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PAVEL (P.V.) BLOKH: SCIENTIST AND TEACHER, AND THE FRIEND WE REMEMBER

The paper is dedicated to the memory of Pavel V. Bliokh, an outstanding Ukrainian scientist in the fields of theoretical and radio physics, on the occasion of his 100th anniversary. P.V. Bliokh (PhD, D.Sc, Professor, Honored Scientist of Ukraine) was one of the founders of the "space radio physics" branch of research. While working in that direction, he created a well-known scientific school at the O.Ya Usikov Institute of Radiophysics and Electronics and the Institute of Radio Astronomy, National Academy of Sciences of Ukraine.

Keywords: P.V. Bliokh, National Academy of Sciences, radio wave propagation, space radio physics, Schumann resonances, gravitational lenses, dusty plasma.

This brief note is a humble attempt of paying tribute to the memory of Pavel V. Bliokh (08 March, 1922 — 13 March, 2000), an outstanding physicist/radio scientist and a bright representative of the scientific school and academic community of Kharkiv, Ukraine. Earlier this year, his former colleagues and disciples in Kharkiv and elsewhere intended respecting Dr Bliokh's centenary in the format of an international on-line event on March 8. At the daybreak of February 24 the idea was fatally ruined by the barbaric rushist attack against Ukraine, with "special emphasis" on Kharkiv.

P.V. Bliokh was born into the family of a physician, however preferred becoming a physicist and engineer. Upon leaving high school in 1939 he entered the Military Mechanical Institute in the then Lenin-

grad, which was a heir to the modest pre-revolutionary Handicraft College. In early 1941 a large group of MMI students were transferred to an Air Force Academy and enlisted in the Force. So, on the eve of the Soviet–German war (and a few months into it) P.V. completed his education as a Communications Engineer, and soon afterwards got involved in teaching essentials of radio to cadets of an AF technical college who were to become wireless communication technicians — a novel specialty at the period. At that time, the college was stationed in the town of Syzran on the Volga but later was returned to its place of origin in Kharkiv, Ukraine and granted a higher-level accreditation.

After 1945 the military career of captain, major, and finally Lt-colonel P.V. Bliokh lasted till 1958,

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being uninterrupted by even as challenging an engagement as a five year correspondence course at the School of Physics and Mathematics in the University of Kharkiv. The *cum laude* Diploma in theoretical physics, received in 1951, permitted the Air Force engineer to participate, on a part-time basis, in a number of research projects of the famous UPhTI, the Ukrainian Institute of Physics and Technology (currently the National Science Center "KIPT", National Academy of Sciences of Ukraine). Paradoxically enough, this new activity of the officer greatly annoyed his army bosses, despite the fact that all of the projects that P.V. was involved in were in full correspondence with the profile of the college of his affiliation. Indeed, those projects concerned generation and propagation of electromagnetic waves in different structures and media, being focused on such applications as radar and radio communications. Anyway, through the period between 1952 and 1958 P.V. filed numerous petitions to allow him leave the Army, with the aim of concentrating on research work. All of those reports were rejected by the command of different levels (and with reprimands quick to follow) until the advent of Khrushchev's ill-famed campaign of cutting the Air Force down by about 50 per cent. One positive result of it was that the former Lieutenant-Colonel and Senior Lecturer at the Air Force College of Communications in Kharkiv (KhVAUS) became an ardent research assistant with the Institute of Radio Physics and Electronics (IRE, Acad. Sci. of Ukraine), an institution that had split off the UPhTI only two years before. Roughly one year of intense efforts, under the guidance of Professor Venyamin L. Herman, allowed P.V. to submit and defend a Candidate of Science (\approx PhD) thesis. In 1960 he faced an unexpected necessity of replacing his supervisor and friend in the capacity of Leader of the theoretical laboratory TO-2 within the IRE. Since then, Dr Bliokh *de facto* never changed his place of work, while altering fields of research, preferable frequency ranges, names of the Lab and even institutional affiliations.

During his UPhTI period P.V. was engaged in theoretical studies of VHF radio wave propagation through the atmosphere, with emphasis on realistic models for the non-uniform troposphere (this was done together with Prof. Herman, along the lines of the extensive experimental work conducted by Professor S.J. Braude and several teams of his co-



Pavel V. Bliokh

workers). Another area of P.V.'s interests at the time included field-particle interactions, and dynamics and stability of electron beams, with applications to microwave electronics.

The early years of the TO-2 Laboratory, between 1965 and 1969/70, were of crucial importance for the Lab's development as P.V. vigorously re-configured its research profile and essentially re-cast its staff. While retaining the name of Theoretical (and much of orientation toward theory of wave diffraction in natural conditions), the Lab was replenished in 1966/67 by a group of experimentalists headed by Dr Volodymir Shulga. The two leaders invited about half a dozen of forbiddingly young people to join the team. All were recent graduates of the Radio Engineering department of the Aviation Institute of Kharkiv (currently known as the National Aerospace University "KhAI"), and the School of Radio Physics at the State University of Kharkiv (now V. Karazin National University of Kharkiv). In either case, the selection process was rather easy for P.V., as he had participated in the formation of radio science-oriented profiles of education in both of the varsities, and retained helpful connections since. In early 1960s Dr Bliokh was Head of the Chair for Theoretical Foundations of Radio Engineering at the Aviation Institute. By 1966 he had for several years been a part-time Associate Professor, Lecturer in plasma physics and physics of the upper atmosphere at the University of Kharkiv. (Moreover, Prof. Vsevolod Misyura, Dr Pavel Bliokh, and Dr Friedrich Bass had been there co-founders of the Space Radio Physics Chair, whose graduates of the two or three earliest rounds became successful competitors in P.V.'s casting sessions). The same

approach to brains and hands recruitment continued till 1980s. Each of the young researchers was suggested a piece of a scientific problem to work on, under a seemingly loose control by the Lab Leader, plus some amount of guidance from a senior colleague. Despite the fact that P.V. Bliokh, V.F. Shulga and Yuri F. Filippov were, at the moment, the only PhDs within the team, P.V. initiated several long lasting, macro-scale research programs of considerable complexity. Two of these concerned, respectively, global ELF (Schumann) resonances in the Earth-Ionosphere cavity and long distance propagation of VLF waves through the natural waveguide between the Earth's surface and the ionosphere. This thematic bias toward ionosphere-connected physics was reflected in the new name given to the Lab, specifically Theoretical Lab for Radio Wave Propagation and Ionosphere (transcribable from Cyrillic as TORRI). However, from this point on theoretical aspects of the Lab's activities became tightly connected with observations and experiment.

The year of 1970 was marked by a bright presentation of P.V.'s second doctoral dissertation. At that time the DSc degree, as awarded in the USSR and some of the East European countries, represented a research doctorate of much higher level than the Cand. Sci. Soon afterwards P.V. became Full Professor, while a sizable group of staff members in the Lab, both old timers and the newcomers, were presenting and defending their Cand. Sci. theses over 1969 to 1972 (five or six PhDs over the period, and more to follow soon).

Some ten years later the organizational structure of the IRE was subjected to notable changes when several laboratories united to form a semi-independent Sector (later, Division) of Radio Astronomy. (The move had been initiated by Academician S.J. Braude but its implementation required lots of efforts and "diplomacy" for overcoming the bureaucratic barriers in the governmental and ruling party's cabinets). Dr. Bliokh and virtually all members of the TORRI Lab joined the Sector that was expected to become, before long, a full-scale institute within the Academy of Sciences. In actual fact, fulfillment of the good intentions took several years more, till the new institute appeared on the map of the Academy (end of 1985). Those years too, were filled with a great volume of organizational work that was done, for the most part, by Professor Leonid Lytvynenko

who became the first Director of the Institute of Radio Astronomy (IRA), Acad. Sci. of the Ukrainian SSR (currently, the National Academy of Sciences of Ukraine). As for the Lab, it obtained a new name again, which name has since lived until now, namely the Laboratory of Space Radio Physics. Indeed, by that time the interests of Dr Bliokh and many of his team members shifted even more toward global-scale, circumterrestrial and outer-space physics, like lensing of electromagnetic waves in the terrestrial atmosphere and solar corona; long- and very long-range radio wave propagation; the global EM resonances already mentioned; next, lensing of optical-frequency waves by galaxies, and gravitational interaction between macroscopic dust particles and electrons or ions in space plasmas.

What is worth special attention is that P.V. never ceased combining intense research activity with various forms of teaching. At the University of Kharkiv alone he developed at least three courses that were new to the curriculum of the Radio Physical department, namely aeronomy, plasma physics/waves in plasmas, and statistical radio physics. He continued lecturing on these, first in the capacity of an Associate and then a Full Professor, from 1964 till 1984. Quite often he was an invited lecturer or co-organizer of seminars and workshops of all sorts that related to ionospheric radio propagation, atmospheric or space physics. This reflected an essential trait of his personality, not just to learn something for himself but to produce new knowledge and openly share it with the widest possible community. One way to reach such goals was, in his view, to publish books. Indeed, books and brochures falling into the categories of both 'hard' and popular science are duly represented in Dr Bliokh's list of publications. The "Global electromagnetic resonances in the Earth — ionosphere cavity" by P.V. Bliokh, A.P. Nickolaenko, and Yu.F. Filippov first appeared in 1977 as a publication of the Ukrainian "Naukova Doumka" Publ. Co. (It was later translated into English and issued by the Peter Peregrinus, Ltd of London). Another solid monograph followed in 1984: V.G. Bezrodny, P.V. Bliokh, R.S. Shubova, and Yu. M. Yampolski, "Fluctuations of VLF radiowaves in the Earth — ionosphere waveguide", M., Nauka. The "Gravitational lenses" by P.V. Bliokh and A.A. Minakov appeared in 1989, again as a title from the list of the "Naukova Doumka". This was followed in 1990 by a shorter and seemingly sim-

pler version, issued as a brochure in the *Space Science and Astronomy Series* of the popular-science publisher *Znaniye*. Meanwhile, the next in order "hard-science" monograph (P. Bliokh, V. Sinitsin and Victoria Yaroshenko: "Dusty plasmas in space", Kluwer Publ. Co., 1995), specifying the role of gravitation effects due to the presence of "heavy" macroscopic particles (dust) in a plasma, was not followed by a smaller book for non-specialists, hence the problem was not closed. In fact, it could have been, since Professor Bliokh did complete a manuscript entitled "Radio waves on the Earth and in the outer space", covering the entire spectrum of questions that he had suggested answers to over the preceding 30 years. By that time he had published tens of articles in Russian and Ukrainian popular-science magazines, like *Priroda*, *Kvant*, *Quantum*, and *Nauka i suspilstvo* (Ukrainian for "Science and Society"), and the idea was to offer the MS to a reputed English-language publisher. The brochure was read and re-read, for more than a year, by editors of a solid publishing company in the UK, until they decided the scientific content was a bit too popular for their distinguished readership. It should be stressed here that P.V.'s pop-sci booklets and pamphlets, while containing smaller amounts of mathematical derivations, in order not to divert an interested but non-professional reader, never lacked the due rigor in explaining the essence of the subject matter. In a peculiar way P.V. needed writing such booklets, along with sound monographs, for finalizing certain periods of his activity and crossing all the t's that might have remained after formal treatment of the subject. They too, were a reflection of his pedagogical style, of his wish and talent to speak in simple but precise and clear terms of matters that might not be as simple. As for the "Radio waves on the Earth and in the outer space", the booklet found its reader in 2006/2007, long after P.V. had passed away (*Kvant Supplement No1/2007*, issue 99, published by Bureau Quantum, M.)

As said above, both Dr Bliokh himself and many members of his team fostered broad cooperation with colleagues across the then USSR, from Lviv in the West of Ukraine to East Siberia, Kazakhstan and Uzbekistan. Also, he worked energetically to extend international cooperation of the Lab, which idea was not heartily welcomed in 1970s to 1980s neither by the then authorities, nor by management of the IRE. Still, in 1969 P.V. made his first personal hole in the

long standing Iron Curtain and traveled to Stresa in Northern Italy (near the Lago Maggiore lake) for participating in an URSI symposium on wave propagation. Results of the trip included a wonderful album of photographs, pencil drawings and water colors by the voyager, plus a real and serious long standing cooperation with British colleagues David Llanwyn Jones and Michael Rycroft in the study of global ELF resonances. (An English-language translation of the 1977 monograph on the subject was touched upon by David's editorial brush and appeared in London in 1980).

Two years later P.V.'s steps were directed to the Far East, as the 1971 Antennas and Propagation Symposium was held in Sendai, Japan. The informal report of that trip also included artistic photographs and a few paintings, inspired by the views of Mount Fuji, characters in the streets of old Kyoto, and evidence of a meditation session in the Garden of Stones. One of his pictures of Fuji-san was executed in an unusual technique combining a 3D succession of fore- and backgrounds with plane images in several layers of the glass-underlain picture. It is hard to say definitely, still can be supposed with a non-zero probability that the implementation was influenced by the style of P.V.'s friend Rita Schroeder, a professional artist from California, the spouse of a colleague radio scientist.

In the years that followed there were trips to Bulgaria and Czechoslovakia (still undivided at the time), with more works of art to fix the memories, and many attempts to break the resistance of the then authorities against closer contacts with the West. That resistance became too obviously unwise and died away by early 1990s, so the 1992 International Conference on Gravitational Lenses in Hamburg, Germany was attended by Professor Bliokh and Dr Minakov (soon after publication of their relevant monograph).

At the break of the century P.V. ceased to be the managing officer of the Laboratory but he remained its scientific leader, constantly generating new ideas and searching for new areas of their application. The situation did not change even a decade later, when the old Lab split into two independent parts (under rather similar names, both including such terms as *wave propagation* and *outer space*). It happened so that Dr Bliokh had changed the areas of his research activity more than once during his scientific life, however



Military Mechan Inst, Leningrad, 1940



First Lieutenant, Kharkiv, 1945



Theoretical Lab-2, IRE, Kharkiv, 1966



Space Radio Phys Lab, IRA, Kharkiv, 1985



Theoretical Lab for Radio Wave Propagation and Ionosphere (TORRI), IRE, Kharkiv, 1968

his interest in environmental and space physics really was the last in time but in no way the least.

Perhaps, it should be specially noted that when engaging into new areas of research P.V. never left the previous "battlefield" to chance. Instead, the leading positions were occupied by accomplished specialists from among his immediate disciples who were able to continue the Teacher's business, often with the support and assistance of their own disciples. The number of dissertations prepared under P.V.'s direct guidance or due to his advice and

benevolent critique can be estimated as 14 or 15 for PhDs (to be exact, Cand. Sci.'s) and 5 in the case of the highergrade DSc's.

In the March of 2022 we marked the centenary of Professor Pavel Victorovich Bliokh, PhD, DSc, Honored Scientist of Ukraine — but before all a person of fine human qualities and many talents, teacher and friend to a whole lot of people who miss him. The present authors have had the privilege of sharing happy years of work and social life with P.V. Bliokh, an outstanding scientist and teacher.

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ПАВЛО БЛІОХ: ВЧЕНИЙ І ПЕДАГОГ,
ДРУГ, ЯКОГО МИ ПАМ'ЯТАЄМО

Стаття присвячується пам'яті Павла Вікторовича Бліоха — видатного українського фізика-теоретика з нагоди його 100-річного ювілею. Доктор фізико-математичних наук, професор, заслужений діяч науки й техніки України, П.В. Бліох був одним з основників наукового напрямку «космічна радіофізика». За цим напрямком ним було започатковано відому в подальшому наукову школу в Інституті радіофізики та електроніки ім. О.Я. Усикова і Радіоастрономічному інституті Національної академії наук України.

Ключові слова: Павло Вікторович Бліох, НАН України, поширення радіохвиль, космічна радіофізика, шуманівські резонанси, гравітаційні лінзи, пилова плазма.