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AUTHORS: Khramova ND, Miroyedov VA, Yur'yev VV:

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MAIN SUBJECT HEADING:

[✓ AN] ANALYTICS

HU HUMAN EFFECTS

AT ANIMAL TOXICITY

IH WORKPLACE PRACTICES-ENGINEERING CONTROLS

M MISCELLANEOUS

SECONDARY SUBJECT HEADINGS: AN HU AT [✓ IH] M

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DISTRIBUTION OF ULTRASHORT WAVE FIELDS IN THE VICINITIES OF URBAN TELEVISION CENTERS

Moscow O BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY RADIOCHASTOT in Russian 1973 pp 37-42

[Article by N. D. Khramova, V. A. Miroyedov, and V. V. Yur'yev]

[Text]

Instrumental measurements were made of the electromagnetic field intensities around television centers. Good agreement was obtained between calculated and measured data. At a distance of 250-750 m from a television center the intensity of the electromagnetic field noes not exceed 1 V/m.

The distances which are covered by radio and television have been greatly expanded by the large network of radio stations designed for broadcasting and communication, the increase in the number of television centers and relays, the tendency to use superhigh frequency as well as the increase in the power of the transmitters and improvements in the antenna systems.

At the same time the rapid rate of civilian and industrial construction has resulted in the fact that radio and television stations find themselves surrounded by residential homes.

Consequently, people are exposed to the potential hazard of irradiation by radio waves.

We've studied the distribution of electromagnetic fields around large television stations in the USSR.

Television communication in the USSR is conducted at frequencies ranging from 48.5-230 MHz with corresponding wavelengths of 6.25-1.3 m. Omnidirectional multi-storied turnstile antennas are employed with a gain factor of about 4. The antennas are located on supports at a height of 140-160 m and higher, up to 190-230 m.

Generally, 3 characteristic zones are considered in a high frequency field of radiation: the adjacent zone, the intermediate zone, and the distant (wave) zone.

In considering field distribution in populated areas around television centers we are concerned only with the wave zone.

However, the conditions for the dissemination of electromagnetic energy in the city represents a very complex problem since, from the point of view of dissemination of the radio waves, the city can be regarded as a highly rugged terrain. For all practical purposes, it is extremely difficult to determine field intensity by means of calculations in such a situation.

We elected to employ instrumental evaluation of electromagnetic field intensity. Furthermore, in hygienic practice it has come to be accepted to express the intensity of radiation in distant zones in units of power flux density. We chose to evaluate this factor in terms of the intensity of its electrical component, i.e., in volts per meter (V/m). This was advantageous because in determining the levels of radiation in residential areas we had to conduct measurements both outside of buildings and within buildings (on staircases, in apartments, and so forth).

Under these conditions we have to deal with limited spaces and a large number of secondary emitters. Consequently measurements that were conducted within buildings--irregardless of their distance from the antenna of the television center--are related to measurements conducted in the adjacent zone where the intensity of radiation is commonly evaluated in terms of the intensity of the components of the field, in part in terms of the electrical component, i.e., in volts per meter.

During the period 1970-1971 we investigated 9 television centers and relay stations. Studies on the distribution of field intensity were conducted in the greatest detail in the cities of Tartu, Tallin and Riga.

The measurements were conducted with instrument PZ-2. In order to increase the sensitivity of the instrument we employed an additional removable antenna, in addition to the standard antenna which came with the instrument. The instrument was calibrated in a field of plane-parallel capacitor at the Leningrad Tekhnikum of Instrument Construction and Automation. Calibration was conducted with both a standard antenna and the accessory removable antenna.

A detailed plan for carrying out the measurement was devised. To that end, we laid out 3 routes along which we conducted our measurements which were most representative of the residential area; the measurements were conducted in 3 to 4 different directions for a distance of up to 3 km. Along the selected routes measurements were conducted at intervals of 50 m up to a distance of 1.5 km and then at intervals of 100 m. At each point 3 measurements were made and the arithmetical mean was determined. The measurements were largely conducted at the height of a human being--1.5 m above the ground level.

Now, let us consider the intensity distributions of electromagnetic fields in some cities. A composite plot is presented in Fig. 1 which delineates the relationship between the field intensity at a distance from several television stations in the USSR on the basis of the measurement conducted from 1969-1970.

In 1971 we repeated in greater detail our measurements in the residential zones around the television centers in Tartu and Tallin.

The vicinity around the Tartu television center is characterized by a virtually flat region which consists of one and two storied cottages and gardens; the street plan in that area is straightforward and uncomplicated (Fig. 2).

In Fig. 2 we have indicated the routes of measurements which radiate from the television station. In addition, we made measurements along 2 circular routes around the television station (one larger and one smaller).

Measurements of field intensity conducted in areas close to this television center have given us a very clear picture of field distribution (Fig. 3).

Comparison of the field characteristics for the Tartu television center which were conducted in 1971 and 1970 (Fig. 1 curve 3), we can see that up to a distance of 1 km from the television center the field intensity was greater in 1970. This difference can easily be explained on the basis of the fact that in 1970 a shortwave radio center was located at the territory of the television center. In 1971 this radio center was moved outside the center by a distance of proximately 8 km and, consequently, the field intensity ound the television center decreased.

different type of residential construction is found in Tallin. Tallin the television center is located in a residential ea consisting of 5 to 7 storied buildings. This signifintly alters the distribution of the ultrashort wave field d decreases the average level of intensity (Fig. 4).

Tallin, in addition to the measurements conducted at 1.5 m, also conducted measurements at heights of 4, 8, and 12 m th the assistance of an automatic lift. Measurements at the rious heights were conducted on the same streets and at the me points as were the measurements which were conducted witht the assistance of an automatic lift. In addition, measurents were also conducted at the same height and at the same stances from the television center on staircases in buildings ich were next to windows which were facing the television ation.

e results of these measurements are given in Fig. 5(a,b).

nside the buildings the field intensities were 2.5-7 times ower than they were at the equivalent point out on the street. urthermore, the closer we came to the television center the ore significant the differences became.

ithin the conditions prevalent in a city an accurate mathemaical calculation of the distribution of the field intensity hich was generated by the antennas of the television center ould not be made in view of the non-uniformity of the city uilding constructions, the frequent irregular street plans, he fact that various materials were used in the constructions s well as the presence of a large number of reflecting suraces.

Therefore, our approach to this problem was largely utilitarian.

On the basis of our experimental investigations we attempted to calculate the expected field intensities by using the interference formula of B. A. Vvedenskiy which characterizes the dependence of the intensity of an electric field on the distance, wavelength, and the height of the antenna.

$$E = \frac{2,18\sqrt{PD}}{r^2\lambda} h_1h_2,$$

where E is the expected field intensity,
P is the power of the transmitter,

D is the antenna gain
r is the distance from the antenna to the point at which E was determined
λ is the wavelength
h_1 is the height of the phase center of emitting antenna,
h_2 is the height of the point of measurement.

However, the applicability of this formula is limited by the following consideration.

$$h_1 h_2 \leqslant \frac{r\lambda}{18}.$$

This condition may be met in the region of meter waves when the heights h_1 and h_2 are comparable.

In our case, since the height of the emitting antenna was more than 100 m, as a rule, and the height at the point of measurement was 1.5 m, determination of the effective (actual) value for the field intensity can be determined more readily by using the following formula

$$E_g = \frac{173\sqrt{P[\mathrm{kW}]D}}{r\,[\mathrm{km}]} \cdot V[\mathrm{mV/m}].$$

We introduced the coefficient V which represents the attenuation factor which takes into consideration the attenuation of the field due to its distribution over a highly rugged terrain (this term may be used to describe large cities). The value of the attenuation factor may be determined from the following expression

$$V = 1{,}7\,\frac{h_1(\mathrm{м})\cdot h_2(\mathrm{м})}{r\,(\mathrm{м})}.$$

In Figs. 3 and 4 the thick line indicates the calculated relationship between field intensity and distance.

The calculated relationship between field intensity and the distance conforms with the rounded curve for the maximum values of intensity of the electric field which were obtained on the basis of experimental measurements in these localities. The agreement between calculated and experimental values is fairly good. On the basis of the comparative results presented in Figs. 3 and 4 we may conclude that the attenuation factor could be decreased somewhat.

The fact, that a certain relationship prevails in the agreement between the calculated and experimental values, is supported by the fact that the agreement in the results was better in Tartu. In Tartu the field is distributed more evenly since in the vicinity of the Tartu television center the residential area consists of buildings of approximately the same height (1-2 stories and the topography of the region is relatively flat).

Analysis of the experimental data obtained in the vicinity of various television centers in the USSR has shown that at a distance of 250-750 m the local population is exposed to radiation which is equal to 1 V/m; these distances are indicated in Figs. 1, 3 and 4 and the value for the level of intensity is in accord with the maximum permissible level for ultrashort wave radiation.

This work requires further study in order to obtain unequivocal agreement between experimental and calculated values, the introduction of correctional coefficients, and the determination of the applicability of the formulas to various environmental conditions (the type of construction, the height of the building, the design, the constructional materials, as well as the distance from the point of emission, the parameters of the emitting antenna, and so on).

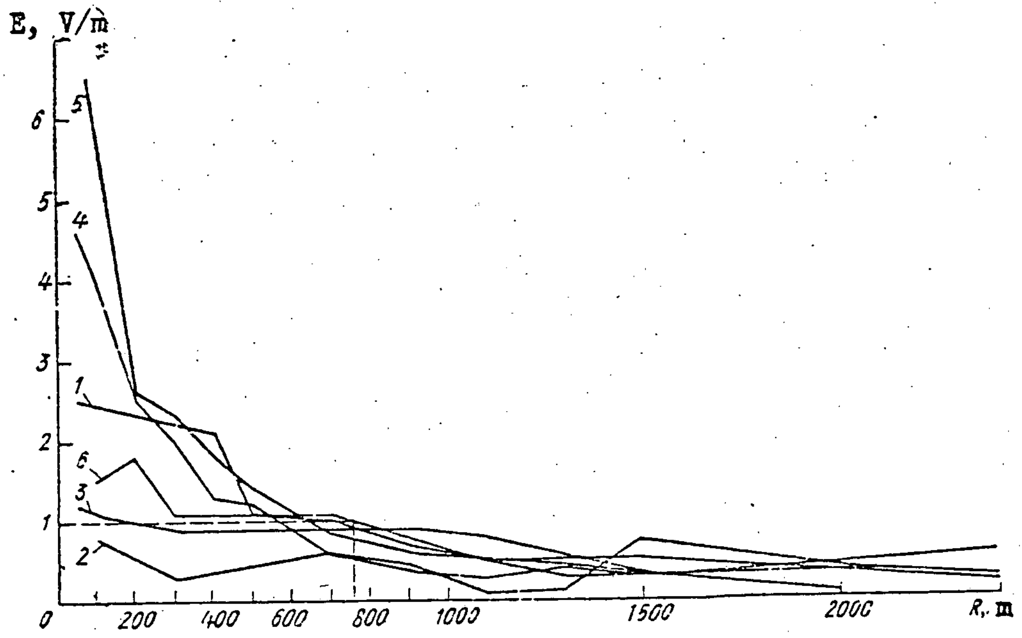

Figure 1. Distribution of USW Fields in Cities Around Television Centers According to 1969-1970 Measurements. 1) Saratov. 2) Vinnitsa. 3) Donetsk. 4) Tallin. 5) Tartu. 6) Vilnyus

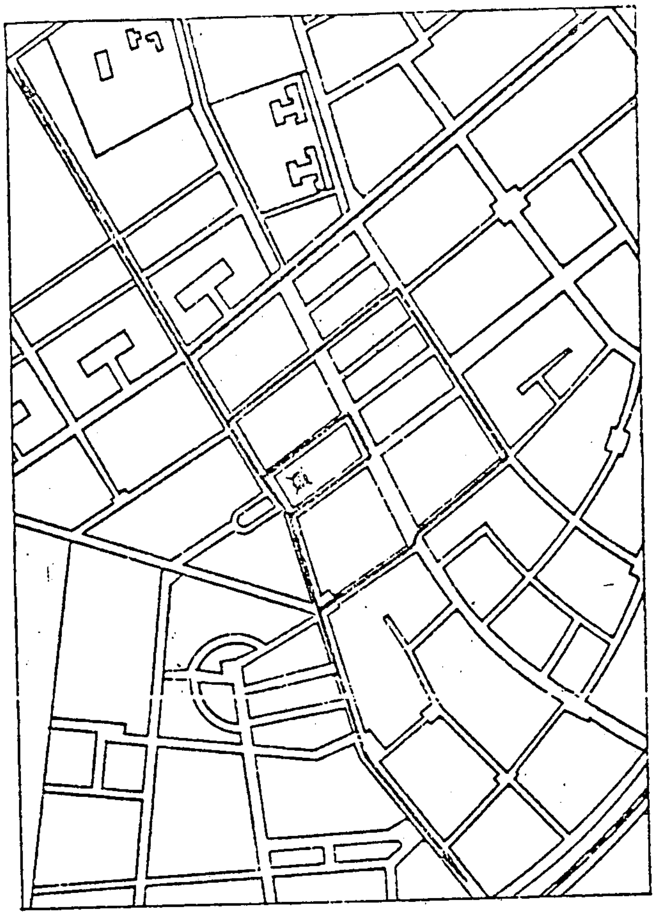

Figure 2. Build-Up Area in the Vicinity of the Tartu Relevision Center

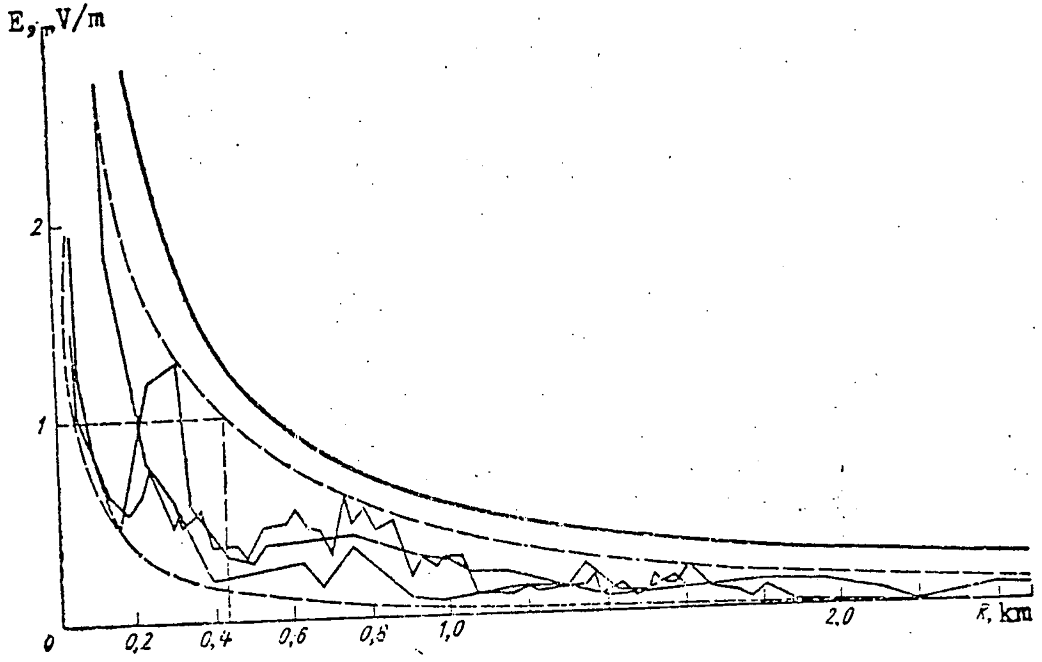

Figure 3. USW Field Distribution Around the Tartu Television Center

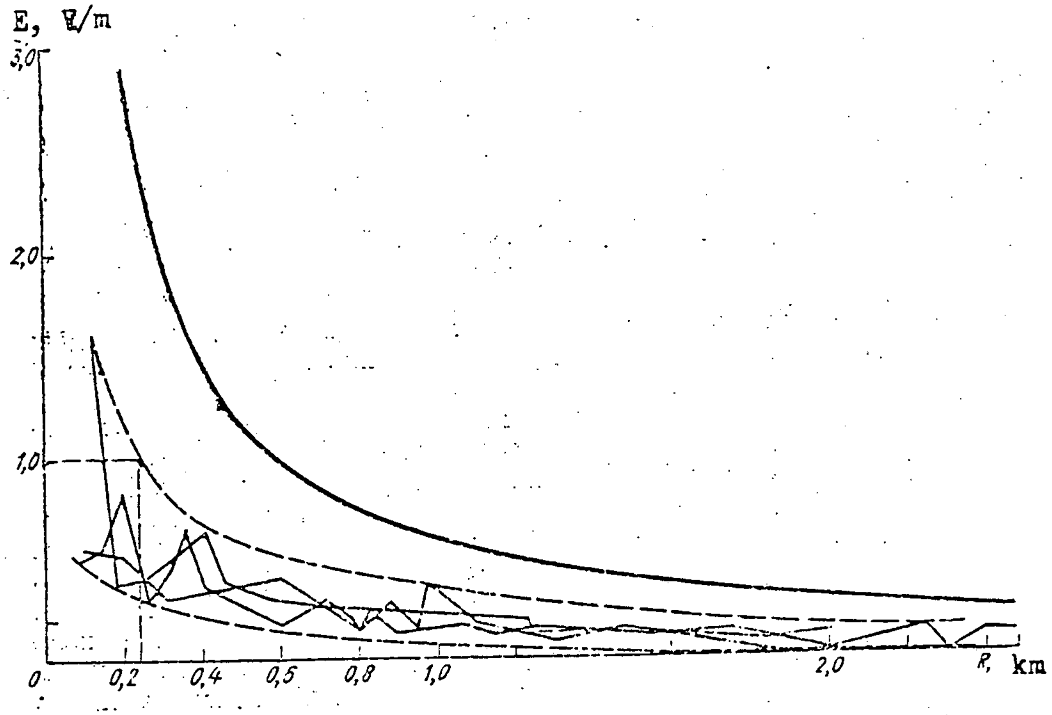

Figure 4. USW Field Distribution Around the Tallin Television Center

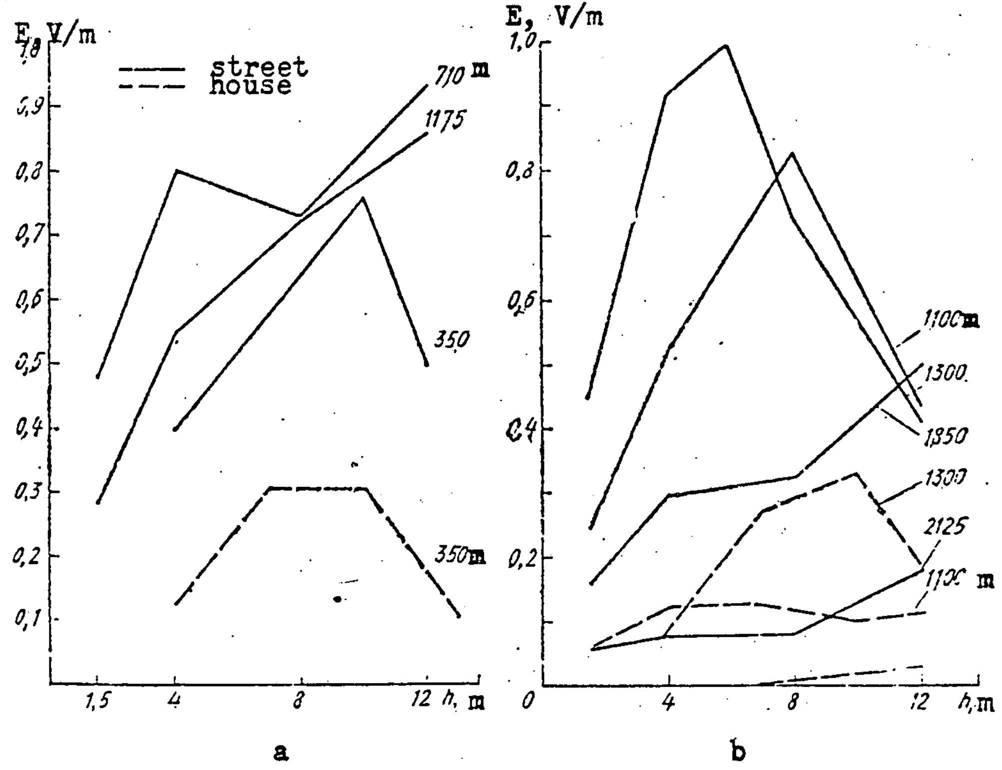

Figure 5. The Relationship Between Field Intensity and Height at Different Distances from the Television Center (Tallin)