The International Atomic Energy Agency scheduled a symposium on neutron dosimetry in Vienna, August 29 through September 2, 1966. Twenty-eight nations and international bodies participated. Over 60 papers were read and discussed, 11 of those papers submitted by Soviet scientists.

The papers dealt with the physical aspects of neutron dosimetry, with liquid-dielectric detectors, scintillation counters and semiconductor detectors, single-sphere and multisphere systems, reviews of experience in dosimetric work, neutron dosimetry using different sets of equipment, development of neutron personnel dosimeters, dosimetric investigations of nuclear accidents, comparisons of different dosimetric systems, standardization and calibration of neutron sources and instruments.

A review paper presented by J. Auxier (USA) reported on basic advances in neutron dosimetry, and took note of the most promising method for counting tracks in solid insulators (glass, mica, etc.).

F. Williamson (USA) reported data on calculations of kerma/flux ratio for fast neutrons in the 0.1-10 MeV energy range, for H, C, N, O, and Ar, as well as several hydrocarbons (CH₂, Ch, etc.), in which the latest available data on differential elastic scattering cross sections was made use of. The data clash with data published earlier only where neutron energies upwards of 3 MeV are concerned. The calculations also indicate that the use of a CO₂-filled air-equivalent chamber for \( \gamma \)-dose measurements in the presence of neutrons can run into an error of 5 to 20% at the same absorbed doses. This leads Williamson to recommend argon as the filling gas, since the error remains within 2% under these conditions.

V. Zolotukhin (USSR) cited results of Monte Carlo calculations of the proton depth dose distribution and of the distribution of recoil nuclei hit by neutrons of 0.1 keV–10 MeV energy, in the cross section of an elliptical cylinder of tissue-equivalent material. The findings referred to each of the components of the doses, and to 264 zones formed by the intersections of 12 polar rays and 22 elliptic curves. The dose distribution along the minor axis was in practical agreement with the data reported by W. Snyder.

D. Watt (Britain) and I. Keirim-Markus (USSR) presented experimental data on neutron depth dose distribution in phantoms. Watt found excellent agreement between recoil proton dose calculations and data reported by Snyder, S. Booth, and J. Smith referable to the surface of a phantom, but Watt's results for the deep interior of the phantom were twice as high. A discrepancy with Snyder's data, in reference to proton dose in the N¹⁴ (n, p) C¹⁴ reaction and \( \gamma \)-ray dose in the H(n, \( \gamma \)) D reaction, suggested a different position for the depth dose maximum. Keirim-Markus used a broad neutron beam in a study covering the 130 keV–5 MeV energy range, and analyzed the distribution in three mutually perpendicular directions. The \( \gamma \)-ray dose distribution was in excellent harmony with Snyder's data, but the proton dose in the N¹⁴ (n, p) C¹⁴ reaction was twice as high, at the maximum, as Snyder's data indicated, possibly because of an error in the calculations.

J. Broers (Netherlands) compared different types of tissue-equivalent ionization chambers experimentally (comparing the chambers with each other and with sulfur detectors), and obtained excellent agreement in all measurements at 15.6 MeV neutron energy. Results of measurements in the 2.5–3.4 MeV neutron energy range, using the sulfur detector, were 1.58 to 1.77 times higher than results obtained with ionization chambers at the same neutron flux level. The difference is explained by sulfur resonances in the 2.5–3.4 MeV range and by the large energy spread of incident neutrons (≈ 0.1 MeV). Broers concludes that the use of sulfur in neutron dose measurements can lead to significant errors in the 2.5–3.4 MeV energy range.

F. Tardy-Joubert (France) reported on experimental studies of the relationship between maximum absorbed dose in the organism and the dose measured with the aid of tissue-equivalent counters in air.

(kerma) in exposures to fast 0.4 MeV and 4.14 MeV neutrons. In contrast to the theoretical ratio of 1.3 to 1.5, the ratio reported for the Tardy-Joubert experiments (for the torse) was 1.15-1.2 for neutrons from a point source, and 0.3-0.6 for the isotropic angular distribution of incident neutrons. The author's conclusion is that the estimated absorbed dose in the organism based on data for dose measurements in air can produce large errors.

A report by I. Keirim-Markus (USSR) discussed the recent recommendations by the International Commission on Radiation Units, on determinations of dose equivalent and quality factor of the radiation.

M. Zelczynski (Poland) discussed, in two papers, the possibility in principle of determining the dose equivalent of mixed radiation with the aid of detectors of LET-dependent sensitivity, and the concrete implementation of this method in the differential recombination chamber.

Papers by D. Blanc (France) and M. Pellicchioni (Italy) contain the results of studies of tissue-equivalent ionization chambers with a liquid dielectric (hexane, hexane-CCl₄ mixture), which can be used to measure absorbed dose of neutrons and γ-rays separately and additively, as well as quality factor. One of the principal shortcomings of these chambers is the very high supply voltage required (several tens of kilovolts).

Papers by V. Verbinsky (USA), H. Gredel (West Germany), V. Kukhtevich, I. Goryachev, A. Bakov (USSR) described organic-scintillator neutron spectrometers, and presented the results of studies of the neutron spectra of (α, n)-sources (Po-Be, Po-B, etc.). All the spectrometers described operate on the principle of pulse shape discrimination of γ-ray emission. The low threshold is at 0.1 to 0.2 MeV. These spectrometers can be used to measure γ-ray emission spectra in the presence of neutrons, total neutron dose, and total γ-ray dose.

In their reports, M. Bohrmann (West Germany) and D. Blanc (France) discussed methods for recording neutron flux with Li6 glasses and fast neutron spectrometry with the aid of gaseous (helium) scintillators.

S. Deme (Hungary), M. Thurston (USA), D. Blanc (France), T. Salgier (Britain) presented results of semiconductor detector measurements of flux, dosage, and fast neutron spectra. Deme showed methods based on particle counting and on the use of a suitable operator can be successfully used, in conjunction with semiconductor detectors, to measure the dose associated with the first collision of fast neutrons. The detector developed by Deme has an energy threshold of ≈0.8 MeV for neutrons, and is capable of recording neutron dose rates starting with 1 rad/h. The accompanying γ-radiation must not exceed 5 rad/h. Thurston determined the fast neutron dose in the 1-15,000 rad range by measuring the resistance of three silicon diodes exposed to neutron bombardment. The energy variation of sensitivity differed slightly from the dose associated with the first collision in tissue. A dose measurement of 1 rad is accurate to within ±20%, and above 50 rad the measurements are accurate to within ±5%. Blanc made use of the variation in the capacitance of semiconductor detectors exposed to neutron bombardment.

Papers presented by I. Keirim-Markus (USSR) and F. Tardy-Joubert (France) dealt with the study of multisphere moderating systems with thermal neutron detectors. Keirim-Markus investigated the performance of these systems over a wide range of neutron energies, from 5 eV to 17 MeV. The second paper presented the design of a BF₃-filled proportional-flow short counter. Both papers recommended optimum dimensions for the moderating systems, to facilitate measurement of the dose equivalent rate and neutron flux density.

J. Leek (Britain) described two portable instruments designed to measure the neutron equivalent dose rate over the energy range from thermal to 12 MeV in both pulsed and stable radiation fields. The sensor in the first instrument is a sphere 20.8 cm in diameter, with a LiI (Eu) crystal at its center. The second instrument, similar in design to the first, employs a BF₃-filled ionization chamber as thermal neutron detector. The sensitivity of the first instrument remains constant within ±50% accuracy over the neutron energy range from 200 keV to 10 MeV, but increases markedly below 200 keV. The sensitivity of the second instrument is constant to within ±50% over the neutron energy range from thermal to 12 MeV.

D. Nachtigall (West Germany) measured the contribution of intermediate-spectrum neutrons, of energies 0.5 eV to 100 keV, to the total dose equivalent of neutrons of all energies at many points in