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The naturalist I. P. Puljuj and the discovery of X-rays

I SHALL DARE TO BEGIN THE REPORT according to known Ukrainian poetess Lina Kostenko from her book *Humanitarian aura of the nation, or defect of the main mirror*:

> When with a roar the Iron Curtain has fallen, it has appeared, that on another side of a curtain we are not present. Very few people knows Ukraine, it still confuse to Russia, its problems for the world are not actual, there is the loop of the historical biases which have been not denied by us and lasts till this days.

Certainly, such state of affairs should be corrected, but not in the way like does it the certain circle of short-sighted propagandists of Ukrainian. According to the same Lina Kostenko «it is done with ingenuous «accuracy on the contrary» by a principle — not «Russia — the native land of elephants», but we — the native land of turkey-cocks». However this is just one extreme point of view. There is also another approach. Its representatives try to prove, that all done by Ukrainian sons and daughters is — not of prime quality, that in history of culture of Ukraine there are no persons which activity allows to speak about Ukraine as about the state with cultural traditions and a genofond, which capable to give the outstanding art workers, including scientists.

Stumbling block for many researchers in the field of history of science became the scientific heritage of an outstanding scientist, the citizen of Austria-Hungary, ethnic Ukrainian, Ivan Pavlovich Puljuj.

Ivan Puljuj, the citizen of Austria-Hungary, was born on February, 2nd, 1845 in a small town Grimajlovo in Ternopol region. After leaving grammar school in Ternopol, and then theological and philosophical faculties of Viennese University, Puljuj started in it his scientific and pedagogical activity. I. Puljuju's way to Ukraine was closed, because of his considering as unreliable in Russian empire. The reason for that was the book «About motionless stars and planets», which was recognized as directed against the Russian monarchy. All I. P. Puljuj's further life passed in Austria-Hungary. Nevertheless, his active public work-educational activity was closely connected with Ukraine. However, it is a plot of another research.

In Austria-Hungary he quickly won a scientific name by the works in the field of physics and electrical engineering, reached the level of the scientist with the European and world name. He finished his life in 1918 in Czechia where he was the head of physics faculty at German supreme technical school, also he was the rector of this higher school, etc.

It would be wrong to speak, that I. Puljuj's name has been betrayed in Ukraine to absolute oblivion. However only in the last decades in Ukraine there are conditions for the thorough historical and scientific analysis of his activity. In this respect the author of the report gives due to the professor of physics R. Gajda and his follower R. Pljatsko (6, 29). Namely these scientists have created the base on which the objective research practice of the historical and scientific analysis of the scientific heritage of I. P. Puljuj is under construction. The report, presented to you, the author considers as following of the researches of these scientists.

In the work I made a start from R. P. Gajda's initial thesis that «the most part of publications about Ivan Puljuj (and their quantity has increased for the last few years up to three-value number) does not meet even to the softened requirements to works of such type» (6, *2*).

First of all the majority of these publications are concentrated on the problem *of discovery* of X-ray radiation. Concerning his contribution to discovery, X-ray radiation two different approaches are brightly shown. According to it the attitude to his scientific achievements in physics is formed also. A number from those who addresses to the life and creativity of the scientist, actively enough defend an

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idea that I. P. Puljuj was the discoverer of X-rays. Another group of researchers considers that I. P. Puljuj did not bring any contribution to discovery of X-rays and its subsequent studying.

Such opposite sights lead often enough, to put it mildly, to the inexact conclusions made even by known scientists. From what positions and about what will this report speak? The first question concerns the priority of X-rays discovery for which applied, as known, many scientists. I. Puljuj himself didn't have pretensions of priority. In a number of publications, the attention to the question on I. Puljuj's priority in discovery of X-rays was accordingly brought. The author of the report does not support this point of view and considers that the priority in *detection and the primary description* of properties of X-rays belongs to W.K. Roentgen. By the way, as correctly specifies R. P. Gajda «source material of the similar sights which don't have any base belong … to foreigners» (6).

Here I would like to finish a theme of the priority of detection and the primary description of some properties of X-rays in relation to I. Puljuj. I completely support R.P. Gajda's point of view, «that unreasonable by documents statements, which were stimulated in a greater degree by emotional factors, but not by the objective scientifically-historical analysis, will not bring any benefit». Even more, I. Puljuj in his articles always spoke about «invisible cathodic beams discovered by Professor Roentgen». *Therefore in the question on the discoverer of X-rays all is clear enough. This is W. K. Roentgen.*

The further statement is broken on two basic parts. The first part of the paper is devoted to the questions *of research of properties and disclosing of the nature of X-rays*, the second — *to the discussion of prospects of their practical use in medical practice and the first works in this area (especially in Russian empire).* At a statement of the first part of the report the author follows R. P. Gajda's (6) concept as, unfortunately, many of its positions are poorly known to the European and world scientific community. At that And, the author is consciously restricted to the first of two or three months after discovery of X-rays. In this period were published W. K. Roentgen's and I. P. Puljuj's (20–25) basic works. After that I. P. Puljuj did not come back to researches of X-rays which he named beams of Roentgen.

I shall remind listeners what are X-rays (attention to the screen). X-rays (beams of Roentgen) according to the modern scientific point of view is electromagnetic ionizing radiation, which occupies spectral area between gamma-and ultra-violet radiation and lies in the range of waves lengths from 10^{-12} up to 10^{-5} cm. The brake X-ray radiation which is abouve-mentioned, arises as a result of sharp braking of electrons in the field of nuclear kernels.

Any physicist will tell that such definition follows from *understanding of the nature and full set of properties of X*-rays. In the work, devoted to the 50 anniversary of discovery of X-ray radiation, the former trainee and W. K. Roentgen's assistant, known Soviet physicist A. F. Ioffe wrote: «On December, 28th, 1895 at the session of physical and medical Society in Würzburg, the professor of a local university Wilhelm-Konrad Roentgen made his first report «About a new kind of beams». Later, in some time, on March, 16th, 1896, the second report was made and in May, 1897 — the third. All these three reports … *with such unusual completeness opened the nature* (? — the Author) of the new phenomenon, equal which we do not know in the history of a science» (8, *343*). A little bit earlier, in the biographic sketch which opens the book edited by A. F. Ioffe (11) was told: «In three small articles, published during one year, *so exhaustive description of properties of these beams* is given, that hundreds of the works which have followed during 12 years, could neither add, nor change anything essential» (11, *12*). At last, concerning the design of the tube and application of X-rays in medicine A. Ioffe wrote: «I doubt whether somebody another as Roentgen could create Roentgen's tube and receive with its help the pictures amazing with accuracy of details. In 1896 I saw the first pictures and I do not know anything more perfect… Roentgen from the first steps understood the value of his discovery and particular prospects of its application in medicine» (10, *26*). Such absolutism has gradually got accustomed in historical and scientific works.

But, as O. G. Vloh, R. P. Gajda and R. M. Pljatsko marked, the estimations of the contribution of Roentgen in *research* of X-rays (not discovery) in the specified time interval are a little bit overestimated (29). We shall add to these words «and in *finding-out of the nature* of X-rays».

This question is important enough in the general context of the European science history studying, in particular physics, and findings-out of the basic scientific positions details formation concerning X-rays. Therefore I shall dare to show the chronology of the events which happened in the first months after X-rays discovering. We shall return to the time of their discovery and we shall make an attempt

to consider the chronology of the scientific publications and statements of W. K. Roentgen and I. Puljuj, which accompanied with this discovery opening.

- On December, 28th, 1895 — the first message on the discovery of X-rays. Also it is the date of submission of the first article of W. K. Roentgen «About a new kind of radiation» in the Journal «Messages of physical and medical Society in a Würzburg» (it was published in January, 1896).
- On January, 23rd, 1896 — Roentgen made report on the first results of invisible radiation research.
- The Message from the session of mathematical and natural Society of Viennese academy of sciences of February, 6th, 1896 about I. Puljuj's roentgenograms and his comments concerning these photos (it was published in «Wiener Berichte»).
- On February, 13th, 1896 — I. Puljuj submits to Viennese Journal «Message of the Imperial academy of sciences» article «About occurrence of photographic beams and their photographic action».
- On February, 15th, 1896 — I. Puljuj made a report at German supreme technical school «About invisible cathodic beams and photographing of invisible».
- On March, 5th, 1896 — I. Puljuj submits to the same journal the article «Additions to the discussion of the article «About occurrence of X-rays and their photographic action» with a series of photos.
- On March, 9th, 1896 — date of finishing the manuscript of the second Roentgen's article «About a new kind of radiation. Part 2.», designated by him.
- On April, 29th, 1897 — Roentgen submits to the press the third article «The further supervision of properties of X-rays».

That is, between the first and the second articles of W. Roentgen there were also I. Puljuj's two articles in which he, as it follows from their analysis, received a number of essential results of priority character. Unfortunately, A. F. Ioffe and many other historians of science, missed this moment or did not know about it. Our comparative analysis of the works of W. Roentgen and I. Puljuj showed objective character of conclusions, made earlier in R. P. Gajda's works and his co-authors. It is possible to carry results of priority character (on the screen in columns are brought for comparison of the citation from the text of articles of W. Roentgen and I. Puljuj):

1. Discovery of the ionizing abilities of X-rays

«*In the event that the pumped out tubes without electrodes, discharged lamps, radiometers and other vacuum devices arrange in the way of X-rays, in a dark room they show the discharged phenomena more strongly and radiate the more strongly, if they are closer located to the device* ... an electric charge in the vacuum tube is caused not by the device Rumkorfa» (Puljuj, 13.2.1896).

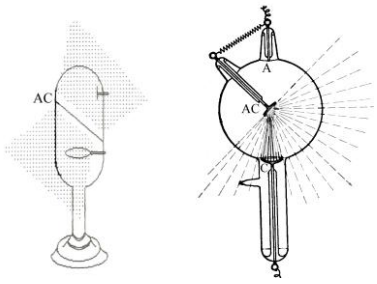
«By time of my first message I already known, that X-rays could discharge the electrified bodies … I, had however, postponed the publication of the researches before the reception of quite faultless results... *Supervision shows, that the air shined by X-rays got the property to* discharge *the electrified bodies being with it in contact*» (Roentgen, 09.03.1896).

That is, approximately one month prior to W. Roentgen I. Puljuj officially informs about the effect of ionizing actions of X-rays on the rests of gas in vacuum tubes, having shown experimentally, that this effect was not caused by a high voltage from Rumkorf's coil.

2. I. Puljuj the first investigated spatial distribution of X-rays at their spread (Puljuj, 13.02.1896) and established that they leave the anticathode mainly in a perpendicular direction to it. The results of similar researches were met only in the third W. Roentgen's article (29.04.1897).

Besides I. Puljuj strictly and authentically determined also the place of X-rays occurrence, proceeding, by the way, from assumption of W. Roentgen that «X-rays start with that place where, according to various researchers, cathodic beams meet a glass wall». Importance of such definition was doubtless, on what specifies in O. Gljasser's work. He wrote: «In many researches were engaged in to find, whether there are X-rays the anode or from the cathode: first in this question was the big mess, though W. Roentgen stated the worthy instruction» (7, *219*). Unfortunately, O. Gljasser does not mention I. Puljuj's name, referring on such attempts, undertaken already after exact experiments of the scientist, in particular on A.N. Karnozhitskiy's and B.B. Golitsyn's works.

3. Namely I. Puljuj offered in 1882 a design of a tube, which had prominent features of a modern x-ray tube (in particular, the anticathode separated from the cathode located aslant). Such design has enabled to receive practically bunch of X-rays with the maximal intensity for that time, that provided high quality of pictures and allowed to reduce time of an exposition. About it wrote also I. Puljuj's contemporaries — famous scientists D. Pilchikov, E. Frost (5, 16–19) and other researchers. In January, 1896 the first experiences with X-rays with various tubes were done on the American continent, among which there was also a tube of a design by I. Puljuj. Professor E. Frost who did these experiments wrote about this tube: «In the beginning of 80th years professor Iogann Puljuj from the Viennese university designed the tube of Crookes type, excellently adapted for generating the X-rays, though completely he did not realize it. He built a plate in aslant …. in section of a tube and covered it with phosphorescent salt. It gave good phosphorescence, and cathodic beams, falling on this salt, created intensive beams of X type» (5). There are *drawings of a tube designed by I. Puljuj (1882) and a modern x-ray tube are presented accordingly on the picture.*



4. I. Puljuj in his first article was the closest, among modern to him scientists, (Roentgen, Sezerland, Mikelson, Stoks etc.) to correct understanding *of the mechanism of occurrence* of X-rays. Such understanding followed, first of all, from correct comprehension by scientists the nature of cathodic beams, as stream of negatively charged particles. To comprehension of it he came in 1880–1882 (21.) I. Puljuj considered, that new beams (X-rays) arise at collision of these particles with firm bodies, and microscopic character of interaction leads to occurrence of X-rays.

«*Actually there is a transformation of cathodic beams on invisible* by *means of material objects.* In terms of the theory about the shone electrode matter, published in 1881 and 1882, I consider, that transformation of cathodic beams, happens so. *Under influence of a current and a high voltage from the cathode material particles* (particles of a material of an electrode and gas) *are pulled out* and accelerated perpendicularly to a surface of the cathode. These *particles have a negative static charge* …T*he Place of collision on a glass wall or on the screen becomes a place of ether waves shining …. Alongside with visible beams of a phosphorescence there are also invisible beams with other period of fluctuations. These beams are discovered by mister W.* Roentgen *invisible beams. Probably they are longitudinal, instead of cross-section fluctuations though till this time there are no serious bases for such assumption*» (I. Puljuj, 13.02.1896).

«Whether *new beams to longitudinal fluctuations on ether should be attributed?*

I should admit, that I tend to this opinion more and more, and I dare to come out here with this assumption though I know, certainly, that it requires the further substantiations» (Рентген, 28.12 1895). «As X-rays *are formed by means of cathodic represent similar processes*» (Roentgen, on April, 29th, 1897).

I. Puljuj's statement is rather significant. On the one hand, it testifies, that I.Puljuj recognizes a priority of V. Roentgen in discovery of X-rays. On the another hand, it brightly testifies, what exactly I.Puljuj offered in due time, the closest to true, physical interpretation of the mechanism of occurrence, the nature of the x-ray radiation, based on understanding of the nature of cathodic beams. I shall note, that I. Puljuj's role in upholding a hypothesis according to which cathodic beams are a stream of negatively charged particles which have come off the cathode, is underlined in a number of works of his contemporaries, in particular H.Bauer (1) J. Thomson and V. Kaufman determined the size of a charge of the particles, which compose cathodic beams, named electrons (corpuscles). According to J. Thomson's hypothesis, stated after I. Puljuj, these particles (electrons or corpuscles) «cause the acyclic fluctuations of an ether which in the form of X-rays leave a tube.» (4, *33*).

V. Roentgen long time did not perceive such physical reality as electron. Therefore, representations concerning microscopic character of the phenomena, which were observed, the scientist long rejected. On the A.F. Ioffe's memoirs «till 1906–1907 the word electron should not be said in Physical institute of the Munich university. Рентген considered it as not proved hypothesis, applied often without the sufficient bases and without need …» (11, *18–19*). So it is not surprising, that V. Roentgen was far from correct understanding of the mechanism of occurrence and the nature of x-ray radiation. Especially powerful looks I.Puljuj's point of view on the mechanism of occurrence and the nature of X-rays.

Priority character has one more position *precisely formulated* by I.Puljuj in his works on studying X-rays *and supported by experimental and practical activities.*

High quality of the pictures, received by I. Puljuj, allowed him to receive them not simply for demonstration, but also to apply them in January, 1896 in a medical practice. Results of teamwork with doctors, which asked I.Puljuj to photo various parts of patients' bodies, led the scientist to statement of a problem of use of new radiation in medicine. V. Roentgen in his first three articles wrote nothing about perspectives of application of X-rays in medicine. He mentioned only about the image of a hand received by him. I.Puljuj wrote, describing the picture of a hand of 12-years girls, made on January, 18th 1896: «In comparison with the known picture of a hand made by V. Roentgen , it is possible to see on it the distinct image not only of fingers' bones, but also average hands bones, epiphysis and the top parts of radius and joints» (22, *252*). I. Puljuj, instead of W. Roentgen, analyzing the first data on photo action of new beams which «have shown, that the surgical operational technical equipment can have benefit of a photo of an opaque subject …» has set already in first article the task «to determine precisely limits of their probable use in surgery» (22, *252*).

The questions concerning the application of X-rays in a medical practice, which were put by I. Puljuj already in his first article are the following: 1. A problem *of detection* of an alien body; 2. A problem *of exact definition of its site (localization);* 3. A problem *of use of* X-rays *for anatomic researches*; 4. *Studying of pathological processes and the changes caused by them* in alive organism. 5. *Diagnosing of fracture* of a various origin.

Concerning the first problem I. P. Puljuj stated an idea that the result is determined by intensity and divergence (a degree of parallelism) of used X-rays. So, «parallel beams enable to receive precise images of such small objects, as a needle, on the certain distance from a plate» (22, *253*), and impossibility of detection of an alien body (in this case it was not possible to receive grits, «because, as I consider, radiation of the lamp was concerning small intensity and very big divergence» (22, *253*). The problem of a site (localization) of extraneous object I. Puljuj suggests solving, using comparison «two or a lot of pictures of the extraneous object made in different directions of beams» (22, *253*). The idea of reception of a set of compared photos in essence underlies «principles of stereo metric reconstruction of the flat x-ray image whether due to movement of the object of research, whether due to displacement of focus of a tube» (12, *74*). This idea was developed in 1896–1901.

Opportunities of application of X-rays in anatomic researches were shown by I. Puljuj in his first-ever roentgenogram of the whole human skeleton. I. Puljuj so described this roentgenogram: «The deadborn child was photographed by means of the old digit device, but, according to prof. Chijari, the image of bone formations was almost fine. It was possible to see precisely a ridge up to a head, which only partially laid on a plate, edges of a thorax in which heart and liver gave stronger blackout» (22, *253*). The London magazine «The Photogram» (1896, Vol. 3, No 28), giving the picture of I. Puljuj lamp and photo of a seven-mouth deadborn child specifies, that this first image of the whole human skeleton made by means of X-rays» (6, *36*).

For the first time, in my opinion, I. Puljuj shown an opportunity of studying and definition of various pathologies. It was shown in a picture of a tubercular hand of Professor Peaks patient: «The tubercular hand had the truncated phalanx of an index finger which was thereof shorter, than a small finger. Sick parts of bones differed from healthy by a shade» (22, *253*). In fact, he was the first who made the comparative analysis of healthy and sick bodies (the hand healthy and struck by tuberculosis).

At session of mathematical and natural department of Kiser Academy of sciences in the Vein on February, 6th, 1896 I. Puljuj, concluded: «Images show significant enough successes in comparison with reproductions of other pictures known to me earlier, and allow clearly realize what practical applications in a surgical operational practice will find this type of photos» (27, *258*).

Complex character prof. I. Puljuj's researches lead in conditions as medical practice, and specially tasks in view, enables to speak about him not only as about the pioneer of medical roentgenology, but also as about the scientist who put in pawn its bases and some directions of the further development.

W. Roentgen did not give this question due attention. It was possible consequence of his doubts in practical application of X-rays in surgery and anatomy. A basis of these doubts was that soft parts of a body, nerves, muscles for their beams represented objects approximately of identical density and were not allocated in photos. This fact also has served, as specifies O. Gljasser (7), as motive of the negative answer of W. Roentgen on a question of anatomist Kelliker, set to the scientist at session of a physical and medical society (on January, 23rd, 1896) concerning practical opportunities of application of X-rays in anatomy and surgery.

In first half of 1896 there were many doubts concerning opportunities even in simple detection of alien bodies by means of new radiation. So, the position of one of leading medical magazines (New-York Medical Record) is reflected with the following statement: «… it not seems to us, that the new photo can be widely used in surgery, as it cannot find out presence of bullets in a skull, and the task to photograph a bullet in a chest or belly cavity will be very confused and difficult …» (Cit. on 12, *70*).

It is especially important to estimate all made by I. Puljuj at sources of medical roentgenology. Here not W. Roentgen but other researchers, as well as I. Puljuj, are pioneers.

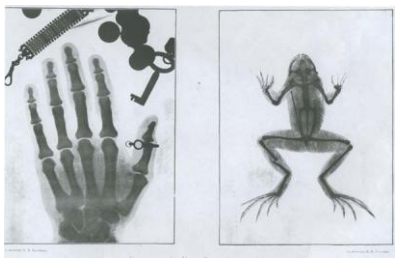
Scientific and practicing physicians of all world including Russian empire, already in the first month after opening X-rays (January, 1896) have paid huge attention to their application in medicine. Chronological comparison of the first pictures received in different laboratories of the Europe and America is complicated, however, as specifies R. Gajda, 9 photos of a hand of the person presented, in particular, in O. Gljasser's work «first, are executed in second half of January and in February, and, secondly, their quality insignificantly differs from the X-ray picture of a hand of his wife. In this connection any conclusions interesting from the point of view of medicine, their authors did not state» (6, *33*). As on exception R. Gajda specifies on article of doctor L. Pfaundler from Graz, in which the roentgenogram of a hand of the girl with a piece of a needle is given. The picture was made on January, 19th, 1896 (15).

I shall stop on works of scientists of Russian empire as they are less known to historians of a science. Though the same O. Gljasser refers to some of them (7). In one of Russian editions on signed for publishing on 1 February 1986 was informed following: at once after the message of W. Roentgen physical cabinets of Army medical college and the St-Petersburg university «it was started recurrence of these experiences and their further development» (14, *8*). Almost at the same time in all physical cabinets experiments with X-rays began. In the table (on the screen) there are data about these first experiments and the practical applications, concerning by January, 1896.

Table. X-rays in medical and biologic roentgenology of Russian empire (the beginning of the 1896)

Date	Experimenters, Doctors	The place of carrying out	Object of studying
January, 6th	G. B. Rautenfeld, G. E. Pflaum	Riga	Saw fish(the top jaw)
January, 7–14 th	G. B. Rautenfeld, G. E. Pflaum	Riga	The hare paw, a hand of the person
January, 12–13th	I. I. Borgman, A. L. Gershun	Petersburg	Various subjects
Not later on January, 16th	E. P. Golovin	Petersburg	The Frog with a pin
January, 16th	I. I. Borgman, A. L. Gershun	Petersburg	The Hand
January, 16th	Faculty of physics of Army medical college	Petersburg	The Hand
January, 18th	Commercial school	Moscow	The Hand
January, 19th	Physical laboratory, university	Moscow	The Hand
January, 21st	P. V. Preobrazhenskiy	Moscow	The Frog, a fish, a hand
January, 21st	P. N. Lebedev	Moscow	Pictures of patients with a fragment of glass bead and a splinter of glass (under the request of the surgeon, проф. A.A.Levshin)
Not later on January, 28th	Clinic of Pr.M. A. Malinovsky	Kiev, university	The Needle in soft fabrics
Not later on February, 8th	P. N. Lebedev (demonstration by doctor S. E. Berezovsky)	Moscow	Normal stop in a boot, a hand with a fragment of a needle, grits in soft fabrics of a shoulder, tubercular phalangette at the child and the adult, a hand with a tumor on a back surface
February, 13th	V. N. Tonkov	Petersburg, Biological laboratory	Research of a structure and growth of a skeleton

I shall note high quality of the roentgenograms received already in this period. *On fig. there are photos of a frog with a pin and of a hand received by E. P. Golovin, F. N. Blumbah, I. I. Borgman and A. L. Gershun.*



In various cities of Russian empire in January–February took place numerous statements of scientists, both physicists and physicians (3, 13). In particular I shall note statements on January, 29th in Riga at joint session of scientists Societies and practical doctors, on February, 9th at session of the Society of Russian doctors in Moscow, etc. Already on February, 3rd 1896 the work of Kiev's professor G. de Metz «X-rays of Roentgen and area of their application to medicine» was ready for printing. (3) (its cover is

presented on the screen). In the same year there was «A Review of literary data on Roentgen beams» by doctor Uftjuzhaninov (28). These and other authors give numerous examples of a wide spreading in Europe using of X-rays in medicine.

Already in the second half of January and February, 1896 such doctors as Jastrovits, von Mozetig, L. Pfaundler, G. Gertner, Lannelong, Noisser, Gashek and Lindeltal, Mihael and others started applying of X-rays in medicine and to analyze their opportunities. In particular, it is the first operation of removal of a superfluous phalanx of the left foot big finger (von Mozetig, a picture is made by professors S. and F. Eksner); diagnosing of position of a stone in bilious and uric bubbles (Noisser, Vienna); definition of a femur destruction direction at affection it by osteomyelitis (Lannelong), etc.

G. de Metz in his work made the analytic review of the first results of X-rays application in medicine (3) and one of the first concluded that, «is doubtless, X-rays will bring big benefit at treatment of bones crises, at studying the bones fusion, their regeneration and tubercular disease, at definition of stones position and joints in bubbles and channels» (3, *8*).

It is possible to speak that explosive character of spreading of researches on X-rays application in medicine in 1896 determined its many directions. Physicians, working *everyone in the our area of study*, received an extensive actual material. But the first, *really complex research, touched various directions of X-rays use in medicine, with an estimation of its opportunities* was nevertheless made by I. Puljuj.

My research testifies, that *discovery, studying of properties, finding-out of the nature, opportunities of use* of X-rays are not and cannot be the one-stage act converging only on the person of one scientist. It is nonlinear process, which has both a prehistory, and the post history, lying in vicinity of the event. And only careful, objective, system studying of this process can explain that synergetic effect, which was caused by the discovery of X-rays by the outstanding German physicist W. K. Roentgen.

The speaker suppose in the further wider use of the original documents, and sincerely counts on information support of colleagues from the different countries of the Europe which are working in the field of history of science and techniques, and on cooperation with them.

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