

PHENOMENON OF DEMIKHOV.**At the Sklifosovsky Institute (1960-1986).****C.N. Barnard and the first clinical heart transplantation****(December 3, 1967)****V.P. Demikhov and C.N. Barnard: touchpoints¹**S.P. Glyantsev^{✉1,2}, B.M. Gorelik³, A. Werner⁴¹ *A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery,**135 Roublyevskoe Hwy., Moscow 121552 Russia;*² *N.A. Semashko National Research Institute of Public Health, 12 Bldg. 1 Vorontsovo Pole St., Moscow 105064 Russia;*³ *The Institute for African Studies, 30/1, Spiridonovka St., Moscow 123001 Russia;*⁴ *Cardiothoracic Surgery Clinic, HELIOS Hospital Krefeld, 40 Lutherplatz, Krefeld 47805 Germany*

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Abstract

Having studied the available printed, visual, and verbal sources from Russia, South Africa, the USA, and Germany, we have identified and reviewed in the article the facts of face-to-face and correspondence communication between V.P. Demikhov, the "father" of experimental heart transplantation (Moscow, USSR), and C.N. Barnard, a pioneer of clinical heart transplantation (Cape Town, South Africa). We have shown

that C.N. Barnard mastered the heart surgery techniques, including those under conditions of artificial circulation, in the USA in 1956-1958, and later improved them in his homeland both in clinic (heart surgery for cardiac defects), and in the experiment (heart transplantation). The main events preceding the first world human heart transplant performed by C.N. Barnard on December 3, 1967, were his trip to the United States in August 1967 to study immunosuppression techniques, and the kidney transplantation he had performed in Cape Town in September, 1967. Prior to that time, C.N. Barnard had visited the USSR only once, in May 1960, as a delegate to the XXVII All-Union Congress of Surgeons. In the Soviet Union, he visited a number of clinics dealing with heart surgery and tissue and organ transplantation, including the N.V. Sklifosovsky Institute for Emergency Medicine, where he met V.P. Demikhov, but C.N. Barnard could neither talk to him personally, nor watch his operations. In December 1967, V.P. Demikhov spoke with C.N. Barnard on the phone, but the conversation was highly professional. This paper has shown different approaches of V.P. Demikhov and C.N. Barnard to the transplantation problem: the Soviet surgeon paid more attention to the transplantation technique, meanwhile, the South African surgeon considered the solution of immunological problems to be the basis of success. Nevertheless, C.N. Barnard knew about V.P. Demikhov's scientific achievements and used some of them in his surgical practice. The authors have substantiated the interaction between V.P. Demikhov and C.N. Barnard as between an ideological mentor and a student (in a broad sense) rather than as a teacher and a student (in a narrow sense). Therefore, in a broad, philosophical sense, the Soviet surgeon can be considered one of the inspirers of the world's first heart transplantation, which, in turn, proved that his ascetic work was not in vain.

Keywords: history of medicine, heart transplantation, V.P. Demikhov, C.N. Barnard, the first heart transplantation, in-clinic heart transplantation

Conflict of interests Authors declare no conflict of interest

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CPB, cardiopulmonary bypass (pump)

Introduction

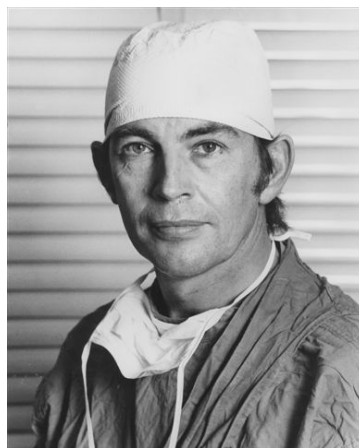
On July 18, 1916, an outstanding Russian surgeon Vladimir Petrovich Demikhov was born in a Cossack village not far from Tsaritsyn. Six years and 3 months later, on November 8, 1922, another outstanding surgeon of the twentieth century, Christiaan Neethling Barnard², was born in a small South African town near Cape Town. And it is quite possible that these two people would never have learned about

² Usually, in Russian the name of Christian Barnard is pronounced with the stress on the last syllable of both his first and last name as Christi'an Bar'nard. In fact, in English they sound stressed on the first syllables as 'Christian 'Barnard.

each other if they had not become pioneers of heart transplantation: V.P. Demikhov in the experiment (Fig. 1), C.N. Barnard in the clinic (Fig. 2).



Fig. 1. Doctor of Biological Sciences V.P. Demikhov in the experimental Operating Room equipped in the Pathology Department of N.V. Sklifosovsky Research Institute for Emergency Medicine. Moscow, 1967 [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]



**Fig. 2. S.N. Barnard, Professor of the University of Cape Town, 1967
URL: <https://www.biospectrumasia.com/opinion/30/9913/celebrating-50-years-of-mending-hearts-dr-christiaan-barnard.html> [Accessed September 15, 2020]**

In Russia and abroad, both in the medical literature and in the mass media, including the Internet, there is a mythologeme that, before performing the world's first human heart transplantation in 1967, C.N. Barnard came to Moscow to see V. P. Demikhov, from whom he "learned the subtleties of the surgical methodology and technique of heart transplantation" [1]. Even the years of these visits have been named: 1960 and 1963 [2, 3]. There is also a legend that immediately after completing surgery, C.N. Barnard called V.P. Demikhov to Moscow to report his achievement [4, 5]. Hence, proponents of such versions conclude that C.N. Barnard was V.P. Demikhov's disciple, and in support of their words, they quote the words of the South African surgeon, who said in 2001 in an interview to the Russian media that the Soviet surgeon was his teacher [6, 7].

However, a little is known about the documented contacts of V.P. Demikhov and C.N. Barnard³. Their search and critical analysis became the goal of our research. The sources were available Soviet and foreign press, film and photo documents, memoirs of V.P. Demikhov, C.N. Barnard and their colleagues from Moscow and South Africa, materials from Russian medical museums (S.P. Glyantsev) and the Heart Museum in Cape Town (B.M. Gorelik).

³ Having addressed to the Central Archives of the FSB [Federal Security Service] of the Russian Federation (former KGB [Committee for the State Security] of the USSR) in 2011 with the request about the documented contacts of V.P. Demikhov with foreign surgeons, we received the answer that there was no such information in those Archives. It is possible that visits of foreigners to V.P. Demikhov's Laboratory "passed through" the USSR Healthcare Ministry, but we found no information about them in the archives of this Department either.

Vladimir Demikhov: international renown

It is known that foreign surgeons and journalists visited the Laboratory of V.P. Demikhov both in⁴ the 1940s and in the 1950s⁵ (Fig. 3). But the world community learned about the Soviet surgeon and his unique operations in December 1958 – January 1959, when V.P. Demikhov, having received an invitation from the Academy of Sciences of the German Democratic Republic (GDR) to visit this country⁶, performed in Berlin and Leipzig several demonstration operations of transplanting the anterior half of the puppy's torso onto the neck vessels of the adult dog and transplanting the heart of one dog into the chest of another one as a second, additional pump. In his lectures V.P. Demikhov gave in the GDR, he stated that a dog with two heads, in his opinion, was a model for studying the functions of the central nervous system of the donor and recipient, and a second heart in a heterotopic position was needed in order to support the native, sick heart. At that time, there was no Berlin Wall, which separated West Berlin from East Berlin in 1961, therefore surgeons and journalists from both the future GDR and the future Federal Republic of Germany (FRG) attended the operations and lectures of the Soviet scientist, and the German and world press widely covered his visit and the operations he performed [8, 9].

⁴ That was mentioned by A.V. Vishnevsky in spring of 1948 in his conversation with the members of the Commission of the Presidium of the USSR Academy of Medical Sciences, which inspected the Institute of Surgery of the USSR Academy of Medical Sciences.

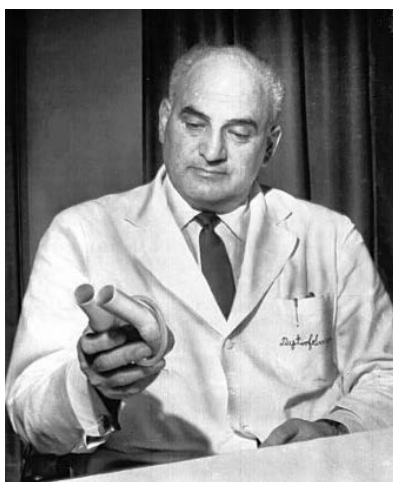
⁵ . Information about these visits is available in the Operation Log of the Experimental Surgery Department of A.V. Vishnevsky Institute of Surgery for 1954-1956 that is stored in the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery.

⁶ The invitation was initiated by P. Kokkalis, Professor of Surgery at the Humboldt University School of Medicine (Berlin), who at the same time headed the Institute of Experimental Surgery of the Circulatory System of the German Academy of Sciences (GDR). Dealing with the problem of transplantation of vital organs, P. Kokkalis met V.P. Demikhov in November 1957 during his trip to the USSR.



Fig. 3. V.P. Demikhov is operating. His work is closely watched by a surgeon in the background. 1960s [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]

The fact that those materials were read not only by ordinary people, but also by surgeons, was evidenced by D. McRae, who in his book "Every second counts" reported how A. Kantrowitz (Fig. 4) from New York visited V.P. Demikhov's Laboratory in the summer of 1959 [10]. The fact of A. Kantrowitz's visit to V.P. Demikhov's Laboratory, in our opinion, is true. After all, he was a member of the US delegation that arrived at the International Exhibition in Moscow Sokolniki where R. Nixon, the US Vice President, opened the American pavilion on July 24, 1959. The visit of a major American surgeon to the Sklifosovsky Institute shortly after V.P. Demikhov's return from Germany proves the undoubted interest of foreign scientists to V.P. Demikhov and his achievements.



**Fig. 4. A. Kantrowitz examines a heart model. 1960s URL:
<http://cardiologistsinfo.com/adrian-kantrowitz> [Accessed September
15, 2020]**

V.P. Demikhov's second trip to Germany (to Munich, FRG, that time) took place in September 1959. At the International Conference on Cardiovascular Diseases, with great success he demonstrated the delegates our know-how: a suture applied on the carotid artery of a dog using the original Soviet-manufactured vascular stapling device. Unfortunately, after that trip, the USSR authorities no longer allowed V.P. Demikhov to travel abroad⁷ [11].

We shall repeat that the visit of 43-year-old V.P. Demikhov in the GDR and FRG was widely covered in the international press, including in South Africa. In particular, the Cape Town newspaper "The Cape Argus", in its October 26, 1959, issue, in a small article entitled: "Red claims he can transplant hearts," reported that

"Dr. Vladimir Demikhov, the Russian doctor who successfully transplanted a dog's head, has now planted hearts in two dogs. He hopes

⁷ For the third time, V.P. Demikhov was invited to Germany in April 1989, where at the International Congress on Heart and Lung Transplantation he was awarded a special diploma as a pioneer of experimental heart transplantation [14].

to attach a heart to a human being in an experiment before the end of the year. <...>

At the end of interview, he said: “I hope to live until it is possible to replace human hearts. Dr. Demikhov added that he hope to perform an operation soon to transplant a leg of a woman, who had loss one leg in a train accident.” [12]

Christiaan Barnard: the path to heart transplantation

By 1959, C.N. Barnard turned 36 years old. He graduated from the University of Cape Town and a residency in General Surgery; and since 1956 he had been trained for two years in the Department of Surgery, the University of Minnesota (Minneapolis, USA), which was headed by O.H. Wangenstein. Working with R.L. Varco and C.W. Lillehei, C.N. Barnard mastered cardiothoracic surgery and contributed to writing several scientific articles [13]. We should note that R.L. Varco and C.W. Lillehei were experienced cardiac surgeons who at that time were among the very few who operated on children with congenital heart defects under conditions of cardiopulmonary bypass. Thus, C.N. Barnard completed his primary specialization in heart surgery in the United States. There, at the University of Minnesota, C.N. Barnard met N. E. Shumway, who was a trainee with O. H. Wangenstein and for several years before and after the internship at Stanford University (California, USA) was dealing with the development of an isolated heart transplant technique in an experiment [13].

Returning to South Africa, in addition to knowledge and skills in Cardiothoracic Surgery, C.N. Barnard brought the Master's degree in Surgery and a Ph. D., as well as R. DeWall's original heart-lung machine with C.W. Lillehei's bubble oxygenator, the Grant from the National Institutes of Health (Bethesda, USA) to continue surgical research and a great desire to develop Heart Surgery in Cape Town. Having been

appointed to the position of the Head (Director) of Surgical Research in the Department of Surgery at the Groote Schuur University Hospital⁸ (Fig. 5), C.N. Barnard developed such a vigorous activity that, as soon as by 1959, he had the experience of more than 30 operations on the heart under conditions of cardiopulmonary bypass, including the correction of such complex congenital heart defects as tetralogy of Fallot⁹ (Fig. 6).

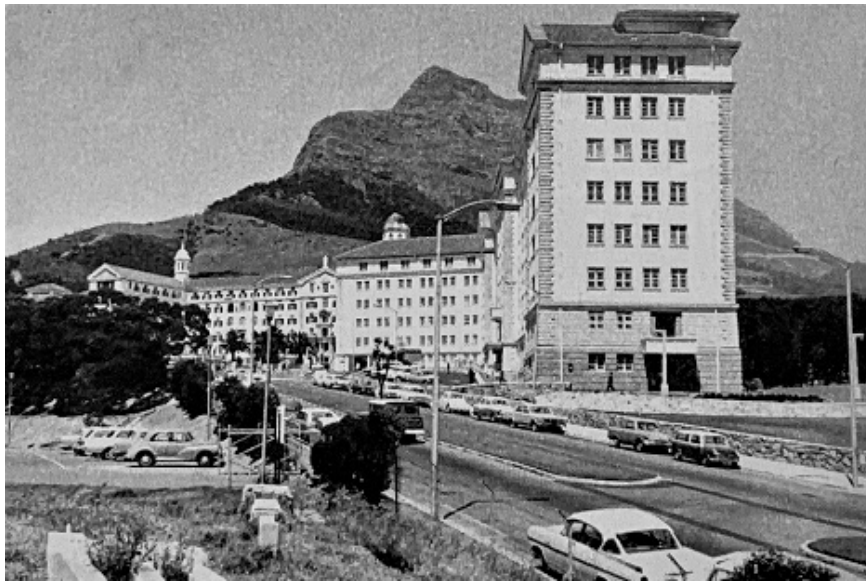


Fig. 5. Groote Schuur Hospital building. Cape Town, 1967.
[Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]

⁸ In Russian-language literature there are several variants of this hospital name transliteration into Russian. It is pronounced correctly as Khrute Schuur ['hru:te 'shu:r], which is translated from the Dutch language as Big Barn. On the site where the hospital is located, there used to be a rigging warehouse built by the settlers who founded Cape Town (Kapstadt) in the 17th century.

⁹ In the USSR, the first palliative operations (valvulotomy and infundibulectomy) for the acyanotic tetralogy of Fallot, using cardiopulmonary bypass pump, were performed by A.A. Vishnevsky in 1957 at A.V. Vishnevsky Institute of Surgery of the USSR Academy of Medical Sciences. At the Institute of Thoracic Surgery of the USSR Academy of Medical Sciences, the first operations for pulmonary artery stenosis (valvulotomy), interventricular septal defect (defect suture) and the acyanotic tetralogy of Fallot (complete repair) were performed in May 1959.



Fig. 6. In the operating room of the Groote Schuur Hospital. Cape Town, 1967. [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]

In his article on C.N. Barnard's life and work, V.I. Kaleda, an investigator-physician, described that

"... By 1965, Barnard and six other surgeons working under his leadership had made more than 1,500 heart operations, including 834 operations for acquired heart defects and 737 for congenital diseases. <...> Thus, by the mid-1960s, Barnard and his team had gained enormous experience for their time, and their publications on various topical problems of heart surgery brought Barnard authority among foreign colleagues" [13].

In addition, C.N. Barnard performed up to 6 operations per week in the experimental laboratory, transplanting various tissues and organs into dogs. In his autobiography, he recalled that, having perfected the transplantation technique in an experiment, he saw the main problem of clinical transplantation not in transplanting a foreign organ to a human,

but in ensuring its acceptance. The experiments made by him and his foreign colleagues showed that it was technically quite feasible.

"The big battle in a heart transplant was not going to be in placing a new heart in a human being, but in getting it to stay there. Our experiences with animals and reports from overseas made this quite clear. We could insert a new heart and immediately it would begin to sustain life. Yet at the same time, a rejection process would begin because the host body was immune to any foreign element - even an organ sustaining it in life. That was our problem. Unless we could control this immunological rejection, there was no basis for attempting a heart transplant.

At the beginning of 1966, evidence indicated some control was possible. In kidney transplants, ways had been found to prevent, or at least delay rejection - indicating we would soon be able to transplant a heart. For if the human system could be conditioned to accept a kidney, it could take other organs, especially something as basic as a pumping muscle. Obviously we had to learn to transplant a kidney, and more important, control its rejection. The kidney had become a stepping stone to the heart. Its transplant would be a run-through for a heart transfer.

With this in mind, I applied for a training course under one of the great pioneers in this field – Dr David Hume, formerly of Harvard and now with the Medical College of Virginia, at Richmond. Dr Hume and his team were experienced both in kidney grafts and rejection control. He graciously accepted me for a three-month course, to begin in August.

Since my first return from Minneapolis, I had made six trips abroad - attending conferences, seminars, and visiting medical centres in Europe, the Soviet Union, India, Australia and New Zealand. Whenever possible, I also returned to America because it was there I learned the most.

Richmond was no exception. It met all my expectations. Dr Hume assigned me to work in a renal transplant unit and I assisted at kidney transplant operations. With this I learned how to manage these patients in the post-operative period. I studied rejection and its control by means of drugs in rats, dogs and people. Besides this, Dr Hume allowed me to visit

other medical centres working on the same problem. This included Denver, where they had developed the use of anti-lymphocyte serum as an immunosuppressive agent.

There was a spirit of open scientific inquiry at Richmond which was stimulating. The staff included Dr Richard Lower who had worked with Dr Norman Shumway on the technique of heart transplant. Prodded by Dr Hume, we never slept and the drama never ceased.” [15].

From these words we learn that in summer of 1967, C.N. Barnard undertook a trip to the University of Virginia (Richmond, USA) to D.M. Hume, one of the pioneers of kidney transplantation. He spent 3 months there studying the clinical and immunological features of kidney transplantation. The Department of Cardiac Surgery in Virginia was headed by R. Lower, the co-author of N.E. Shumway, in developing a biatrial heart transplantation technique in an experiment. It was there in Richmond that C.N. Barnard watched as R. Lower in the experiment transplanted the heart. In addition to Richmond, C.N. Barnard visited the University of Colorado (Denver, USA), where he studied the use of anti-lymphocyte serum for immunosuppression from T.E. Starzl, the pioneer of liver transplantation [13].

After returning to Cape Town, C.N. Barnard began preparing for kidney transplantation at clinic. He considered this clinical experiment as a preparatory stage for heart transplantation to form and train the transplant team, to control complications associated with the rejection reaction and to overcome it. Barnard performed the only in his practice kidney transplant in a female patient in September 1967¹⁰, after that he began preparing for heart transplantation in clinic [13].

¹⁰ The operated woman lived for 20 years after surgery.

Later C.N. Barnard recalled that preparing for kidney transplantation also gave him the opportunity to document organ harvesting in accordance with South African law [17].

There was another problem that he recalled in 1993:

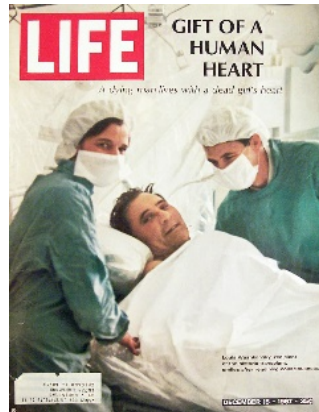
"I could have done the transplant several weeks earlier when I was presented with a very suitable black donor. We turned down this opportunity because Dr Schrire¹¹ and I decided that we would not use a black recipient or a black donor for the first transplant in case we, as South Africans, were accused of 'experimenting' on black people." [17]

On the night of December 2–3, 1967, C.N. Barnard performed the first human heart transplant in the world, using a modified biatrial technique that was originally proposed by the British surgeons M.H. Cass and R. Brock¹², in 1959 [13]. And although L. Washkansky, a 54-year-old native of Lithuania who received a new heart, lived only 18 days after the operation, the clinical experiment was considered successful. At least, the world learned about him soon after the patient had been placed in a specially equipped room for him, and then watched L. Washkansky's condition with great interest for 2 and a half weeks (Fig. 7) [18], continuing to inquire about the details of the operation and the postoperative period for several months after L. Washkansky's death (Fig. 8) [19]. It was not our task to describe the circumstances of this intervention. The medical features of the *Operation*, calling it *The Operation*, as well as the management of the pre- and postoperative periods, were described by C.N. Barnard himself [20, 21], and the events preceding and following it, up to the death of L. Washkansky, were

¹¹ Head of the Cardiology Department at Groote Schuur Hospital.

¹² This technique became famous after it was published in 1960 by R. Lower and N.E. Shumway [16]; however, to avoid accusations of plagiarism, C.N. Barnard insisted that, first, he had used the M.H. Cass and R. Brock method described a year earlier, and second, he applied a modification of that method.

described in detail by M. Lee [22]. Let us emphasize once again the fact that the heart transplantation technique that he modified just on the eve of the operation (Fig. 9), as well as the management of the postoperative period after it, C.N. Barnard mastered not in the USSR, but in the USA, and South Africa.



**Fig. 7. Cover of the "Life" Magazine of December 15, 1967.
[Collection of the Museum of Cardiovascular Surgery of A.N.
Bakoulev National Medical Research Center for Cardiovascular
Surgery]**



**Fig. 8. Cover of "Der Spiegel" Magazine, No. 10 of March 3, 1968.
[Collection of the Museum of Cardiovascular Surgery of A.N.
Bakoulev National Medical Research Center for Cardiovascular
Surgery]**

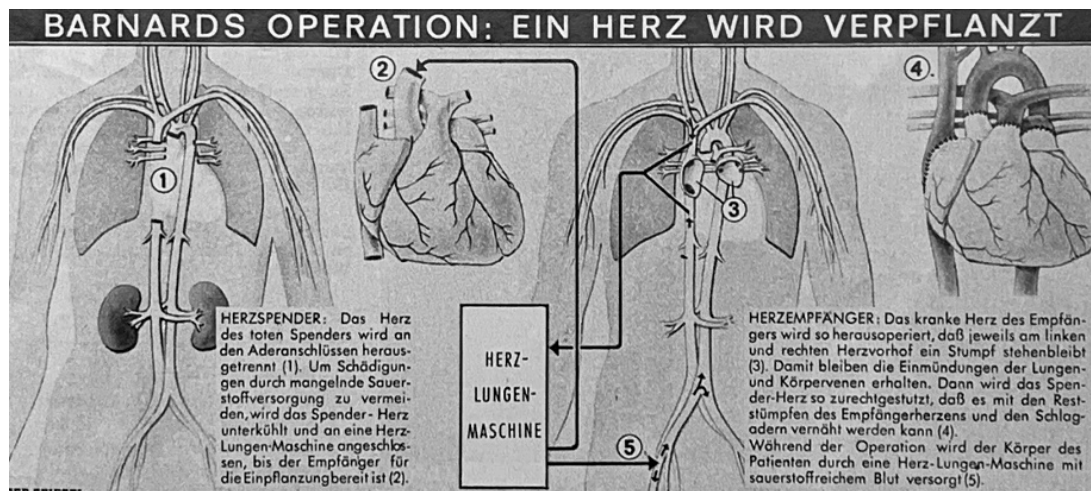


Fig. 9. The scheme of heart transplant surgery, which C.N. Barnard performed on December 3, 1967: (1) "... explantation of the donor heart shall be performed by transecting the aorta distally to the innominate artery, the inferior vena cava at the diaphragm level, and the superior vena cava at the level of the azygos vein. The right and left pulmonary veins are transected; the pulmonary artery trunk shall be loosed. The left atrium is mobilized by transecting 4 pulmonary veins"; (2) an explanted donor heart; (3) "The heart of the recipient is excised after clamping the aorta proximally to the aortic cannula. The aorta is transected over the coronary arteries, the pulmonary artery is transected over the pulmonary valve annulus. The ventricles shall be separated from the atria as close as possible to the atrioventricular groove. The interatrial septum is divided as close to the ventricles as possible. While the atria are cut off, the part of the left atrium with the orifices of the pulmonary veins is retained, as well as the part of the right atrium containing the vena cava"; (4) "The left atrium of the donor heart shall be connected to the left atrium of the recipient by anastomosing the orifice in the posterior wall of the donor left atrium to the left atrial wall and the interatrial septum of the recipient heart. <...> Then the orifice in the posterior part of the donor right atrium is anastomosed with the remaining wall of the right atrium of the recipient's heart. <...> The donor's pulmonary artery is truncated to the required length and anastomosed to the recipient's pulmonary artery. The donor's aorta is truncated and connected to the recipient's ascending aorta"; (5)

Cardiopulmonary bypass scheme [21]

The second heart transplant in the world was performed on December 6, 1967, by A. Kantrowitz at the Maimonides Medical Center in Brooklyn (New York, USA). As for C.N. Barnard, he performed his second heart transplant in clinic on January 2, 1968; and on January 6, 1968, he transplanted the heart to N.E. Shumway at Stanford. The further history of cardiortransplantation developed as follows.

During 1968, (according to different authors) from 95 [23] to 102 [24] operations were performed worldwide (according to various authors). D. Cooley from Houston (Texas, USA) had the greatest experience (17 transplantations) [23]. However, according to our information, of all these surgeons, only P.K. Sen (India) wrote that the impetus for his pioneering operations was his visit to V.P. Demikhov's Laboratory in Moscow, and then, on February 16, 1968, P.K. Sen performed the first heart transplant in his country (and the 6th in the world) at the KEM hospital in Mumbai (India) [25].

In November 1968, A. A. Vishnevsky performed the first heart transplant in the USSR (and the 73rd in the world) at the hospital surgical clinic of the S. M. Kirov Military medical Academy in Leningrad [26]. According to N. M. Amosov's memoirs, in 1968 he was technically ready for this operation, but for moral and ethical reasons he could not do it [27]. In November 1968, A. A. Vishnevsky performed the first heart transplant in the USSR (and the 73rd in the world) at the hospital surgical clinic of the S. M. Kirov Military medical Academy in Leningrad [26]. According to N.M. Amosov's memoirs, in 1968, he was technically ready for this operation, but he could not perform it for moral and ethical reasons [27]. Subsequently, attempts to transplant hearts in the USSR were made by G.M. Soloviev (1971) and V.I. Burakovsky (1983). The first successful operation in the USSR was performed in March 1987 by V.I. Shumakov at the Institute of Organ and Tissue Transplantation of the

USSR Healthcare Ministry. From December 1967 to November 1974, C.N. Barnard had performed 10 orthotopic heart transplants in the Thoracic Surgery Clinic of Groote Schuur Hospital: 4 of 10 patients lived for more than a year and a half, 2 patients lived for 13 and 23 years, respectively [13].

V.P. Demikhov started his experiments on extra-heart transplantation from 1946, and had performed 250 such operations by 1960. He transplanted an isolated heart into an orthotopic position at A.V. Vishnevsky Institute of Surgery and in the 1st MOLMI named after I. M. Sechenov (now: I.M. Sechenov First Moscow State Medical University) from 1951 to 1959, and described both the anatomical and original biatrial methods of transplantation in his book "Experimental Transplantation of Vital Organs" (1960) [28]; and in 1959-1963, when working at the Sklifosovsky Institute for Emergency Medicine, several times he expressed the idea of transplanting an additional heart to a human using the original two-stage technique he had developed [29].

We should note that V.D. Demikhov's methods were radically different from those used by C.N. Barnard in 1967-1974. In addition, as we have shown above, the South African surgeon was primarily interested in the ways to overcome tissue incompatibility rather than in the organ transplantation technique. V.D. Demikhov, however, believed that the main problem was the technique of suturing blood vessels, preventing their thrombosis, and restoring organ function, but unlike other transplant surgeons, he considered the issues of immunology not that important.

But if this is so, then what touchpoints can we talk about between the two surgeons who were so different in their ideological views and technical approaches? And yet, there were such points.

C.N. Barnard and V.P. Demikhov: touchpoints

C.N. Barnard first learned about V.P. Demikhov and his activities in 1959. According to one version, after having viewed in the dining room of Groote Schuur Hospital the morning issue of “the Cape Times” with an item about V.P. Demikhov's stay in Germany and his operation of transplanting a puppy's head to the neck of an adult dog, C.N. Barnard immediately decided to repeat that intervention [10].

And here's how Ch. Logan wrote in his book about C.N. Barnard:

"As director of surgical research at Groote Schuur he was able to explore new ideas, and the transplanting of organs was beginning to grip his imagination. It would lead him to perform a controversial experiment for which he was mostly condemned - the creation of a two-headed dog. The grafting of one dog's head onto the chest of another horrified most of Barnard's colleagues, especially 'Vel' Schrire and Jannie Louw¹³.

Barnard made a film of the monster lapping up milk with both heads, which he planned to show during a forthcoming trip to Russia¹⁴, where the experiment had also been carried out¹⁵.

When he published a paper on the subject the story got into the newspapers, and Barnard found himself at the centre of his first media controversy. He argued that the experiment was valid and would help test rejection - others said the work had no scientific value and had been a stunt.<...>After this, Barnard found it harder to obtain funding for his research work." [30].

Already at an advanced age, in an interview with the newspaper “Die Welt” C.N. Barnard confirmed that he once performed a head transplantation from one dog to the torso of another, but his boss,

13 Head of the Surgery Department at Groote Schuur Hospital, where C.N. Barnard worked.

14 We mention here the trip to the USSR in May 1960, which will be discussed below.

15 This refers to V.P. Demikhov's experiments.

Professor J. Louw, however, forbade him to conduct such experiments, so he was no longer dealing with that. [31]

But the surgeon was tricking. Here is what J. Terblanche, a resident and assistant of C.N. Barnard, (now a Professor at the University of Cape Town) told one of us (B.M. Gorelik) in those years (D. McRae writes that it was J. Terblanche who helped C.N. Barnard to create *a two-headed monster* [10]):

"We were looking for a transplant model that could be tested easily and in which rejection could be determined clinically rather than with complex biochemical or histological studies. A head transplant on a dog had been performed in Russia and this stimulated Chris Barnard. We were able to perform several successful auxiliary (heterotopic) head grafts on dogs and published a paper in a local medical journal."

Indeed, C.N. Barnard and his colleagues reported the results of their experiments in a paper that was published in Johannesburg in 1960. The authors noted that the goal of those studies was to determine "whether it was possible to solve the problem of homoplastic transplantation in a surgically effective sense":

"It was found better to use a small donor dog and a large host dog... one common carotid of the host can be used as the source of supply to both common carotids of the donor, by effecting an *end-to-end* or an *end-to-side anastomosis*... the trachea and the oesophagus of the donor were brought out and sutured to the skin on the side of its neck, in order to study the functions of breathing and swallowing afterwards.

Within 24 hours, the 'animal' reacted normally, as ascertained by tests performed. The cerebral and cranial functions of both heads were normal. For example, both heads were observed to lap milk when this was offered." [32].

The authors concluded that the technical problems of organ transplantation could be overcome, and the transplantation of homologous tissues was a matter of the near future. They began to consider the immunological response to transplanted homoorgans to be the problem on which they should focus their main efforts.

It is interesting that C.N. Barnard and co-authors did not mention in this article that such operations had been performed in the USSR before them, nor did they mention the name of V.P. Demikhov. But Dr. H.A. Shapiro the Journal Editor, who wrote the Preface to the article, reported that the operation was a repeat of "a remarkable Soviet experiment." H.A. Shapiro also clarified that South African two-headed dogs lived for about a day, while V.P. Demikhov's ones lived for up to 29 days. Further H.A. Shapiro wrote about the wide opportunities that could be opened up to transplant surgeons, including in the field of heart transplantation, if the main problem of tissue rejection had been solved:

"It is not clear, from the information so far available, whether the Soviet scientists have made a breakthrough on this immunological front; but this is obviously the next stage, which will be the focus of intensive biological investigation." [33].

If we take into account the information from J. Terblanche (1960) and the data from Ch. Logan (2003), it turns out that the idea of the organ transplantation program occurred C. N. Barnard in the late 1950s. This is confirmed by the fact that, having begun to study this problem, in March 1960 he addressed to S.V. Kurashov, the USSR Healthcare Minister, with a letter informing him that he was planning to visit the Soviet Union in the 2nd half of May and expressed his request to arrange for him the

visits to Moscow clinics where work on cardiac surgery and tissue transplants is being performed [10].

But in what capacity could a surgeon from a country where apartheid flourished (Fig. 10), and with which the USSR had not had diplomatic relations since the mid-1950s, be able to visit Moscow? We have established that C.N. Barnard came to Moscow as a foreign delegate of the XXVII All-Union Congress of Surgeons, held from 23 to 28 of May, 1960. His name is recorded at the very end of the list of foreign guests. However, S.V. Kurashov did not need to organize visits to Moscow clinics for foreigners personally, since the guests visited them in an organized manner. So, on May 25, a group of foreign delegates (R. Deterling, W. Walters and a number of other surgeons, among whom was C.N. Barnard), visited the Sklifosovsky Institute (Fig. 11). Foreigners were shown operations of esophageal reconstruction with a large intestine (P. I. Androsov), stomach resections for ulcers and cancer (B. A. Petrov), the procedure of cadaver blood transfusion. But they could not view V.P. Demikhov's operations [34]. As W. Walters from the Mao Clinic (Rochester, Minnesota, USA) recalled, they were informed that V.P. Demikhov had only recently moved to the Institute, and his Organ Transplantation Laboratory had not yet been deployed¹⁶. Therefore, in W. Walters' words, V.P. Demikhov told about his experiments on extra-heat transplantation, showed a dog with two hearts, demonstrated its ECG and invited guests to listen to the separate beating of two hearts [35].

¹⁶ This was indeed the case. Officially, V.P. Demikhov began working at N.V. Sklifosovsky Research Institute for Emergency Medicine in September 1960.

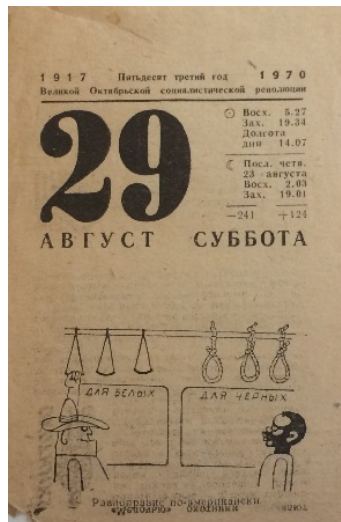


Fig. 10. A leaf of a tear-off calendar dated August 29, 1970, with a cartoon "American Equality." A similar situation was in South Africa. [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]



Fig. 11. Foreign delegates at the XXVII All-Union Congress of Surgeons at N.V. Sklifosovsky Institute. (The 1st row from left to right): R. Deterling (Boston, USA), M.M. Tarasov, W. Walters (Rochester, USA), P.I. Androsov. May 25, 1960. S.I. Divilkovsky
Warrior and laborer of Emergency Medicine. To the 100th anniversary of M.M. Tarasov's birth. URL:
<https://www.divilkovskiy.com/tarasov> [Accessed September 16, 2020]

Since C.N. Barnard was not yet internationally known as a surgeon at this time, then neither R. Deterling, nor W. Walters mentioned him. But, returning to Cape Town, on June 9, 1960, C.N. Barnard sent a letter of gratitude to "Professor Demikhov" for his cooperation and hospitality during C.N. Barnard's visit to Moscow. C.N. Barnard mentioned the operations he had seen at Demikhov's lab as very interesting and hoped to hear more about further progress in V.P. Demikhov's work and noted that in Cape Town Laboratory they were also interested in and working on organ transplants. He also wrote that he was greatly enjoyed visiting the USSR and after having returned to South Africa he was busy working in his Laboratory planning to make about 6 operations per week. He thanked V.P. Demikhov for his friendliness and expressed his wish to see him again.¹⁷ [14]

It is not clear from the letter what operations were in question, since other surgeons did not mention them. Most likely, he was talking about the surgical schemes of transplanting a supplemental heart, which V.P. Demikhov showed to the guests when talking about his work. It is interesting that such a serious journalist as McRae describes the circumstances of this "visit" with a fair amount of imagination:

"He still enjoyed ritual early morning vodkas with Demikhov and listening to him speak, through an interpreter, of his early kidney and heart transplants. The laboratories and operating theaters were frighteningly primitive, but the extraordinary Demikhov encouraged Barnard to dream.

Why should an American, Demikhov asked, be the first to walk on the moon? Why could it not be a Russian, or, as Demikhov said, slapping Barnard on the back, a South African? Demikhov roared when Barnard explained earnestly that South Africa did not have a space

¹⁷ Unfortunately, the original letter has been lost.

program, Okay, okay, Demikhov laughed, a Russian would have to walk across the moon first. But why, then did the world's greatest surgeon have to be an American? <...> [10].

“Nothing is impossible,” the Russian said through his interpreter. “*Nothing...*” [10].

We should emphasize, however, that in Moscow C.N. Barnard visited not only the Sklifosovsky Institute. Together with other delegates, he visited the Vishnevsky Institute of Surgery, where M. DeBakey was the main guest. The visit of C.N. Barnard and the Congress delegates to the In-hospital Surgery Clinic of the 1st MOLMI named after I.M. Sechenov was recollected almost 40 years later by B.V. Petrovsky being then the Head of that Clinic [36]. At the exposition dedicated to C.N. Barnard, the Heart Museum in Cape Town has exhibited several congratulatory telegrams from the USSR including that from Professor S.A. Kolesnikov who headed the Institute of Thoracic Surgery of the USSR Academy of Medical Sciences in 1959-1966. Therefore, it is obvious that in addition to N.V. Sklifosovsky Institute, C.N. Barnard, as he had planned, visited a number of other clinics. In the TV documentary "Rejection" dedicated to V.P. Demikhov, there is an interview taken from C.N. Barnard in Cape Town. In it, the surgeon recalled his trip to the USSR as follows:

"In my opinion, it was year 62nd. I then attended the Moscow Congress of Cardiologists. During this visit, some participants were invited to see Dr. Demikhov's Laboratory. In those days I was a totally unimportant member of the visiting group..., and *I did not have the chance to personally communicate with Dr. Demikhov* (our italics - Auth.) But he talked to other doctors, showed us a dog with two hearts and an electrocardiogram of its two hearts...

I never thought that I would be the first to do a heart transplant. But we started thinking about such an operation about five years before it took place in 1967." ¹⁸ [37]

C.N. Barnard clearly confused the year and name of the Congress. But the circumstances of the visit to V.P. Demikhov's Laboratory were correct: (1) he did not have the opportunity to personally communicate with V.P. Demikhov; (2) V.P. Demikhov showed guests a dog with two hearts. Possibly it was after visiting V.P. Demikhov's Laboratory that he got the idea of a heart transplant¹⁹.

Thus, the first time C.N. Barnard came to the USSR in May 1960, not specifically to V.P. Demikhov's, but to participate in the All-Union Congress of Surgeons, according to which Program he visited several Moscow clinics. But did C. N. Barnard considered then necessary to learn from the experience of the Soviet colleagues he met in Moscow? Obviously, not.

"Years ago on his return from an overseas trip, he had said to the Press that in the field of surgery South Africa was not far behind European countries and America, and added impetuously that surgery in Russia was so bad that it was "virtually an insult to the profession". He complained that facilities there were poor and most doctors did not even sterilize themselves properly before operating." [38]

M. Malan's view was confirmed by C.N. Barnard in his letter of October 31, 1960 addressed to O. H. Wangenstein in Minneapolis. In it,

¹⁸ We have provided a Russian voice-over translation of a fragment of the interview with C.N. Barnard. From the original Barnard's words, we were able to make out only the following words: "In those days I was a totally unimportant member of the visiting group ...".

¹⁹ In 1968, V.P. Demikhov stated that C.N. Barnard spent 8 days in his Laboratory and even operated together with him, but, in our opinion, this was not true. For, we repeat again: the South African surgeon was interested in the immunology issues rather than in the techniques of organ transplantation [39].

the South African surgeon reported his disappointment with the state of surgery in the USSR and did not recommend traveling to this country for advanced training:

"As far as my visit to the U.S.S.R. is concerned, except for the interest value and for the satisfaction of my curiosity regarding their stage of development in surgery and research, the journey was a waste of time and I would not advise anyone to visit the Soviet Union to increase their knowledge in these fields. On the whole, they seem to be using methods that we discarded years ago and their theatre technique appeared to be very out of date, particularly their method of giving blood transfusions and intravenous fluids. <...>"

V.P. Demikhov and the visit to his Laboratory were not mentioned in the letter. But C.N. Barnard describes the state of tissue and organ transplantation in the USSR as follows:

"it was obvious from discussions with various research workers that they are no nearer the solution of the problem of tissue rejections than we are. <...>"

Heart surgery was commented on even more categorically:

"I saw no open cardiac surgery but was told that they use a Russian pump oxygenator²⁰. However, I was never permitted to see this apparatus for various reasons²¹".

20 At that time, in the USSR, there was only one heart and lung machine: "AIK-57" manufactured by the Research Institute of Experimental Surgical Equipment and Instruments (transliterated Russian abbreviation: NIIEKHAI). And two others were "under way": "AIK-60" (NIIEKHAI) and ISL-2 (manufactured by Leningrad "Krasnogvardeyets" Plant).

21 We have at our disposal a copy of this letter in English. The original is kept in the C.N. Barnard's archives in the Heart Museum collections in Cape Town.

We have no other documentary information about C.N. Barnard's stay in the USSR in the 1960s. Unfortunately, we must admit that, having set off on a long journey for knowledge in the field of overcoming biological incompatibility, C.N. Barnard saw nothing instructive for his work. That's why he chose to focus on the work of American researchers, which he considered advanced.

The Museum of A.V. Vishnevsky Institute of Surgery has a photograph of C.N. Barnard standing next to Professor A. A. Vishnevsky, the Director of the Institute, Academician of the USSR Academy of Medical Sciences, in the courtyard of A.V. Vishnevsky Institute of Surgery at the monument to A.V. Vishnevsky (Fig. 12). However, dating this photo is difficult. It is possible that the photo was made in May-June 1960, since the construction of the 17-storey laboratory and clinical hospital founded in the early 1960s, had not yet begun.



Fig. 12. C.N. Barnard (3rd from the right) in the courtyard of A.V. Vishnevsky Institute of Surgery of the USSR Academy of Medical Sciences. The Director of the Institute, Professor A.A. Vishnevsky, the Academician of the Russian Academy of Sciences, is to his left (on the photo). 1960 (?) [Collection of the Museum of A.V. Vishnevsky National Medical Research Center of Surgery]

V.P. Demikhov and C.N. Barnard: talking on the phone

There is another myth: that the morning shortly after the end of the heart transplant operation C.N. Barnard called V.P. Demikhov on the phone to Moscow to inform him of his achievement. There was no such call.

Nevertheless, a telephone conversation between V.P. Demikhov and C.N. Barnard took place, but not at the beginning, but at the end of December 1967, and not between Moscow and Cape Town, but between Moscow and New York, where C.N. Barnard flew to the next day after L. Washkansky autopsy. The fact is that the CBS television company invited the South African surgeon to take part in a panel discussion with the participation of M. DeBakey and A. Kantrowitz in a special edition of Face the Nation Program, which was scheduled to air on Christmas Eve, December 24, 1967 [22] (Fig. 13).



Fig. 13. Panelists in the CBS special run-in of the *Face the Nation* program (left to right): C. Barnard (Cape Town, South Africa), M. DeBakey (Houston, TX. USA), A. Kantrowitz (Brooklyn, New York). Washington, December 24, 1967. URL: <https://whyy.org/articles/50-years-heart-transplant-surgery-hasnt-changed-significantly>. [Accessed September 15, 2020]

The telephone talk between V.P. Demikhov and C.N. Barnard (Fig. 14) was arranged by the Editorial Board of the *Literaturnaya Gazeta* that published a transcript of the conversation between the two surgeons in issue No. 1 of 1968. The transcript was originally published in Russian. Here we have made its translation into English:

“– Professor Barnard, with you I am deeply saddened by the death of your patient. Unfortunately, the first steps in science are always difficult, sometimes tragic. But they give us invaluable experience, teach us. Tell me, please, what the results of the autopsy, performed by Professor Thomson are.

– I left Cape Town the day after the autopsy. Thus, I do not know the histological picture in all details. I'll check it out next week when I get home.

– During our meetings in Moscow in 1960, we discussed the problem of a possible reaction of the heart to immunosuppressive drugs, as well as to various toxins. How did pneumonia affect the patient's heart?

– I can tell you that there were no signs of infection in the heart per se or in the suture area. The heart dimensions were normal. No signs of thrombosis were found either. Both lungs of the patient were affected by pneumonia, but microscopic examination revealed no changes that would have indicated incompatibility.

– Could pneumonia have been caused by the use of immunosuppressants?

– It is quite possible that the use of these drugs contributed to the occurrence of pneumonia. They made the patient's body more susceptible to diseases. Besides, you know that Vashkansky's body was weakened by diabetes.

– Could you send me the results of the histological examination?

– I will definitely send it!

– The newspapers reported that you are preparing for your next operation. When can it be performed?

– In the next two weeks.

– Who is the patient?

- Doctor Philip Blaiberg.
- So he's both a doctor and a patient?
- Yes.
- Who will perform the operation?
- Me.
- Thank you, Professor Barnard. I am sure the following operations will be more successful, although the first stage might undoubtedly still face great difficulties. I wish you a success. Taking this opportunity, I would like to congratulate you on the upcoming New Year." [40]



Fig. 14. Fragment of a page from *Literaturnaya Gazeta* (1968, No. 1) with the published transcript of the telephone conversation between V.P. Demikhov and C.N. Barnard that took place at the end of December 1967. [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]

In our opinion, the transcript does not give grounds to assume that the interlocutors knew each other closely. The conversation took place in a strictly professional style: V.P. Demikhov asked, C.N. Barnard answered, briefly and dryly. We do not know about the reader, but the authors got the impression that this communication was not much like a conversation between a teacher and a discipulus.

Let us also note that V.P. Demikhov himself mentioned only one date of their meeting – 1960. It is also obvious that a conversation with foreign surgeons in May 1960, among whom C.N. Barnard was, included a discussion of a recipient response to immunosuppressive drugs, in which efficacy V.P. Demikhov doubted at that time, considering them toxic. V.P. Demikhov did not name any other points of contact with his colleague who became a global celebrity overnight²².

Obviously because there were none.

Conclusion

Nevertheless, speaking about the influence of V.P. Demikhov's achievements on C.N. Barnard's activities, we must first recall the reaction of the South African surgeon to the news of V.P. Demikhov's transplant of a dog's head in 1959, and the words J. Terblanche said that it was the impetus to launch the entire organ transplantation program in Cape Town.

Was the meeting between C.N. Barnard and V.P. Demikhov in May 1960 year effective? In contrast to the operations performed in Germany, in Moscow V.P. Demikhov spoke about transplanting a second heart and explained why he was doing that. We can only assume that the memories of that conversation had an effect on C.N. Barnard's surgical work in the 1970s. Because after 1974, he stopped making orthotopic heart transplants and began to perform clinical transplants of a second, additional heart in a heterotopic position [13], and in several cases by using a modified left ventricular bypass [41], which concept had first been developed experimentally by V.P. Demikhov [28]. Over the

²² In this regard, C.N. Barnard sarcastically said about the following: "Still on Saturday (December 2, 1967 - *Auth.*) I was an unknown surgeon from Cape Town, and on Sunday (December 3, 1967 - *Auth.*) the whole world learned about me!"

following 10 years, C.N. Barnard had performed about fifty such operations. And although their technique was different from that of V.P. Demikhov's, the principle was the same: the second heart was implanted to assist the first, sick one. Moreover, several patients had their own sick heart subsequently removed and replaced with a new one, and the transplanted additional heart continued to beat [13], which concept was also described by V.P. Demikhov at a time²³ [28].

Participating in a correspondence talk with C.N. Barnard and his patient Ph. Blaiberg in 1968, V.P. Demikhov said that the heart transplant operation performed by a South African surgeon confirmed the validity of all his previous organ transplant activities for a quarter of a century [42]. Thirty years later, in 1999, in an interview in the TV movie "Rejection", C.N. Barnard stated that having visited V.P. Demikhov several years before his operation, he was impressed by his success. [37]

Above, we mentioned two interviews that C.N. Barnard gave to the reporters of the *Izvestia* and *Rossiyskaya Gazeta* newspapers in 2001. In them, he also spoke of V.P. Demikhov with great reverence, as of a pioneer in the field of experimental transplantation, and baldly called him his teacher [6, 7]. True, C.N. Barnard did not provide any evidence of his training with the Soviet surgeon.

Thus, the results of our study do not support the view that C.N. Barnard studied directly from V.P. Demikhov, for example, assisting him at the operating table. However, we believe that the Soviet scientist still influenced the pioneer of clinical cardiac transplantation: V.P. Demikhov granted his colleague with a model for studying the rejection reaction in 1959, which C.N. Barnard immediately implemented, and the idea of assisted circulatory support in 1960, which C.N. Barnard turned to 15

²³ In 1962, V.P. Demikhov's book "Experimental Transplantation of Vital Organs" was translated into English and became widely known in English-speaking countries.

years later. But if we look at the problem of apprenticeship and mentoring more broadly, then, from the point of the science philosophy, and also taking into account everything that C.N. Barnard said about V.P. Demikhov in different years, it can be assumed with a high degree of confidence that the extraordinary and even "crazy" (from the point of view of Western surgeons) Russian scientist could not help but attract the attention of such an ambitious surgeon as C.N. Barnard.

We have established a curious fact: many items about C.N. Barnard and his achievements published in the American press were accompanied by a number of printed alongside materials on the alternative achievements of V.P. Demikhov, which were traced by Reuters in Moscow (Fig. 15). Thus, if C.N. Barnard followed the publications about his person, then he could learn from the same publications about alternative achievements of V.P. Demikhov. It looked like a kind of competition between two approaches: the Western, pragmatic and rational one, and the Soviet, the searching and subjected to the biological and physiological theories that existed in the USSR at that time.

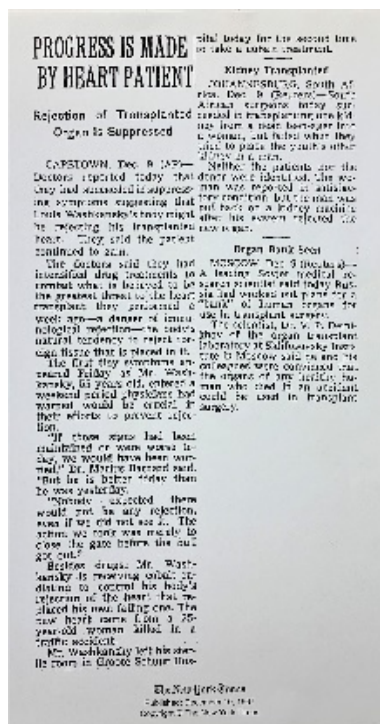


Fig. 15. The reprint from *The New York Times* of December 9, 1967. Next to the item from Cape Town on L. Washkansky's condition, there is an item from Moscow about V.P. Demikhov's work at creating a bank of organs for their further transplantation [Collection of the Museum of Cardiovascular Surgery of A.N. Bakoulev National Medical Research Center for Cardiovascular Surgery]

In this case, we do not think that "imaginative" D. McRae was that wrong when he suggested that V.P. Demikhov had influenced C.N. Barnard, first of all, as an ideological mentor, experienced experimental surgeon who had passed through fire, water and copper pipes, showing by his activity that “nothing was impossible” [10]. Therefore, in a broad, philosophical sense, the Soviet surgeon can be considered one of the inspirers of the world's first heart transplant. But also C.N. Barnard exerted his influence on V.P. Demikhov, proving that his 25-year ascetic work was not in vain.

V.F. Ostwald, a German physicist and philosopher of science, the winner of the Nobel Prize in his famous book of the early twentieth century "Great people" divided the outstanding scientists into classics and romantics by their style and creative understanding of their work. The classical style meant the development of a limited number of topics with their deep mastering. A distinctive characteristic of the classical scientist, according to W.F. Ostwald, was a very limited contact with colleagues and students and, as a result, the frequent absence of his own scientific school. In such cases, V. F. Ostwald spoke of "indirect" students who found their own innovations in the achievements of a classical scientist. Romantic scientists work in many directions and more often as a team. It was that romantic impulse that helped the C.N. Barnard's operating team to overcome the threshold of clinical and experimental experience in the field of heart transplantation accumulated in the world by 1967, thus opening a new chapter both in cardiac surgery, and also in medicine in general [43].

In 1997, 4 years before his death on September 2, 2001, C.N. Barnard wrote about V.P. Demikhov to the surgeon I.E. Konstantinov:

"Well, I think he was a remarkable man, an absolutely remarkable man who conducted all his research without extracorporeal circulation. And, as I said previously, if we were to choose the father of heart and lung transplantation, I'd put my money on Dr Demikhov." [44]

V.P. Demikhov, who died on November 22, 1998, hardly read these words.

References

1. Konstantinov BA. Predislovie. In: Konstantinov BA. (ed.) *Klinicheskaya transplantologiya*. Moscow: Air-Art Publ.; 2004. (In Russ.).
2. *Demikhov Vladimir Petrovich*. URL: https://ru.wikipedia.org/wiki/Демихов,_Владимир_Петрович [Accessed September 14, 2020]. (In Russ.).
3. *Vladimir Demihkov: The Two-Headed Dog Surgeon*. URL: <http://bored-bored.com/top-10-mad-scientists-in-history> [Accessed September 14, 2020].
4. Onopriev VI. *Zhit' po umu i po sovesti*. Krasnodar: Raritety Kubani Publ.; 2007. (In Russ.).
5. *Barnard Christian*. URL: https://ru.wikipedia.org/wiki/Барнард,_Кристиан#cite_ref-23 [Accessed September 14, 2020]. (In Russ.).
6. Bateneva T. Professor Christian Barnard: Peresadka serdtsa – ne glavnoe, chto ya sdelał. *Izvestiya*. 2001; 25934 (96, June, 1): III, IV. (In Russ.).
7. Yakovleva E. Zhizn' – eto prazdnovanie togo, chto ty zhiv. Umer Christian Barnard – khirurg, kotoryy pervyy sdelał peresadku serdtsa. *Rossiyskaya gazeta*. 2001; 2783 (171, September, 4): 1, 8. (In Russ.).
8. Glyantsev SP. Phenomenon of Demikhov. In the 1st Moscow Medical Institute named after Sechenov (1956–1960). V.P. Demikhov's first business trip to Germany (December 1958 – January 1959) A Round Table discussion for the newspaper "Stuttgarter Zeitung" (March 1959). *Transplantologiya. The Russian Journal of Transplantation*. 2016;(1):47–58. (In Russ.).
9. Glyantsev SP. Phenomenon of Demikhov. In the 1st Moscow Medical Institute named after Sechenov (1956–1960). V.P. Demikhov's

second business trip to Germany (May, 1959). "Organ transplantation: Is it possible?" (1959). *Transplantologiya. The Russian Journal of Transplantation*. 2016;(2):58–66. (In Russ.)

10. McRae D. *Every second counts. The race to transplant the first human heart*. London, Sydney, New York, Toronto: Pocket Books; 2007.

11. Glyantsev SP. Phenomenon of Demikhov. In the 1st Moscow Medical Institute named after Sechenov (1956–1960). V.P. Demikhov's third business trip to Germany (September 1959). Advances of world transplantation (1951–1959). "The Soviet suturing machine", or "Androsov's stapler" (1959). *Transplantologiya. The Russian Journal of Transplantation*. 2016;(3):46–55. (In Russ.)

12. Sapa AP. *Red claims he can transplant hearts*. The Cape Argus. 1959; October 26.

13. Kaleda VI. Christiaan N. Barnard (1922–2001) and his path to heart transplantation. *Patologiya krovoobrashcheniya i kardiokhirurgiya = Circulation Pathology and Cardiac Surgery*. 2017;21(3S):92–100. (In Russ.). <http://dx.doi.org/10.21688/1681-3472-2017-3S-92-100>

14. Revishvili ASh, Demikhova OV (eds.). *Demikhov Vladimir Petrovich. 100 let so dnya rozhdeniya (1916–1998): fotoal'bom*. Moscow: FGBU «Institut khirurgii im. A.V. Vishnevskogo» Minzdrava Rossii Publ.; 2016. (In Russ.).

15. Barnard CN, Pepper CB. *Christiaan Barnard: One Life*. Cape Town: Howard Timmins; 1969.

16. Lower RR, Shumway NE. Studies on orthotopic homotransplantation of the canine heart. *Surg Forum*. 1960;11:18–19. PMID: 13763847

17. Brewer C. (ed.) *Barnard S. The Second Life: Memoirs*. Cape Town: Vlaeberg; 1993.

18. Progress is made by heart patient. Rejection of transplanted organ is suppressed. Capetown, Dec. 9 (AP). *New York Times*. 1967; December, 10.

19. Malan VM. “Herrgott, es schlägt wieder”. Die Herzverpflanzungen des Professors Barnard. *Der Spiegel*. 1968;10(4):118–130.

20. Barnard CN. The operation. A human cardiac transplant: an interim report of a successful operation performed at Groote Schuur Hospital, Cape Town. *South Africa Med J*. 1967;41(48):1271–1274. PMID: 4170370

21. Barnard CN. A human cardiac transplant: an interim report of a successful operation performed at Groote Schuur Hospital, Cape Town. *Patologiya krovoobrashcheniya i kardiokhirurgiya = Circulation Pathology and Cardiac Surgery*. 2017;21(3S):101–106. (In Russ.). <http://dx.doi.org/10.21688/1681-3472-2017-3S-101-106>

22. Li M. *Heartbeat. A story told by Michael Lee*: tr. from eng. Moscow: MED press-inform Publ.; 2017. (In Russ.).

23. Rowe HT. *Der Chirurg von Kapstadt. Die Herztransplantationen des Professor Christiaan Barnard*. München: R.S. Schultz Verlag; 1968.

24. Myerowitz PD. *Heart Transplantation*. Mount Kisco, New York: Futura Publ. Comp., Inc; 1987.

25. Mittal CM. Profulla Kumar Seb. His Contributions to Cardiovascular Surgery. *Texas Heart Institute J*. 2002;29(1):17–25.

26. Vishnevskiy AA, Kolesnikov IS, Portnoy VF, Arapov AD, Ballyuzek FV, Kaydash AN, et al. Peresadka serdtsa cheloveku (Predvaritel'noe soobshchenie o pervoy operatsii, osushchestvlennoy voennymi vrachami 4.XI.1968 g. v Voенno-meditsinskoy ordena Lenina

Krasnoznamennoy akademii imeni S.M. Kirova. *Military Medical Journal*. 1968;(12):8–13. (In Russ.).

27. Amosov NM. *Golosa vremeni*. Moscow: Vagrius Publ.; 1999. (In Russ.).

28. Demikhov VP. *Peresadka zhiznennno-vazhnykh organov v eksperimente*. Moscow: Medgiz Publ.; 1960. (In Russ.).

29. Glyantsev SP. Phenomenon of Demikhov. In the Sklifosovsky Institute (1960–1986). Research Coordination Council of the USSR Healthcare Ministry: Missed opportunities. Part 1 (1963). *Transplantologiya. The Russian Journal of Transplantation*. 2019;11(3):244–258.

<https://doi.org/10.23873/2074-0506-2019-11-3-244-258>

30. Logan Ch. *Celebrity Surgeon. Christiaan Barnard: A Life*. Johannesburg & Cape Town: Jonathan Ball Publishers; 2003.

31. Pioniers der Transplantationschirurgie. *Die Welt*. 2001; 2 September.

32. Terblanche J, Cywes S, Barnard CN. Tissue transplantation in the form of head grafting. *Medical Proceedings (Johannesburg)*. 1960; May 21: 212–214.

33. Shapiro HA. New hearts for the old? *Medical Proceedings (Johannesburg)*. 1960; May 21: 211.

34. Deterling R. Russia Revisited. *Arch Surg*. 1961;83:275–285. PMID: 13722260 <https://doi.org/10.1001/archsurg.1961.01300140117023>

35. Walters W. Russian Surgery and the Russian Surgical Congress. *Arch Surg*. 1961;82:191–212. PMID: 13782975 <https://doi.org/10.1001/archsurg.1961.01300080019002>

36. Petrovskiy BV. *Khirurg i zhizn'*. Moscow: Meditsina Publ.; 1998. (In Russ.).

37. Barnard CN: Interview. Sonina M, Shmakov A, Kravchenko M. *Rejection: TV documentary*. Moscow, Respublikanskiy tsentr reproduksii cheloveka i planirovaniya sem'i MZ RF Publ., 1999. (In Russ.).

38. Malan M. *Heart Transplant: The Story of Barnard and the "Ultimate in Cardiac Surgery"*. Johannesburg: Voortrekkerpers, 1968.

39. Podarennoe vremya. *Krugozor*. 1968;(9):9. (In Russ.).

40. Demikhov V, Barnard K. Peresadka serdtsa – fakty i perspektivy. *Literaturnaya gazeta*. 1968;1:9,11. (In Russ.).

41. Barnard CN, Losman JG. Left ventricular bypass. *South Africa Med J*. 1975;49(9):303–312. PMID: 1090016

42. Demikhov VP. Part 1. Uspekh. *Krugozor. Audioprilozhenie*. 1968: 9. (In Russ.).

43. Ostvald V. *Velikie lyudi*: trans. from the 2nd germ. ed. G. Kvasha; 1910. (In Russ.).

44. Konstantinov IE. A Mystery of Vladimir P. Demikhov: The 50th Anniversary of the First Intrathoracic Transplantation. *Ann Thor Surg*. 1998;65(4):1171–1177. PMID: 9564962
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The Editorial Board of the "Transplantologiya" journal considered it possible to publish Professor D.A. Balalykin's commentary to the article by S.P. Glyantsev and co-authors, which is of special scientific interest with respect to this science field:

The article by S.P. Glyantsev, B.M. Gorelik, and A. Werner entitled "PHENOMENON OF DEMIKHOV. At the Sklifosovsky Institute (1960-1986). C.N. Barnard and the first clinical heart transplantation (December 3, 1967). V.P. Demikhov and C.N. Barnard: touchpoints" deserves a very serious professional attention. First, this is excellent research by medical historians who, relying solely on facts, sources, and documents, have brought a lot of new details in restoring a historically accurate description of the interaction between famous surgeons of the 20th century: C.N. Barnard and V.P. Demikhov. Second, this is an important experience of critical understanding of the stereotypes

that have developed in historiography, and, most importantly, revealing the genesis of these stereotypes.

Unfortunately, in Soviet times, the History of Medicine developed as a memoir specialty, which attention was mainly paid to the narration of certain events. At the same time, the general rules of historical science, in particular the principles of critical work with sources, were not systematically taken into account.

World science has been dealing for a long time with the facts from the history of individual scientific disciplines in a more general methodological context: today this scientific area is called "history and philosophy of science." It is necessary to clarify factology (what happened and under what circumstances), chronology (when it happened), as well as ontology and epistemology, the essence of ideas and concepts, as well as the methods of studying phenomena. After all, the History of Medicine existence is justified only when it teaches useful lessons from the past in order to educate those living.

The key methodological solution for understanding historical and clinical medicine, including the emergence of present-day cardiac surgery and transplantology, is the theory of scientific revolutions proposed in the middle of the 20th century. The set of today's ideas about a scientific problem and methods to solve it (the modern paradigm) once arose within the framework of the previous paradigm and on its basis. At some point, the "shell" of the old theory ceased to satisfy the dynamic movement of modern practice. And this practice, having rapidly transformed the cognition methods, led to the emergence of new knowledge: the chicken (new paradigm) broke through the shell (old paradigm). At the same time, the ontological and epistemological connection between the egg and the new chicken has not gone anywhere. I hope the reader will forgive me

this free analogy, but it is the best way to represent the relationship between the old and the new in science.

In global science, it is customary to use general concepts of the philosophy of science: "rationality type", "scientist's presentation of the world", etc. to explain the fundamentally new revolutionary transformations in clinical medicine of the XX century. Obviously, the "rationality type" of C.N. Barnard, A. Kantrowitz, and their colleagues was characterized by a multidisciplinary approach: they had to go beyond the traditional horizon of a practicing surgeon. They needed simultaneously to comprehend critically the state of their contemporary clinical cardiac surgery, and also to collect together the data of resuscitation, anesthesiology, immunology, etc. In addition, their personalized understanding of the technology of medical devices and instruments required for the intervention was needed. This is the level of synthetic thinking, when a scientist appears capable of providence, that is, prospective modeling of the future desired form of his clinical and experimental activities. Their "scientist's presentation of the world" was supposed to imply both the possibility of creating speculative and experimental models of activity, and also (using K. Popper's terminology*) to have an extremely high potential for falsifying and verifying hypotheses.

In such a situation, C.N. Barnard per se can be imagined as a person looking at a conventional platform, on which a variety of tools and structures are randomly laid out. His task is to put together a complete puzzle from all those, a certain mechanism that must work and perform an intended function. This puzzle can be imagined as a kind of dynamic system consisting of many elements rotating around a certain axis, which

*Popper K. *The logic of scientific discovery*. New York: Harper Torchbooks; 1959. 479 p.

is not even a hypothesis, but an idea. The concept of "hypothesis" in the philosophy of science has specific characteristics of an applied nature; and here we are talking about that very key idea, which presupposes the possibility of realizing the previously impossible. The essence of the theory falsification and verification processes in this case can be described as an incredibly fast process of selecting an infinitely wide variation of solutions for the compatibility of the tools laid out on this speculative platform. C.N. Barnard had to operate with a huge amount of data based on surgical experience, immunological theory, and the capabilities of modern pharmaceuticals, etc. The core idea, apparently, was formed when C.N. Barnard began to comprehend the first, available for him information about V.P. Demikhov's experiments. It is around this axis, that all the other elements of the puzzle were lined up, representing a complex solution to a new scientific and clinical problem.

I believe that S.P. Glyantsev, B.M. Gorelik, and A. Werner are absolutely right in their final assessment of the influence of V.P. Demikhov's ideas on C.N. Barnard's work. One must understand that the "influence of ideas" is a much higher level of ontology than a story of a few days spent together at the operating table. The historically proven right to exist in the world of ideas (eidos, "ideal essences", according to Plato) is a higher mission than the opportunity to show one or another practical technique. The influence of V.P. Demikhov's ideas on C.N. Barnard, proved by the authors of the article, puts the great Russian scientist on a higher level in the history of medicine. We are talking about global influence, which allows to rank V.P. Demikhov among the authors of the scientific revolution in cardiology and cardiac surgery. Only a few scientists have the opportunity to successfully travel to the world of "ideal entities" and return to everyday life for their successful implementation.

C.N. Barnard and V.P. Demikhov certainly belong to the category of these lucky ones.

I also want to draw attention to one point that is most important for the methodology of historical science, i.e. the criticism of sources. Unfortunately, in Russian historiography, statements from witnesses of certain events have quite often been accepted without proper verification. If Academician N. recalled that Professor P. said this or that (all the more if this recollection was in a diary, memoirs, anniversary article, etc.), it was used to being accepted as an indisputable fact. And so, the study of history turned into myth-making. In this case, such a myth is the abundance of historical anecdotes, and here it is not only about Russian historiography. We must study them carefully, but study them critically, differentiating a myth or historical anecdote from historical facts. An equally fabulous recollection seems to be the story of C.N. Barnard's eight days with V.P. Demikhov at operating table. The undeniable facts provided by the authors regarding the nature and content of C.N. Barnard's trip to the USSR refute that. Indicative are C.N. Barnard's memoirs presented by the authors and containing a generally negative assessment of the level of the clinical surgery development in the USSR at that time. Indeed, a scientist who came to the conclusions so disappointing for the reputation of Soviet surgery would have never spend two weeks studying what he did not like. Moreover, it is becoming known that at the same time he studied the complex practice of organizing the activities in leading American cardiac surgery hospitals. This list can be completed with more examples of remarkable historical analysis made by S.P. Glyantsev, B.M. Gorelik, and A. Werner, but this would run beyond the format of my commentary.