PERSONALITIES WHO HAVE CONTRIBUTED TO THE DEVELOPMENT OF OUR SPECTROCHEMISTRY

Eduard Plško

Donská 97, SK 841 06 Bratislava

Unlike in sports or art, names of scientists use to be cited rarely and if so only in pure scientific works and books having only a limited circle of readers. This situation results in a state when personalities of the science are practically unknown and eventually forgotten in spite of their incomparably greater merits for the development of human culture as compared with generally known names of football, ice hockey, tennis players or actors, musicians, singers etc. As an example, the following list of officially chosen most popular Slovak personalities in 1997 can serve as an evidence for this statement: 3 sportsmen, 3 artists, 1 economist and 1 church dignitary, but no scientist.

Therefore, I would like to devote this lecture, presented at least in our closed community of experts to some personalities who essentially contributed to the development of Slovak spectrochemistry and to helping their popularity in order to make them known also for our younger generation which have not had the opportunity to meet them personally and so to prevent their full oblivion. For the sake of time I disposewith I restrict my recollection only on atomic optical emission spectroscopy in the time period till 1970.

As already stated in different contributions dealing with the history of our spectrochemistry, as first pioneers of optical emission spectroscopy in Slovakia *Dr. Ing. Ferdinand Králik* from Zbrojovka Považská Bystrica with his contribution to analysis of electrically conductive metallic samples and *RNDr. Gejza Kupčo, CSc.* from the State Geological Institute in Bratislava and his contribution to analysis of electrically non conductive powdered geological samples can be mentioned.

Their activities began straight after the end of the Second world war. In the sixties several spectrographic methods for geochemical use were worked out by *Doc. RNDr. Ján Jarkovský* from Comenius University in Bratislava.

The development of spectrochemistry itself dedicated to study of some basic problems important for utilization of atomic spectra for analytical application started, however, later, so in mid fifties and is connected with *Prof. Ing. Mikuláš Matherny* 's and my experimental and theoretical activities focused on the postulation of some more general and basic relations. These activities have successively outgrew in the formation of two spectrochemical schools, one in Košice and the other in Bratislava. The beginnings were extraordinally hard: lack of instruments and skilled coworkers, practically no scientific information, contacts, reagents, restricted possibilities to travel abroad etc. Only one thing was of extreme power: our unconquerable will supported by enormous enthusiasm of young people to demonstrate that we are not worse than the others and that we are able to gain a corresponding recognition of our results achieved despite the existing difficult conditions. Beside the mentioned material problems there were also other problems to overcome. Leading spectroscopists from Prague the so called „chemogods" oriented on molecular spectroscopy underestimated namely atomic spectroscopy and forced us to the study of atomic structure, quantum mechanics, theory of spectra etc. and it was not a simple task to convince them that these things are practically irrelevant for spectrochemistry oriented on analytical problems, and to create corresponding position for our intentions. On the other hand we had good contacts with Czech

spectrochemists oriented on atomic emission spectroscopy with analytical application and we had their full support and necessary help. In this connection it is necessary to name e.g. *RNDr. Jaromír Litomiský, CSc., RNDr. Ivan Rubeška, CSc., Ing. Jaroslav Poláček, Ing. František Valška* with whom a fruitful cooperation existed for many years.

As a significant break in the formation of Slovak spectrochemistry the following story which happened at the end of 1958 or beginning of 1959 has to be presented.

I remember as if it was only some days ago, I met my good fellow *Mikuláš Matherny* at the entrance to the Institute of Buildint Materials in Heyduk street in Bratislava. He asked me the following questions: „Edo, what do you say to the idea to organize a spectroscopic conference with participation of foreign scientists ? If you agree, do you want to coorganize it with me ? „ I enthusiastically consented to his questions and accepted his offer with no hesitation. After this talk we immediately started with the necessary preparations which were crowned by the 2nd Czechoslovak Spectroscopic Congress in Tatranská Lomnica in autumn 1959.

We were surprised by the enormous interest. Even the particitation from abroad was numerous and representative but unfortunately only from neighbouring people's democracies. Beside Czechoslovak participants the most numerous participation came from Hungary. Among the Hungarian participants it is necessary to name the world-wide recognized expert in spectrochemical analysis *Prof. Dr. Tibor Török*, from the L. Eötvös University in Budapest, author of a well known Compendium on Emission spectrochemistry (-theory, II- practice) together with *Prof. Dr. Károly Zimmer* from the same University who also attended the conference, the outstanding researchers in photographic photometry. Perhaps the most fruitful collaboration of *Prof. Matherny's* group oriented mainly on the problems of blackening transformations with both these Hungarian scientists resulted in numerous commonly published works. In this connection essential contribution of *Prof. Ing. Karol Flórián* represented by application of computers has to be mentioned, too. This positive collaboration worked for several decades and has survived practically till these days. *Prof. Zimmer* was wery fond of coworking with Slovak collegues and contributed with his active participation in numerous events organized in our country not only scientifically but also socially to their success. Among the Hungarian collegues participating in Tatranská Lomnica, *Prof.Dr. Ernö Pungor*, from the Technical University in Budapest, a known specialist in flame photometry and excellent organizer of Hungarian spectroscopy (for some years he served as minister for science) and supporter of the collaboration with our scientists contributed in following years with his lectures and advices to the development of our spectrochemistry too.

Several prominent scientists could be found in the delegation from German Democratic Republic participating in Tatranská Lomnica. First of all it was *Prof. Dr. Rudolf Ritschl*, director of the 1st Physical Institute of Humboldt University in Berlin. As earlier assistent of Nobel prize winner *James Franck* in Göttingen and coworker of *Friedrich Paschen* and another Nobel prize winner *Johannes Stark* in the State Physical-Technical Institute in Berlin his field of scientific interest was focused on the excitation by electron impact, optical spectra, high frequency and impulse technique. There are not many experts who know that *Prof. Ritschl* was involved also in research of forbidden transitions with the aim of cumulatintg energy in atomic systems represented by ruby monocrystals produced by E.K. Bitterfeld in other words in lasers. In 1960 his working group was overtaken in invention of lasers by better equipped and supported *T.H. Maiman* in U.S.A. only by some months as compared with the construction of the first ruby laser in Berlin by *Prof. Ritschl's* coworker *Dr. K. Lenz*. On the basis of his activities and achieved results *Prof. Ritschl* is considered as one of the best German spectroscopists in the first decades after the 2nd world war. He was a scientific capacity and a noble gentleman. His knowledge, contacts, position and efforts in supporting

young scientists opened the door not only of his Institute where apart from me also my doctorand *Doc. RNDr. Žofia Rybárová* had the opportunity of a useful study stay, but the door of practically all GDR institutions.

Among the outstanding particpants from GDR I want to name also *Prof. Dr. Paul Görlich* from Berlin whose merits in the field of photoelectric detectors are internationally appreciated. From Carl Zeiss Jena compny *Dr. Heinrich Scheller* participated, expert in analysis of metals, author of a book on spectral analysis and constructor of spectral instruments, as well as *Dr. P. Kröplin* who presented in Tatranská Lomnica the first information on the new 2m grating spectrograph PGS-2 which served later for decades as instrument of excellent optical qualities to all our spectrochemists and in some laboratories it has served even till now. Last but not least at that time young scientist who played a significant role in the development of our spectrochemistry by her thirty years of uninterrupted excellent collaboration with my working group in the field of thermochemical reactions, *Prof. Dr. Ruth Rautschke* from the Martin Luther University in Halle took part in Tatranská Lomnica too. This collaboration enabled many, even longer study stays on both sides, working on common projects, mutual information concerning results, exchange of lectures and other activities.

Concerning other participants in the Conference of Tatranská Lomnica, scientists from capitalist countries had at that time no necessary confidence yet in our beginning spectrochemistry owing to restricted and sometimes even deformed information concerning the level of our universities and consequently also our scientists. Western producers of spectroscopic instruments and utensils have already been more progressive, so that Cameca /*J. Astruc*/ from France, Optica Milano /*H. Bückert* / from Italy and Ringsdorff Werke / *Dr. H. H. Rüssmann* / from Federal Republic Germany participated in the conference. All these commercial contacts were positive and durable. The first electron microprobe in Slovakia was a product of Cameca. Optica Milano sold more automatic spectrometers to Czechoslovak metallurgical industry and the first grating spectrophotometer in our country to the Slovak Academy of Science. *Dr. Rüssmann* supplied our spectroscopists with carbon and graphite electrodes and on the basis of good personal contacts with *Ing. Štefan Melluš, CSc., Ing. Gustáv Štrbavý, CSc.* and *Ing. Štefan Országh* from Electrocarbon Topoľčany he supported with his experiences the later production of high quality spectral electrodes and appreciated mainly the production of our boron - free carbon electrodes.

Apart from that also Hungerian producers exhibited modern powerful electronically controlled excitation sources developped by *Dr. Árpad Bardócz* which were purchased by some of our laboratories and among others enabled the application of progressive time resolved spectroscopy used in my working group also for elucidation of the mechanism of sifter electrodes applied by *Doc. Dr. Julian Czakow* from the Institute of Nuclear Research in Warsaw with whom I made good contacts through *Prof. Dr. Leon Pszoniczki* from the same Institute who also participated in Tatranská Lomnica.

The whole proceedings of the Conference inclusive full text of discussions were published in Acta Geologico Geographica Universitatis Comenianae and the meeting started a regular series of similar conferences organized till 1965 yearly in an other People's Democracy (1960-Hungary, 1961-Poland, 1962-GDR, 1963-suspension because of Colloquium Spectroscopicum Internationale in Yugoslavia, 1964-Romania, 1965-Czechoslavakia) and with some breaks and reorganizations it has continued with the name CANAS till now.

This is an extraordinary successful summary of the courageous project of two 29 years young enthusiasts to organize the described conference practically without any necessary experiences. As it is described here this conference represents a crucial point in the formation and fortifying of many decades lasting cooperations and personal frienships of spectroscopists and by these results contributed basicly to the development of our spectrochemistry. In this

direction it was positively rated also by foriegn scientists and professional press. These are the reasons I gave a ralatively greater space to the description of contributions to our spectrochemistry resulting from the organization of this Conference

Encouraged by the extraordinary positive results of the Spectroscopic Congress in Tatranská Lomnica and armed by new contacts and experiences I decided to organize after four years i.e. in 1963 a comparatively smaller „Symposium on the excitation fo optical spectra of powdered electrically non conducting samples " with an aim to break the division between scientists from socialist and capitalist countries and to bring them together to common work and I was very happy when in Smolenice for the first time in the modern history charcterized by the political division of Europe beside of other participants the following known spectroscopists had the oportunity to meet: From the People's Democracies there were *Dr. Gottfried Holdt from GDR, Prof. Dr. K. Zimmer* from Hungary, *Dr. Božena Strzižewska* from Poland, *RNDr. Jaromír Litomiský, CSc., Ing. Vratislav Svoboda, CSc., RNDr. Ján Mráz, CSc., Prof. Ing. Mikuláš Matherny* and myself from Czechoslovakia. From western countries we welcame so famous experts as *Prof. Dr. Kurt Laqua* head of Optical spectroscopy in Institute for Spectrochemistry and applied Spectroscopy in Dortmund FRG and world - wide recognized capacity in the field of spectrochemical analysis with arc, spark, glow discharge and later wih ICP excitation, known expert in chemometric evaluation of spectroscopic results and author of numerous basic publications covering practically the whole area *Prof. Dr. Hans Joachim Eichhoff*, expert in the application of holow cathode excitation from the Johannes Guttenberg University in Mainz FRG, *Prof. Dr. Erich Schroll* specialist in geochemical applications of spectroscopy and one of the founders of the new scientific branche - analytical geochemistry, from the State Experiment and Research Institute in Vienna Austria, *Prof. Dr. Paul, Willy, Joseph, Maria Boumans* from the University in Amsterdam Netherlands who has later become world known expert in optical emission spectroscopy with inductively coupled plasma and author of well known books on electric arc and ICP as spectroscopic sources, *Dr. Jacques Baudin* an outstanding spectroscopists in the field of nuclear materials from the Nuclear Center in Grenoble, France. The whole number of participants was about 60. Invited lectures were published in a special issue „Rozpravy" of National Technical Museum in Prague and original contributions in Collection of Czechoslovak Chemical Works.

As results of contacts strenghtened during the described Symposium, in the following years a useful colaboration with *Dr. Holdt*, author (together with *Albertus Strasheim* from Pretoria South Africa) of the revolutionary concept of scatter diagrams for the statistical evaluation of spectral line pairs homology was created and both our spectrochemical schools contributed to the application of scatter diagrams; in Košice by a more accomplished use of computers and in Bratislava by involving self absorption parameters and finally by precise determination of their restrictions.

A good and durable cooperation was established also with *Prof. Eichhoff* and *Prof. Laqua* who enabled several even long lasting study stays to our spectrochemists in FRG. *Prof. Laqua* contributed essentially to the development of our spectrochemistry by his numerous consultations and lectures presented in Slovakia on different basic for our further development important items.

After the Symposium in Smolenice, the already recognized Slovak spectrochemistry created further contacts with several outstanding personalities of European spectrochemistry.

In this connection it is necessary to name *Prof. Dr. Hubertus Nickel* from the Technical University in Aachen and director of the Institute for Reactor materials in Jülich FRG with whom a durable effective cooperation was established. He has been an excellent expert in the application of spectroscopy in material science, in magnetic stabilization of arc discharge and in investigation of thermochemical reactions enabling direct analysis of non volatile components

in solid samples. He supported systematically our spectrochemists and Technical University in Košice with which he had extremely good and fruitful contacts appreciated his activities with granting of the title „Doctor honoris causa"

The same applies also for *Prof. Dr. Sergej Gomiščck* from the University in Ljubljana Slovenija (at that time Yugoslavia), an outstanding specialist in separation preconcentration techniques enabling improvement of selectivity and limit of determination of spectrochemical procedures who cultivated a significant and informal cooperation with my working group which collaboration consisted in solution of common projects exchange of literature, mutual visits of coworkers etc. Through this cooperation many of my coworkers (inclusive collegues from the B. Kidrič Chemical Institute in Ljubljana) spent even longer study stays in the opposite institutions and so gained new knowledge, skill and so enlarged their professional horizont. What concerns this cooperation a great contribution was performed also by further Slovenian collegues as *Prof. Dr. Vida Hudnik, Dr. Alenka Gogala* and others.

At the occasion of the Conference on Emission Spectroscopy (4th CANAS) held in Görlitz GDR in 1962 I met for the first time *Prof. Dr. Vladimir Vukanović* and his spouse of that time *Prof. Dr. Damjana Vukanović* from the University of Belgrade Yugoslavia. He was head of a well equipped, productive, relatively large working group oriented to the investigation of excitation processes in electric arc. After my information on some results obtained with influence of magnetic field on the arc *Prof. Vukanović* started in a short time a comprehensive research of magnetically stabilized arc and for some years collaborated also with *Prof. Nickel* interested in similar experiments. After *Prof. Vukanović* had left Belgrade for U.S.A. these experiments were further developed and continued by *Prof. Dr. Boško Pavlović*. In spite of great efforts, many publications and lectures in several conferences the results of magnetic stabilized arc have unfortunately not moved any producer of spectral instruments to realize this principle commercially.

In this connection it is necessary to mention the Summer school of spectroscopy organized with extraordinary succes by *Prof. Matherny* in 1967 in Košice. At this occasion we had long general discussions with *Prof. Vukanović* of great importance for understanding of processes occuring in electric arc which esencially helped to our further work. The collaboration in research of processes occuring in electric arc used as excitation source between my and *Prof. Matherny's* research group with collegues from Belgrade, including also *Dr. Momir Marinković* from the Nuclear Center in Vinča, constructor of the U shaped gas stabilized arc utilized in Košice by *Doc. Ing. Ladislav Koller*, successfully grew and gradually several discussions, mutual invitations, longer study stays etc. were realized. As acknowledgement of this scientific collaboration with Yugoslav spectroscopists I was in 1994 elected honorary member of the Serbian Chemical Society and at the occasion of its centenary I was awarded with a medal as token of recognition and appreciation.

As a recognition of the high level achieved by our spectrochemistry visits and presentation of lectures by many known and leading spectroscopy stars can be cited. So in 1967 we welcame in Bratislava *Prof. Dr. Heinrich Kaiser*, director of the famous institute of Spectrochemistry and applied Spectroscopy in Dortmund FRG, world-wide acknowledged expert in spectroscopy, whose results belong to the basic contributions to the development of this scientific branch together with *Prof. Dr. Velmer Arthur Fassel*, Deputy director of the U.S. Atomic Energy Commission from the University in Ames Iowa, inventor of ICP analytical applications and in 1969 *Prof. Dr. Heinrich Specker* from the Ruhr University in Bochum FRG one of the authors of the generally accepted definition of detection limit and specialist in preconcentration separation procedures.

In this place, it is unfortunately necessary to mention that from reasons we cannot understand Soviet spectroscopists in this time fully ignored all our scientific activities and despite all our efforts we were not able to create practically any contacts with them.

Another drawback for our spectrochemistry at the end of sixties was emigration of some our hopeful coworkers. The main reasons for this decision were mainly of economical nature. In the they all found good jobs, but according to my knowledge practically nonef them has produced any contribution to the development of spectrochemistry.

This may seem to some listeners or readers a too long, boring and too personal and subjective description which, however, cannot be in any direction considered as complete (excuse me, please, if I omitted somebody). Its aim was not only to avoid the oblivion of the listed personalities having contributed to the development of our spectrochemistry but also to present its level and international position in the corresponding time on which we can be without any modesty proud. I personally deeply dislike very often heard statements of our contemporary public dignitaries that we should open ourselves to Europe and we should vizualize Slovakia. As it is clearly expressed in this lecture we have, despite extremely difficult conditions characteristic for the time in question, never been closed towards Europe and we vizualized our country by our activities perhaps more that many highly celebrated sportsmen and artists. Our slogan read „Who wants, that achieves his goal! ".

Our system for having mastered the described outcome consisted in following rules which have been without any changes valid till now and can serve as useful advices:

1. High, demanding professional level and regular presentation of results in papers and lectures.

2. Knowledge of foreign languages.

3. Organization of and participation in professional meetings with international participation.

4. Building of broad scientific contacts which can overgrow in durable personal friendships.

5. No hesitation in using private funds for literature, participation in scientific events, as well as sometimes even more important social program.

For the validity of these rules as example my membership in IUPAC Commission for Spectral and other Optical Procedures of Analysis can serve where actively participated in preparation of several documents on terminology and nomenclature in duration of 20 years, as well as membership in Advisory boards of Spectrochimica Acta (B) and Journal of Analytical Atomic Spectroscopy, numerous invitations to plenary lectures, hosting round tables, panel discussions, participation in brainstorming discussions etc. what, however, is not only a personal recognition but much more a recognition of our whole spectrochemistry. All these activities are generally not known in broader public and naturally not considered as representation of our country which, as it seems, is reserved only for sportsmen and artist.

Now it would be the time to show, finally, in brief, the main fields in which internationally acknowledged results in optical emission spectroscopy were achieved by our spectrochemistry:

1. Photographic photometry - blackening transformations.

2. Conditions for application of scatter diagrams - reference elements, evaporation curves, computer processing.

3. Excitation of atomic spectra in electric arc - influence of spectral additives.

4. Statistical evaluation of spectroscopic results - optimization, chemometry.

Before conclusion I would like to present at least some statistical data:

Concerning qualification, among the specialist in atomic emission spectroscopy in our country, there are four university professors, three of them are doctors of science and

according to my knowledge there are about 13 candidates of science (PhD) and 4 of them are university associated professors. This relatively broad list of high qualified specialists has, however, a great shortcoming that all (maybe with one exception) are older than fifty and a considerable majority of them even older than sixty!

I do not know any young doctorands in this field in spite of a great and powerful application of this technique (spark in metallurgy, ICP in environment and new high technologies) documented also by corresponding rich participation of specialists in this conference. This state can be ascribed to the situation that in present practical the whole scientific-technical revolution and development is performed in instruments producing firms and their highly computerized and practically perfect products do not render almost any space for additive experimentation or improvements in normal working conditions. Spectrochemistry has so eventually become a mean and not an aim.

I therefore finish my lecture with the bare statement that the described golden age of classic atomic emission spectrochemistry is over and we must be happy that it has been replaced by new, more effective analytical procedures giving a broad challenge for our young collegues and I wish them at least as grand success as we had in the described middle of this ending centrury.

Note: The names of all states are presented in original version. With the names only two actual titles are listed independently on the time when gained. If there are some incorrect data, excuse me please, I tried to do my best.