In recent years physicians' examinations of patients as well as prophylactic examinations of the healthy are becoming more and more complex. In a majority of cases it is necessary to use several devices for the conduct of a complex investigation. Usually attachments to an ECG are used. Essentially these attachments are independent units without their own recording elements. As independent units these attachments are often heavy and of quite large proportions and thus the connection to the recording element of the ECG demands time and the rearrangement of units. In conjunction with the inadequate number of multichannel ECG this makes the use of methodology requiring the simultaneous recording of several parameters difficult.

In recent years a number of multichannel medical diagnostic complexes have been developed by foreign firms which permit simultaneous recording of several physiological indicators. An analogous apparatus, the electronic polygraph P4Ch-01, was developed at the All-Union Scientific-Research and Construction Institute of Radioelectronic Medical Apparatus. A general view of the apparatus is shown in Fig. 1. Its production was implemented by the experienced plant of the All-Union Scientific-Research and Construction Institute of Radioteleonic Medical Apparatus, and in 1976 the first models of the device were delivered to consumers. The polygraph consists of a base unit intended for the simultaneous use of four diagnostic modules, a four-channel ink-writing recording element, an eight-channel oscilloscope, and the diagnostic modules. The diagnostic modules are four ECG units, two impedance plethysmography units, one unit each for sphygmography, phonocardiography, chronocardiography, thoracospirography, electromyography, two EEG units, and one dc amplifier.

The base unit has outputs to which analyzers (e.g., EEG, EMG), magnetic recorders, and analog–digital converters for computer input can be connected. The output parameters are the following: output resistance less than 500 Ω, signal amplitude for any of the functional units at nominal sensitivity no less than 1 V.

At present the polygraphs come with the full complement of functional units indicated above. However, in the future consumers will be able to order models with only those diagnostic modules needed.

The polygraph primarily ensures the conduct of a multilateral investigation of the cardiovascular system in the functional diagnostic departments of the polyclinics, the regional, city, and area hospitals of any bed capacity, as well as in specialized healing institutions (such as oncological, antitubercular, dermatovenereological, psychiatric, etc.). The polygraph can be useful not only to therapists, but also to surgeons, anesthesiologists, and other specialists of scientific-research institutions. The polygraph is also suitable for use in resuscitation units or in intensive care units, as well as in neurological and psychiatric departments. The presence of a wide-screen (59 cm measured diagonally) oscilloscope permits observation during surgical intervention of the dynamics of variations of the most informative biosignals for the surgeon and anesthesiologist. A sufficiently broad choice of combinations is provided for this.

The four-channel recording element and the four ECG units permit the simultaneous recording of ECG from four leads at the option of the investigator. The advantages of simultaneous multichannel ECG recording are indisputable for differential diagnosis of polytopic extrasystoles, the manifestations of borderline variations of ECG, etc. With the aid of the chronocardiographic unit a chronocardiogram (rhythmogram) recording is possible by means of a curve reflecting the variation of the cardiac rhythms over the time period covered. The chronocardiogram is recorded at a paper feed rate of 1 mm/sec. On a section of paper 18 cm long it is possible to trace the dynamics of the variations of the interval R–R for a 3-min period. Distur-
Fig. 1. General view of the electronic polygraph P4CH-01.

Balances of the cardiac rhythm are easily demonstrated as well as the interrelationship of the sympathetic and parasympathetic regulation of the heart with the aid of the chronocardiogram. The simultaneous record of chronocardiogram and ECG from the I and III standard leads permits not only a demonstration of disturbances of the cardiac rhythm but also the diagnosis of the area of origin of heterotopic impulses.

The sphygmmograph unit provides the capability of recording the pulse fluctuations of the carotid, femoral, and radial arteries.

In addition, a record is possible of the venous pulse and of the pulse fluctuations of the liver. Two impedance plethysmography units ensure the conduct of parallel rheogram recordings of the extremities that are especially important in endarteritis and arterial occlusions. In the treatment of cardiogenic or traumatic shock, valuable information can be gained from simultaneous rheogram recordings of the brain and of the extremities. Such curves can indicate the character, sequence, and regional distribution of variations in the circulatory system and permit the opportune introduction of corrections to the anti-shock therapy. An integral rheogram of the body based on uncomplicated calculations permits data to be obtained on the systematic and minute volumes of the heart. Valuable diagnostic data can be obtained with rheocardiography, rheopulmonography, and rheoaortography. Both impedance plethysmography units have a device for differential rheogram recording which is quite useful for the in-depth study of the rheographic curve.

The phonocardiographic unit has amplitude–frequency characteristics according to Maass and Weber of A, H, C1, C2, and B1. The recording of phonocardiograms (PCG) is implemented by filling in the symmetrical image of the phonocardiosignal with alternating voltage having a frequency near the upper frequency limit of the inkwriting recording pen. An untransformed phonocardiosignal is presented on the oscilloscope.

The thoracospirographic unit ensures the recording of the curve characterizing the changes in the volume of the chest upon inspiration and expiration. By means of the thoracospirographic curve the study of the frequency and correlations of breathing cycle phases and the evaluation of the relative depth of breathing, etc., are possible.

The greatest value is presented by the possibility of the simultaneous recording of a series of parameters which leads to an increase in informativeness. Thus, the simultaneous recording of ECG, phonocardiogram, and sphygmogram of the carotid artery permits a polycardiogram to be obtained which is useful for phase analysis of cardiac activity. The interpretation of the PCG is significantly simplified by the simultaneous recording with the ECG. The same applies to a rheogram simultaneously recorded with the ECG and PCG. Simultaneous recording of the thoracospirogram and the chronocardiogram simplifies the resolution of the role of vagus regulation of the cardiac rhythm.

For neuropathologists, resuscitators, and psychiatrists there is a particular interest presented by the recordings of rheencephalograms and electroencephalograms which can be supplemented by ECG and thoracospirograms.