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NEW SOVIET SURGICAL APPARATUS AND INSTRUMENTS AND THEIR APPLICATION

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EDITORIAL PREFACE

This symposium is compiled from the proceedings of the First Scientific Session of the Scientific Research Institute for Experimental Surgical Apparatus and Instruments, held from 6-8 December 1956 to sum up the first five years of the Institute's work. In future, such symposia on the Institute's work will be published regularly.

The Institute for Experimental Surgical Apparatus and Instruments is a scientific research institution for the organization and co-ordination of technical and medical personnel. The Institute's structure provides for a complete cycle of scientific investigations and practical work for the development of new surgical apparatus, from the drawing board right through to the production of experimental models which are tested in the Institute's experimental clinical department, are proved in the best hospitals and clinics of the U.S.S.R. and are then taken over by the medical instruments industry. The creative co-operation of engineer and doctor has made it possible in a comparatively short space of time to design and modernize more than a hundred surgical appliances, about a dozen of which are unique and have no prototypes abroad.

The scientific works presented in this symposium by no means exhaust the list of the investigations which are being carried out at the Institute. The symposium is mainly intended to familiarize the broad mass of surgeons with the new apparatus and instruments and with the first experience of their use. The institute's close ties with the country's leading surgical departments are reflected in the papers by Members of the U.S.S.R. Academy of Medical Sciences, Professors Vishnevskii and Petrovskii, and by Professors

Kazanskii, Meshalkin and Gerasimenko. These shed some light on the present state of some of the most important branches of surgery and indicate the trends in further work on the development of new apparatus and instruments.

The symposium is divided into several sections. The first section is devoted to general problems of medical instrument-making - the new science of designing medical instruments and apparatus. The papers by Gusenkov, Anan'yev, Babkin and Kabatov summarize the Institute's work and point out the paths in which it will develop. Then come several sections dealing with the experience gained from using the new apparatus. Each section contains an introductory paper which outlines the present state of the problem and the requirements for new products. This is followed by articles written by associates of the Institute (engineers and doctors) on the new appliances and practical experience with their use, and also articles written by doctors from other institutions who have used apparatus and instruments developed by the Institute. The last section is devoted to the problem of artificial blood circulation, first introduced into the Soviet Union in the 'twenties' by Bryukhonenko, inventor of the world's first artificial blood circulation apparatus (autoinjector). Artificial circulation has assumed prime importance in recent years because of the development of heart surgery. The Institute is carrying out a great deal of work on the subject. For the first time after a prolonged break, articles are published here on the development of artificial circulation in the U.S.S.R.

The Institute's staff would like to express their indebtedness to the President of the Academy of Medical Sciences, Professor Vishnevskii, as also to Professors Petrovskii, Kazanskii, Meshalkin, Gerasimenko, Kupriyanov, Shamov, Antelav, Uglov, Yelanskii, Maya, Ryzhikh, Struchkov, Gulyaev, Petrov, Arapov, Luzhnikov and many other leading Soviet surgeons for their important and valuable suggestions which were taken into consideration by the Institute in developing surgical apparatus and instruments.

The Editorial Board asks readers to address all comments and wishes concerning the material published here to the Scientific Research Institute for Experimental Surgical Apparatus and Instruments, Moscow, I-243, Fabrichnaya Liniya 6.

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THE BASIC TASKS OF THE SCIENTIFIC RESEARCH INSTITUTE
FOR EXPERIMENTAL SURGICAL APPARATUS AND INSTRUMENTS

P. V. GUSENKOV

The Communist Party and the Soviet Government devote much attention to problems of public health. More than 310,000 doctors and 850,000 medical staff are active in the Soviet Union. Research institutes and hospitals are showing success in their search for new means and methods of the prophylaxis, diagnosis and treatment of disease. A vast body of workers in the medical industry is striving to supply medical institutions with effective drugs and medical equipment. The incidence of disease and the mortality rate are dropping from year to year, whilst the average life expectancy of the Soviet citizen is on the increase.

One of the many measures taken by the government and aimed at developing medicine is the Decree of the Soviet Council of Ministers, dated 28 September 1951, for the organization of a special Scientific Research Institute for Experimental Surgical Apparatus and Instruments at the U.S.S.R. Ministry of Health. The decree clearly sets out the Institute's tasks. It is responsible for carrying out research to design and improve apparatus and instruments for all branches of surgery and must help to introduce these instruments into therapeutic practice.

In 1951 - its first year of work - the Institute had a staff of 200, among which were five Doctors of Sciences, attached from other institutes, ten Candidates of Sciences, and a design team from the All-Union Scientific Research Institute for Medical Instruments and Equipment. This was

the core of people around which was subsequently built up the staff of an Institute which is now greatly expanded and consolidated and capable of fulfilling the tasks it has been set. The basic feature in the organization of the Institute's work, in contrast to that of other institutes in the medical industry, is the joint participation of both engineer and doctor in developing new appliances. Thanks to this co-operation, complex instruments and apparatus have been designed to meet both their constructional and functional specifications. The development and introduction of new surgical apparatus have formed the basis of the Institute's work. Many appliances have been designed to help the surgeon through the more laborious and critical stages of an operation.

During the five years of its existence the Institute has designed 115 new medical appliances, of which 86 date back to the period 1955-1956. Noteworthy among these appliances is the series of original instruments for suturing vessels and other organs or tissues. Of great practical importance is the work which has been carried out in designing special apparatus for heart and lung surgery, apparatus for artificial blood circulation, electro-sleep and electronarcosis, etc. Over the past two years the Institute's associates have published 59 articles on their work.

The Twentieth Congress of the Soviet Communist Party has imposed new honourable and noble tasks on health workers. They must raise the standard of all practical work, improve the quality and efficiency of public medical services, concentrate the efforts of scientists on the discovery of new methods and agents of prophylaxis and therapy and increase the 1960 output of the medical industry to not less than double the 1955 figure. The staff of the Scientific Research Institute for Experimental Surgical Apparatus and Instruments, as members of one of the leading institutes of the medical industry, have a distinguished part to play in this campaign. We can confidently predict that they will cope ably with the problem and will supply our surgeons with apparatus and instruments in keeping with the requirements of modern medicine.

U.S.S.R. Ministry of Health

NEW SURGICAL EQUIPMENT
AND THE FURTHER PROSPECTS FOR ITS DEVELOPMENT

M. G. ANAN'YEV

The foundations for the production of medical instruments in Russia were laid by an edict of Peter I who ordered "the manufacture of medical instruments" in Petersburg. Since then the production of medical instruments has been constantly developed and perfected, helped in no small degree by the active part played by leading surgeons in designing new surgical appliances. This has become an honoured tradition since the times of Buyal'skii and Pirogov who for many years directed the production of medical instruments at the works which now bear the name of Krasnogvardeyets.

In the last decade the medical instruments industry has begun to develop at a particularly fast rate. Soviet surgery now has quite a large arsenal of equipment at its disposal, containing more than 2,000 instruments, appliances and other surgical apparatus. However, the Twenty Sixth All-Union Congress of Surgeons, held in January 1955, pointed out several grave shortcomings in the development of the medical industry and in the technical equipment of medical institutions. The Congress pointed to a lag in the development of new appliances for several branches of surgery (surgery of the heart, lungs, major blood vessels, etc) and drew attention to the inadequate output of instruments and apparatus and the low quality of some of the products.

Workers in the medical instruments industry and in the research institutes connected with it have taken steps to

eliminate these shortcomings. As a result many new instruments and pieces of apparatus have been designed recently and a number of Soviet and foreign models perfected. The equipment in surgical institutions has been improved and the industry has greatly increased its output of products. However, the demand for surgical apparatus in medical institutions is still not fully satisfied and the quality of certain appliances is still poor. As for the designing of new equipment, i.e., the development of new and the modernization of existing surgical apparatus and instruments, a great deal of work has been done by research institutes (All-Union Scientific research Institute for Medical Instruments and Equipment and the Scientific Research Institute for Experimental Surgical Apparatus and Instruments), the Central Planning and Designing Board and design teams at medical works in conjunction with rationalizers and inventors. The result has been that many original and improved appliances have been added to the surgical instrumentarium.

Among the most original products of the Research Institute for Experimental Surgical Apparatus and Instruments is apparatus for the mechanical suturing of organs and soft tissues and apparatus for the mechanical ligation of vessels with tantalum ligatures. Among the most widely used suturing apparatuses are those for circular angiorrhaphy. The first models, built by a team of engineers and doctors headed by Gudov, were later radically redesigned, so that the appliances have become handier and cheaper, whilst the interchangeable inserts used in them permit vessels of any calibre to be sutured. A universal angioneurorrhaphy apparatus has also been developed which can be used both for end-to-end and end-to-side angiorrhaphy and also for suturing the ends of nerves. Angiorrhaphy apparatus is now firmly established in surgical practice and is used both in the Soviet Union and abroad (in England, China, India and other countries).

An apparatus which has won the general approval of surgeons and has been used in hospital on more than 500 patients is the device for instantaneous mechanical suturing of the bronchial stump in a pneumonectomy or lobectomy. After tests in the hospital run by Bakulev, the apparatus became a firm favourite in thoracic surgery practice and is used with success by Bogush, Uglov, Vishnevskii, the Bulgarian surgeon Stoyanov, etc. On the same mechanical suturing principle and at the suggestion of

Bakulev, the Institute has developed a special apparatus for sewing up the cardiac auricle and has turned it over to the hospital. For lung operations successful use is being made of the ULAV apparatus for suturing and ligating the vessels of the lung hilus, while a smaller version of the same apparatus is in use for ligating the lobular vessels in a lobectomy.

The Institute's staff has developed and passed on to the medical industry notched forceps for sphenoidal resection of the lung and several other instruments for lung operations. For the simultaneous mechanical suturing of vessels and bronchi in resection of the lung an apparatus is being developed which does away with the need for preliminary preparation of the elements of the lung hilus. Once we have solved this complicated technical and surgical problem, the operation for resection of the lung and its lobes will become much easier and will be within the capabilities of a larger number of surgeons.

The known apparatus for ligating the gastric stump (Petz, Neifer, etc.) has not been widely used because it is cumbersome and only permits one row of sutures at a time to be inserted. The Institute has designed a smaller original apparatus for double-row ligation of the gastric stump in a gastrectomy. The apparatus has undergone successful tests in the hospital directed by Yelanskii and at the Sklifosovskii Institute and has now been turned over for commercial production.

The Institute has built an experimental model of an apparatus for performing end-to-end, end-to-side and side-to-side intestinal anastomosis. Work is in progress on an apparatus for performing gastroenteroanastomosis. Apparatus for ligating vessels, bronchi, intestines, perineum, pleura, etc., has been designed. An apparatus for the metallic ligation of vessels in deep cavities, of the ureter in a nephrectomy or of the common bile duct in a cholecystectomy, automatic skin forceps and instruments for fitting clips on to cerebral vessels have been developed and turned over for commercial production. Work is also in progress on apparatus for soft suturing and ligating.

Several new electrical instruments have also been developed. An apparatus for electro-sleep therapy, an electric thermometer and a defibrillator, of great help in

arresting fibrillation in the heart, have been handed over for production. There are three types of defibrillators: two stationary and one battery-powered portable defibrillator which can be used under any conditions when emergency treatment is called for. The experience gained in developing the electro-sleep apparatus has enabled us to build an electronarcosis apparatus which is now being tried out on animals.

A set of instruments for biactive coagulation has passed its clinical tests and has been put into commercial production. An electrotrepine with its set of cutters and drills has been put into production, a dermatherm has gone for clinical testing. Mass production has been approved for an electromanometer for measuring blood pressure and for an apparatus with visual control for constant measurement of pulse and blood pressure during operations. An apparatus for measuring liquor pressure is being developed. Much work is being done on the problem of artificial blood circulation. On the basis of Bryukhonenko's automatic injector, an improved artificial blood circulation apparatus with an automatic electropneumatic device has been built and tried out on dogs to arrest the function of left side of the heart and exclude it from the circulatory system for periods up to 50 min. Thoracic surgery specialists will shortly receive an apparatus which will make possible parallel circulation and exclusion of the heart during operation upon it, or artificial circulation with refrigeration of the circulating blood for performing hypothermia.

A device for intracardial sounding has been developed with which the blood pressure inside the heart and the blood vessels may be recorded and intracardial electrocardiograms made. The basis of the device is an ingenious pickup which can be inserted into a cavity of the heart via a vascular channel. It can even be used on children. The apparatus has been turned over to Bakulev's and Vishnevskii's hospitals and other institutions. Tests are being completed on a refrigerator for storing extracted organs (extremities and kidneys) until they are needed for grafting. This device, in conjunction with a Bryukhonenko autoinjector induces an artificial blood circulation in the removed organ. Working at the Institute, Lapchinskii has succeeded in restoring the functions of extremities and kidneys stored in the device for up to 26 hr and then grafted autoplastically in dogs. An

"artificial kidney" apparatus is being developed and a model will shortly undergo tests. Work is in progress on an ultrasonic scalpel and an ultrasonic device for crushing gallstones and bilestones. A "needleless syringe" is being designed for the subcutaneous injection of drugs.

Besides new products, much work is being done to unify and modernize existing apparatus, instruments and surgical appliances which stand in need of radical revision. The medical industry research institutes, the Central Planning and Designing Board and works' design teams have begun to revise and exclude obsolete apparatus, instruments and appliances from the lists, replacing them with new models. To improve the quality of medical appliances the institutes are making use of new materials - stainless steels, plastics, etc. The Institute for Experimental Surgical Apparatus and Instruments is drafting inventories of equipment for surgical departments and is working on the unification of surgical equipment and the compilation of special sets of instruments for the various branches of surgery and its allied fields (gynaecology, urology, ophthalmology, etc.). The equipment of medical institutions is being studied and their actual requirements in apparatus determined. A study on the selection principle is being carried out in Moscow and in the hospitals of the Kalinin Oblast'.

On the basis of these studies, the special sets of instruments for the various branches of surgery are being revised and complemented with new, modern appliances. The medical industry is already issuing a set of 38 thoracic instruments and a set of 18 instruments for cardiovascular operations. A set is being put together for surgery of the liver and bile tracts, also sets for gastrointestinal, urological, dental and otorhinolaryngological operations. Retractors with a set of hooks of various shapes and sizes, chisels, raspatories, saws, hammers, etc., have been unified and modernized and scalpels with interchangeable blades developed. A special set of instruments (cutters, sharp spatulas) has been designed for the prosthesis of major joints and another set (bone-holders, drills, screws, plates) for uniting bone fragments. Prostheses for major joints (hip, shoulder, elbow, knee) have been developed with pegs of metal and heads of plastic. A portable, collapsible device has been built for the treatment of patients with extensive burns.

Progress in surgery has always been the result of achievements in the field of natural sciences. So it was with the introduction of asepsis and antisepsis after Pasteur's discoveries, and with the introduction of anaesthetics after the development of chemistry. Today we live in an age of great discoveries in physics, chemistry and technology. The incorporation of the latest scientific achievements into medical engineering could lead to a real revolution in the methods of surgical diagnosis and therapy and ensure real progress in surgery. From this stem a number of the tasks with which the staff of the Scientific Research Institute for Experimental Surgical Apparatus and Instruments are faced. These tasks consist mainly in reducing the risk inherent in surgical intervention and connected with the technique of performing the operation, asepsis, anaesthesia, early diagnosis, etc. In view of the growing number of surgeons in the Soviet Union, we must design apparatus and instruments to reduce the operational risks - risks which depend as much on the technical equipment used as on the capabilities of the surgeon. This will help to extend major surgery from the big cities to the provinces and make it available to the general surgical practitioner.

Much effort must be devoted to developing an instrumentarium for restorative surgery, i.e., apparatus and instruments for grafting organs and tissues, artificial limbs, vascular prostheses, absorbable materials for osteosynthesis and suturing instead of metal pegs and wires, tasks on which the Institute is at present engaged (absorbable pegs, sutures and surgical glue for joining live tissues). Finally, much may be done to reduce the risk in major surgical operations by systematic observation of the main body functions in the course of the operation. Apparatus for this purpose must be designed and surgeons furnished with simple heart-lung apparatus and resuscitation equipment in case complications develop or they need to exclude a particular function during the operation. Future progress in surgery will depend largely on the development of medical instrument making.

Scientific Research Institute
for Experimental Surgical
Apparatus and Instruments