot, mainly to California, and traveling from Amsterdam is much easier than it would be from Prague. My wife just drove me to the Schiphol airport, I took a direct flight to Los Angeles, and twelve hours after leaving my house I could already meet my American colleagues. From Prague there were direct flights only to New York, and the flights were often delayed, so that I may miss the connection to the western coast. Another reason was that our daughter, after her studies at the Theater Academy in London and the studies of singing at the Conservatorium in Amsterdam, wanted to stay in Amsterdam where she lives and works, and we did not want to stay far from her. Thus we eventually decided to stay abroad.

I must admit that Holland is not the ideal country for an emigrating Czech. One misses here mountains and even low hills, and weather is mostly characterized best by wind and rain. Also, being so close to the sea, there is no typical winter here, such which we were used to in Prague. Days with snow are very rare, if any, and the snow never stays long. But, as I said, the Dutch people are very kind and friendly, so that the life here is quiet and pleasant. And one has to admire how they have managed to make from this flat land an attractive and rich country.

4. Travels

My first trip abroad, from Czechoslovakia, was in 1954 to Russia, when I became a member of a team sent to Caucasus to observe the full eclipse of the Sun. We were located in Kislovodsk and had our instruments on a platform near a small solar observatory built by Slava Gnevyshev (Figure 7), with whom I and my wife were good friends. I shared with Milan Blaha a small telescope, equipped for measurement of the polarization of the solar corona. Other people had their instruments in Pjatigorsk, where the weather forecast was

Figure 7 M.N. (Slava) Gnevyshev in 1954, in a Caucasus costume on his horse in front of his Mountain Observatory. Gnevyshev was the founder and Director of the Kislovodsk High-altitude Station of the Pulkovo Observatory.



better for that part of the day when the eclipse should occur. However, during almost the whole total eclipse the Sun was completely covered by clouds there, while we could at least see it through a cirrostratus. We found a very high polarization of the corona, but it was obviously caused much more by the clouds through which the light had to come to us than by the Sun itself. Nevertheless our observation had some importance, as it indicated that also during other eclipses in which the polarization of the corona was observed and measured it could have been to great extent caused by the Earth's atmosphere through which the solar light went to us.

Then, in 1955 I traveled first to the western world, to England, to participate in a meeting of radio astronomers at Jodrell Bank and after that to Dublin in Ireland where the IAU General Assembly took place. My co-travelers were two older astronomers, Šternberk and Guth, and Mirek Plavec, only five days older than I am. We have enjoyed this trip very much and had many photographs from it. The life there looked at that time very differently from the life in our country.

I was many times in Moscow, to participate in conferences and also to take part in some regional meetings which did not interest me at all. Moreover, while I really liked Petrograd (Leningrad), I cannot say that I liked Moscow. Only the Arbat street I found really nice and reminding the Russia described by Tolstoy and other old Russian writers, but the Soviets rebuilt even large parts of its surroundings into an unattractive modern town. It might be perhaps more comfortable for the inhabitants, but still I doubt that they really liked it. In any case, the attractiveness of the old Moscow has been lost.

During these Moscow meetings Slava Gnevyshev took me twice by a night train to the Pulkovo Observatory near Petrograd, at that time Leningrad, just for one day, while my colleague Praus, who usually shared a hotel room with me, arranged my bed in the morning so that it looked like that I was sleeping there that night. However, Pulkovo reminded me

more a big factory than a scientific institute. I have realized there that making an observatory bigger does not necessarily mean that one makes it more efficient. Obviously, everything has its optimum size: if too small, it cannot do everything well; and if too large, it begins to spend more time on its maintenance than on the purpose for which it has been built. But Gnevyshev also took me to some very nice places in the surroundings, like the palaces and parks built by the Russian tsars and fortunately either not destroyed during the revolution or rebuilt again in their original form.

Very interesting was my trip to China in 1962, with Kopecký from Ondřejov, where we gave a series of lectures at the Purple Mountain Observatory near Nanjing and at the Nanjing University. An enormous surprise waited for us at the Observatory. They took us there into a large dark room and when lights appeared we found an almost exact copy of our own multi-camera solar spectrograph. We have described our spectrograph in full detail in the *Bulletin of the Astronomical Institutes of Czechoslovakia* and the Chinese followed this description to every single detail. For a while we felt we were at home. During that trip I made a movie which might have been very good but, unfortunately, one of the nice buildings which I put on it were military headquarters (about which I had no idea, of course) and secret policemen guarding it confiscated my camera. I got it eventually back, but the film inside, which they checked, was badly damaged, because they used a wrong developer for my colored film. And parts of it were cut off.

5. Organizing Activities

I had for many years a very good cooperation with Abbé Paul Simon (Figure 8), a solar physicist in Meudon, with whom we organized some international projects, like, for example, the Quiet Sun Year. Looking backwards, I do not think that these cooperative studies brought many new scientific results, but they helped very much for starting and keeping contacts with scientists in the USSR, China, and all the other countries where at that time inhabitants were rather isolated from the free world. We opened for them, as I said once elsewhere, a “window to the west”.

As the chairman of the Working Group 2 of IUCSTP I organized a “Proton Flare Project”, aimed at better understanding of the sources of energetic particles on the Sun. The idea was to check whether we can forecast a strong particle event and if so, to concentrate then on it through intense observational efforts by all accessible means. The project was a success, due to a broad interest of scientists throughout the world, and also to several good forecasts of solar activity made by Abbé Simon and his coworkers in Meudon. For example, after one successful forecast, the participants succeeded to launch a SPARMO balloon just in time for a strong cosmic ray event. The results of all cooperative studies were published in IQSY Annals as a separate Volume 3 and summarized by Paul Simon and myself in several articles in *Solar Physics*. In appreciation of the success of this Proton Flare Project I received as the project leader in 1968 in New York the Guggenheim Award in Astronautics but, of course, this award should have been given to the whole team of scientists who participated in it. This short trip to New York was for me very thrilling. Precisely the same day, when I received the award in New York, our son Petr was born in Prague. It was short time after the Soviet invasion to Prague took place and Soviet tanks were still staying at some quiet places in Prague waiting for new orders after the so called “Prague Spring”. One of the places was very close to the entrance of the hospital where Petr was born.

In 1968 I was the chairman of the Program Committee of the COSPAR Symposium in Tokyo, on “Solar Flares and Space Research”, and I co-edited its proceedings jointly with

Figure 8 Zdeněk Švestka with Paul Simon in the Loire Valley.



Kees de Jager. Six years later, in 1974, I was member of the Program Committees of the IAU Symposium No. 68 on Solar Gamma-, X-, and EUV Radiation in Buenos Aires, and the IAU-IUGG-COSPAR Symposium on Solar-Terrestrial Physics in Sao Paulo. In Buenos Aires I had to organize the symposium replacing the original Program Committee Chairman who was unable to attend it, and in Sao Paulo I prepared, jointly with Leen de Feiter, the program of the solar sessions.

The following year, 1975, I organized a workshop on the “Flare Build-up Study” in Falmouth in Massachusetts, and edited its Proceedings. They appeared in *Solar Physics* Volume 47. A second workshop on this topic was held in Boulder, Colorado, two years later. We tried then to organize cooperative observations all over the world in 1979/1980 including the participation of space probes, but we were not as successful as we would have liked to be. Those observatories which had only limited instrumentation usually participated readily and gladly in the project and obediently carried their observations during the organized alarm periods, but the best equipped observatories mostly ignored the alarms and preferred their own programs. And the same was true for the sophisticated satellites and space probes, as we did not succeed to convince those who operated them about the importance of coordinated studies. After all, it was understandable, because their programs were planned and prepared before, and they were unwilling to modify them. I realized that, if I were one of the operators, I would most probably do the same.

A short time after I moved with my family from the Netherlands to Germany (at the beginning of 1972) we lost our Czech nationality and got from the United Nations passports as emigrants. Some colleagues whom I met a short time later were surprised about my decision and thought that I shall lose my international positions. I am very glad that this didn't happen, in great part thanks to my good friends abroad. We got passports from the United Nations and ten years later we also got Dutch passports. Eventually after the “Velvet Revolution” in our country in 1989 we added to them also again Czech ones. Nevertheless, during the whole period when we were changing the countries where we lived and when I was having a variety of personal documents I had, without any interruption, from 1973

till 1986 permanent positions in COSPAR either as chairman of a working group or as a representative to SCOSTEP's SMA Program and I also had a few other posts in SCOSTEP. My last international job was in 1991 as co-chairman in Program Committee of IAU Colloquium on Eruptive Solar Flares in Iguazu in Argentina. My greatest disadvantage was that the whole period from 1972 till 1989 I could never visit my native country and that I didn't dare to take part of any events which took place in other communistic countries.

6. Scientific Interests

When I began at Ondřejov, I was not interested only in the Sun, but I could make only such other studies which did not need any expensive instrumentation. Thus my first papers (Švestka 1948a, 1948b) were concerned with the photometry of the Earth's shadow during eclipses of the Moon. By adding diffusion to the theory of refraction and by taking into account the occurrence of clouds along the terminator, I was able to explain most of the anomalies observed in the brightness distribution within the shadow. But these were not studies of much importance for the astronomical community and some other studies which I made lost very soon their significance. Thus, for example, I have developed a method which could discover a dust layer in the Earth's atmosphere by measuring polarization of the sky in the zenith during the sunset, but satellites coming soon after that made these studies immediately obsolete.

I also had a long-time interest in variable stars – I began to observe them when I was 16 years old. Thus I published a paper (Švestka, 1954) with a list of stars for which I predicted that they may show flare-like brightenings and, indeed, a great majority of them really did it in the following years. But a few did not, so that my criteria obviously were good, but not perfect.

Thereafter, however, my predominant interest has been in solar physics and in the study of solar flares in particular. Before 1959 I had only flare observations in H-alpha and the H-alpha line profiles at my disposal and that yielded only limited information about the physical conditions in flares. Nevertheless, it was possible to get at least some insight about the physical state in the flaring region (Švestka, 1956) and it could not be entirely wrong, because quite independently Jefferies in Australia (Jefferies, Smith, and Smith, 1959) made a similar study and our results showed much agreement.

This situation has improved very much when I could see and photograph at the same time more lines of the Balmer series and several other important parts of the flare spectra. However, the highest Balmer lines and the Balmer continuum needed much longer exposure times than the lines in the visible region, and that brought still some uncertainty in the evaluation of the whole flare spectrum.

Another problem has been the interpretation of the occurrence of white-light flares (Švestka, 1970b). It has been mostly believed that they are caused by particle streams coming from the corona, but it was not clear whether these were protons or electrons, and also the long duration of some of these brightenings has been a problem.

I have identified in the literature (Švestka, 1966) several tens of solar proton events prior to the year 1956, when riometers began to study them. This made it possible to study their occurrence through several solar cycles and to show that they avoid the phase of the highest solar activity – they are most frequent during the rise and decline of a solar cycle shortly before and after the solar maximum. Strong particle acceleration was found only in magnetically complex active regions. The acceleration of protons appeared closely associated with

Type IV and Type II radio bursts and the association with Type II (Švestka and Fritzzová-Švestková, 1974) has supported the idea that the second acceleration step in flares is a stochastic acceleration behind shock waves.

Many particle increases occurred after the Earth crossed sector boundaries, even when no flares were observed in those sectors (Švestka *et al.*, 1976). This has shown that there must be also other sources of particle acceleration than solar flares. These discoveries of non-flare particle increases and of the Type II burst association with proton flares were made possible by using an extensive catalogue of particle events (Dodson *et al.*, 1975), prepared by a group of solar physicists and space scientists from USA, USSR, France, and Japan and edited by myself and Paul Simon. In particular, Dr. Helen Dodson-Prince and her coworkers in Michigan contributed a lot to this enterprise.

The latest period of my studies was concerned with interpretation of soft X-ray pictures of the Sun obtained on *Skylab* and SMM (by the Dutch HXIS instrument), and later on the Japanese *Yohkoh* satellite. At AS&E, we found that coronal loops visible in X-rays often interconnect active regions over distances as large as 30 degrees, rather surprisingly even across the equator, thus marking complexes of solar activity (Chase *et al.*, 1976; Švestka *et al.*, 1977). This was a different view of the Sun than from my early years at Ondřejov when active regions appeared as isolated islands in H α images. In most cases the large X-ray loops did not seem to be newly born, but they existed as magnetic connections before and became visible when a new magnetic flux emerged near one of their footpoints. It appears that close-by regions may be sometimes “sympathetic”, showing synchronized activity (Fritzzová-Švestková, Chase, and Švestka, 1976). I studied large-scale loops for many years with colleagues including Brian Dennis, Bob Howard, Hugh Hudson, Sara Martin, Giannina Poletto, Aert Schadee, Ron Stewart, and many others (e.g., Howard and Švestka, 1977; Švestka *et al.* 1982a, 1982b, 1983, 1989a, 1989b, 1995, 1998; Schadee, de Jager, and Švestka, 1983; Švestka 1984, 1989, 1996; de Jager and Švestka, 1984; Hick and Švestka, 1985; Švestka and Poletto, 1985; Martin and Švestka, 1988; Fárník, van Beek, and Švestka, 1986; Fárník, Karlický, and Švestka, 2001; Šimberová, Karlický, Švestka, 1993). With HXIS data, I discovered the loop shrinkage phenomenon by comparing the altitude of newly connected loops seen in X-rays with the altitude of cool and dense H α loops that likely represented their remnants. Both loop shrinkage and their accompanying density increase have become standard components in the reconnection scenario (Švestka *et al.*, 1987).

I also cooperated with scientists from Ondřejov, mainly with František Fárník, but also with Marian Karlický, Stanislava Šimberová, and Petr Heinzel. Beginning in 1984 Fárník was coming quite regularly to the Netherlands and we worked together on large coronal structures (flare arches, X-ray bright surges and coronal post-flare loops), mainly using *Yohkoh* SXT images. Petr Heinzel has re-vitalized the Ondřejov flare spectrograph (Figure 9) and together we used the new spectra to reinvestigate the line asymmetries (Heinzel *et al.*, 1994). My last paper (Švestka, 2007) written at the request of an IAU Working Group on Solar Terminology was on the misnomer of the term “post-flare loops”. They really are the flare loops (or post-eruption flare loops).

In looking back on my career, I was very lucky that I became twice a member of an institute which was just at the top in the studies of the Sun. First when I was employed by the American Science and Engineering who had an experiment on *Skylab* – the first solar satellite with an astronaut aboard who could make extremely interesting observations following instructions from the ground – and then in Utrecht in the Netherlands, where I replaced Leen de Feiter after his unfortunate death, operating a Dutch instrument on the *Solar Maximum Mission* satellite. And I was also some sort of a consultant for the Japanese solar satellite *Yohkoh*, which observed the Sun for almost a decade.

Figure 9 A young Petr Heinzel, current Director of the Ondřejov Observatory, at the coelostat of the new flare spectrograph.



Several years ago, in an interview for Czech radio, I was asked what I thought was the most important piece of technology helping me in my work. I answered: “... *I think that one very important thing is the existence of satellites, spacecraft, because spacecraft can observe in regions of the spectrum, which we cannot see from the Earth’s surface, and this brought quite new information about the Sun and without that we wouldn’t know what we know now. And of course, another thing are computers. We couldn’t compute conditions in flares or coronal mass ejections and other phenomena without computers where the programmes make it possible to get the results within minutes, whereas before we spent weeks computing it by hand and by some machines which were hand-manipulated only.*”...

During the years 1948–2007 I published more than 200 scientific papers in *Solar Physics*, *Bulletin of the Astronomical Institute of Czechoslovakia*, Nobel Symposium 9, COSPAR Symposium (1969 and 1972) Proceedings, ESTEC Symposium 1970, *Philos. Transactions Roy. Soc. London*, *Izv. Krymsk. Astrofiz. Observatory*, *Nature*, *Mitt. Astron. Gesellschaft*, *Space Research*, *Space Sci. Reviews*, *Forschungsber. d. Deutschen Forschungsgem.*, *IQSY Annals*, *IAU Sympos. 35*, *Publ. Astron. Inst. Czech Acad.*, and, as mentioned above, I also wrote two books: “Catalog of Solar Particle Events” with P. Simon in 1975, and “Solar Flares” in 1976, as well as a few astronomical books in the Czech language.

At the end of this section, I would like to say that I am very glad that I had the opportunity to work with so many colleagues and always in a friendly atmosphere. Starting with Link, there are too many to mention by name. My main wish here is to thank all coauthors for the cooperation. My wife Lida didn’t want to be mentioned, but I have to thank her for many things.

7. Epilogue

Being now 84 years old, I do not do scientific research anymore, because I get soon tired and cannot read all the current literature which makes any scientific work essentially impossible. But I still follow with great interest all the new issues of the journal “*Solar Physics*” which we founded with Kees de Jager 45 years ago, assisted by our first very efficient secretary Sophie van der Waai. Looking backwards, I have to say that I am very glad that I got the opportunity to start with Kees this journal. We stayed chief editors for many years and all the time our cooperation was running without any disturbing problems. In 1987 Bob Howard



Figure 10 On the occasion of the recognition of the contributions of Zdeněk Švestka to solar physics at the IAU General Assembly in Prague in 2006. This photograph is notable for its concentration of six past and present Solar Physics Editors. Left to right: František Fárník, Dave Webb, John Leibacher, Oddbjorn Engvold, Lidia van Driel-Gesztelyi, Jiri Grygar, Zdeněk Švestka, Harry Blom, Lida Fritžová-Švestková, Takashi Sakurai, Jean-Claude Pecker, Petr Heinzel, Luboš Perek and Cornelis de Jager.

in Pasadena was added to the two of us and that provided the journal with closer ties with the solar community in America. From that time we continued our work permanently in a team of three. When Kees retired, it was Oddbjorn Engvold, who replaced him, and a few years later Jack Harvey replaced Bob Howard. I am glad that in spite of these changes our cooperation remained unharmed and harmonious. In 2005 all three of us passed the whole “chief editorial job” to a completely new excellent team well known to everybody at the present time (Figure 10). I cannot omit to mention Harry Blom who surely played a very important role in making our communication and cooperation with the publishing company during so many years very good and without any problems.

But I believe that I have right now to relax and do my hobbies, like reading interesting books, planting cacti and other succulents, and following some programs, many of them quizzes, on the TV.

References

- Bruzek, A.: 1964, *Astrophys. J.* **140**, 746.
 Chase, R.C., Krieger, A.S., Švestka, Z., Vaiana, G.S.: 1976, *Space Research XVI*, Akademie-Verlag, Berlin, p. 917.
 de Jager, C.: 1996, *Solar Phys.* **169**, 443.
 de Jager, C., Švestka, Z.: 1984, *Solar Phys.* **100**, 435.
 Dodson, H.W., Hedeman, E.R., Kreplin, R.W., Martres, M.-J., Obridko, V.N., Shea, M.A., Smart, D., Tanaka, H., Švestka, Z., Simon, P., Fritžová-Švestková, L., Guitart, A.: 1975, *Catalog of Solar Particle Events, 1955–1969*, Švestka, Z., Simon, P. (eds.) *Astrophys. Space Sci. Library* **49**, Reidel, Dordrecht.
 Fárník, F., van Beek, H.F., Švestka, Z.: 1986, *Solar Phys.* **104**, 321.
 Fárník, M., Karlický, M., Švestka, Z.: 2001, *Solar Phys.* **202**, 81.

- Fritzová-Švestková, L., Chase, R.C., Švestka, Z.: 1976, *Solar Phys.* **48**, 275.
- Heinzel, P., Karlický, M., Kotrč, P., Švestka, Z.: 1994, *Solar Phys.* **152**, 393.
- Hick, P., Švestka, Z.: 1985, *Solar Phys.* **102**, 147.
- Howard, R., Švestka, Z.: 1977, *Solar Phys.* **54**, 65.
- Jefferies, J.T., Smith, E.V.P., Smith, H.J.: 1959, *Astrophys. J.* **129**, 146.
- Martin, S.F., Švestka, Z.: 1988, *Solar Phys.* **116**, 91.
- Pecker, J.-C.: 1999, *Solar Phys.* **184**, 1.
- Schadee, A., de Jager, C., Švestka, Z.: 1983, *Solar Phys.* **89**, 287.
- Šimberová, S., Karlický, M., Švestka, Z.: 1993, *Solar Phys.* **146**, 343.
- Sturrock, P.A.: 1992, In: Švestka, Z., Jackson, B.V., Machado, M.E. (eds.) *Eruptive Solar Flares*, Springer, Berlin, 397.
- Švestka, Z.: 1948a, *Bull. Astron. Inst. Czechoslov.*, **1**, 29.
- Švestka, Z.: 1948b, *Bull. Astron. Inst. Czechoslov.* **1**, 48.
- Švestka, Z.: 1954, *Bull. Astron. Inst. Czechoslov.* **5**, 4.
- Švestka, Z.: 1956, *Bull. Astron. Inst. Czechoslov.* **7**, 130.
- Švestka, Z.: 1966, *Bull. Astron. Inst. Czechoslov.* **17**, 262.
- Švestka, Z.: 1970a, *Solar Phys.* **12**, 332.
- Švestka, Z.: 1970b, *Solar Phys.* **13**, 471.
- Švestka, Z.: 1976, *Solar Flares*, Reidel, Dordrecht.
- Švestka, Z.: 1984, *Solar Phys.* **94**, 171.
- Švestka, Z.: 1989, *Solar Phys.* **121**, 399.
- Švestka, Z.: 1996, *Solar Phys.* **169**, 403.
- Švestka, Z.: 2007, *Solar Phys.* **246**, 393.
- Švestka, Z., Fritzová-Švestková, L.: 1974, *Solar Phys.* **36**, 417.
- Švestka, Z., Fritzová-Švestková, L., Nolte, J.T., Dodson-Prince, H.W., Hedeman, E.R.: 1976, *Solar Phys.* **50**, 491.
- Švestka, Z., Krieger, A.S., Chase, R.C., Howard, R.: 1977, *Solar Phys.* **52**, 69.
- Švestka, Z., Hoyng, P., van Tend, W., Boelee, A., de Jager, C., Stewart, R.T., Acton, L.W., Bruner, E.C., Gabriel, A.H., Rapley, C.G., et al.: 1982a, *Solar Phys.* **75**, 305.
- Švestka, Z., Dennis, B.R., Woodgate, B.E., Pick, M., Raoult, A., Rapley, C.G., Stewart, R.T.: 1982b, *Solar Phys.* **80**, 143.
- Švestka, Z., Schrijver, J., Somov, B., Dennis, B.R., Woodgate, B.E., Fuerst, E., Hirth, W., Klein, L., Raoult, A.: 1983, *Solar Phys.* **85**, 313.
- Švestka, Z., Poletto, G.: 1985, *Solar Phys.* **97**, 113.
- Švestka, Z., Fontenla, J.M., Machado, M.E., Martin, S.F., Neidig, D.F. Jr.: 1987, *Solar Phys.* **108**, 237.
- Švestka, Z., Jackson, B.V., Howard, R.A., Sheeley, N.R., Jr.: 1989a, *Solar Phys.* **122**, 131.
- Švestka, Z., Fárník, F., Fontenla, J.M., Martin, S.F.: 1989b, *Solar Phys.* **123**, 317.
- Švestka, Z., Cliver, E.W.: 1992, In: Švestka, Z., Jackson, B.V., Machado, M.E. (eds.) *Eruptive Solar Flares*, Springer, Berlin, 1.
- Švestka, Z., Fárník, F., Hudson, H.S., Uchida, Y., Hick, P., Lemen, J.R.: 1995, *Solar Phys.* **161**, 331.
- Švestka, Z., Fárník, F., Hudson, H.S., Hick, P.: 1998, *Solar Phys.* **182**, 179.