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Title: Spectral reflectance properties of natural formations.*

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Author: E. L. Krinov.

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The translation of this book is complete except for the Introduction and Part I of Chapter I.

CHAPTER II

APPARATUS AND MATERIAL

4. Spectrographs

In the present work, at various times eight different spectrographs were used. They can be subdivided into three categories. The first category includes spectrographs of the usual laboratory type which were used in very few cases, specifically in studying standard surfaces. The second category includes spectrographs of the field type equipped to work under field conditions. They are of comparatively light weight and can be mounted on light portable tripods. To direct the collimator toward the desired surface they are equipped with mounts adjustable in azimuth and altitude. Furthermore, they have view finders or sights. The third category includes special aerial spectrographs adapted to operate from aircraft. In contrast with the previous type, these spectrographs have a simplified strong construction and can be mounted in aircraft like ordinary aerial cameras. All the spectrographs were equipped with the appropriate devices which made it possible to obtain photometric scales according to the method of stops described above.

Laboratory Spectrographs

1. The N.I.L. Laboratory Spectrograph - This spectrograph, belonging to the P. F. Lesgaft State Natural Science Institute, was assembled in the astrophysical division of the Institute from its various parts. It has glass lenses and a liquid prism consisting of a solution of ethyl cinnamate which fills the glass cavity inside the prism. The linear dispersion of the spectrograph is 28 mm. between the C and H lines. The photometric device consists in a metal straight edge on which 10 circular diaphragms are located in line. The

straight edge is placed between the lens of the collimator and the prism. This spectrograph was used in 1934 to study the reflective properties of several rock samples.

2. A. Khilger Quartz Spectrograph (large model) - The spectrograph belongs to the Central Scientific Research Institute of Geodesy, Aerophotography and Cartography (Ts. N. I. I. G. A. & K.). It was used in 1937 to study the spectral reflective properties of standard surfaces. To use the spectrograph for this study, circular diaphragms were prepared on separate metal plates which could be placed in sequence into a special frame located between the collimator lens and the prism.

3. K. Zeiss Glass Spectrograph - This spectrograph, belonging to the Spectroscopic Laboratory of the Geological Institute, Academy of Sciences, USSR (G.I.N.), was in operation in Sverdlovsk during the evacuation (1942) at which time certain spectrophotometric studies were being completed. A metal straight edge with 10 diaphragms was made for this spectrograph. The straight edge is located in a special frame between the collimator lens and the prism.

Field Spectrographs

4. A. Khilger Quartz Spectrograph (small model) - This spectrograph, belonging to the Pulkovo Astronomical Observatory, was the first to be used. It was used at the very beginning of the study between 1930 and 1932 when the method of research was being developed. The linear dispersion of the spectrograph is 12 mm. between the C and H lines. On one spectrographic plate, 3 x 6½ cm., 11 spectrograms 1 mm. wide can be placed at an interval of 1 mm. As a photometric device a pair of nicols placed in front of the collimator aperture was first used. However, because of the strong

absorption of ultraviolet and the partial absorption of the violet-blue portion of the spectrum the nicols were soon replaced by diaphragms. The diaphragms are located in line on a metal straight edge which is placed in a tube in front of the collimator aperture and any one of the 12 diaphragms on the straight edge can be placed in the path of the pencil of rays passing through the collimator aperture. The spectrograph has a flag shutter operated by a handle and located inside the camera. With this shutter, time exposures of 20 sec. and more were obtained with sufficient accuracy.

5. The N.I.L. Glass Spectrograph - The spectrograph, belonging to the P. F. Lesgaft Institute, was made in 1932 from an ordinary laboratory spectroscope. Incidentally this spectroscope was first used as long ago as 1914 by Nikolai Aleksandrovich Morozov, subsequently a member of the Academy, to obtain spectrograms of the earth's surface from a balloon during the full eclipse of the sun. Considerably later, in 1929, this spectroscope was used by V. A. Faas to obtain spectrograms of natural formations from an aircraft. In both cases the sighting tube of the spectroscope was replaced by a primitive cardboard camera. Regrettably, it was not possible to obtain usable spectrograms in either case. For use in the present research the spectrograph was subjected to considerable remodelling (Fig. 1). A metal camera equipped with a flag shutter was made. Then a photometric device was made consisting of a disc with 10 diaphragms located in the collimator tube between the lens and the aperture. By rotating the disc any desired diaphragm can be placed in line with the light rays. Later, a view finder was added to the collimator. It consists in a tube, at one end of which there is a small total-reflection prism located in front of the exit pupil. Initially the spectrograph was placed on a wooden base which was attached to a photographic tripod.

In 1933 the wooden base was replaced by a metal one, and azimuth and altitude circles were added to the spectrograph. The linear dispersion of the spectrograph is 15 mm. between the C and H lines, and up to 11 spectrograms of the usual width (see above) are placed on the photographic plate (3 x 3 cm.). The spectrograph was in use from the middle of 1932 to the end of 1935. A large number of spectrograms were obtained with this spectrograph. In 1933 and 1934, this spectrograph was used by the author to obtain spectrograms of natural formations from an aircraft.

6. Ts.N.I.I.G.A.& K. Glass Spectrograph (field) - The intrinsic deficiencies of the foregoing spectrograph, constructed in a semi-methodical manner, frequently complicated the work. Moreover, the glass spectrograph (N.I.L.) could only be had on short term loan which was at times inconvenient. Therefore, by the time field operations were started in 1935, a new spectrograph was made. It was constructed specially for operation under field conditions. The spectrograph was designed by the author and was constructed at the machine shop of the Astronomical Observatory, Leningrad University. The spectrograph (Fig. 2) has glass optics, consisting of two equal (in the collimator and the camera) triple Steinheil (Munich) lenses having an aperture of 27 mm. and a focal length of 110 mm.* and the prisms were of Stein and Reiter flint glass with a refractive angle of 60° and a base length of 54 mm. The linear dispersion of the spectrograph is 12 mm. between the C and H lines. The spectrograph has a symmetrical slit of the Wadsworth type (33), a simple

* The lenses, belonging to Professor G. A. Tikhov, were given by him to the Institute specially for the construction of the spectrograph intended for the study of the spectral reflective properties of natural formations.

view finder of the previous type and separate azimuth and vertical circles located on a metal base which, along with the spectrograph, is mounted on a standard theodolite or photographic tripod. The virtue of the above-mentioned slit is that when the screw is turned in the direction to close the slit, after the flanges have come into contact, both flanges begin to be displaced. This prevents damage to the edges of the flanges. As a photometric device the spectrograph has two replaceable discs with circular diaphragms. Each disc is enclosed in a metal holder and, along with the latter, can be placed in the prism container between the collimator lens and the prism, in turn. On each disc there were several diaphragms and on both discs the entire series of diaphragms are placed, from the smallest to the largest. The spectrograph is equipped with six holders for plates having the dimensions 5 x 6 cm. Up to 17 spectrograms of standard size can be placed on one plate. The camera is equipped with a focussing device, as well as one for moving the plate-holder and the angle of the plate-holder part to obtain a sharp picture over the entire spectrum and it is equipped with a standard flag shutter.

The spectrograph described was in operation from the second half of 1935 until the end of the research (1938), and most of the spectrograms were obtained with it. The spectrograph was found to be satisfactory for the work.

One more important point should be noted. All the three field spectrographs described above, which were actually developed during this research, have almost equal dispersion. Therefore, the material obtained (spectrograms) can be considered comparable.

7. <u>The Ts.N.I.I.G.A.& K. Double Prism Spectrograph for the Infrared Region of the Spectrum</u> - The spectrograph was made in 1937 and was designed for a relatively detailed study of the spectral reflective properties in the

infrared region of the spectrum. The author, together with V. A. Faas, compiled a list of the technical requirements which the new spectrograph had to satisfy. The calculation of the optical system was made by scientists of the Pulkovo Astonomical Observatory, G. G. Lengauer and K. A. Kirillov under the supervision of Professor G. A. Tikhov. Moreover, the calculation was checked by the optician of the construction bureau of the "Gosgeosemka" plant, N. F. Kozyrev. The construction of the metal parts of the spectrograph was designed by Afanasev and Skvortsov. The spectrograph was made in the shops of the above concerns.

The spectrograph has a non-symmetrical slit having a screw of 0.5 mm. pitch. The lens of the collimator has a focal length of 400 mm., and the diameter of the effective slit is 38 mm. The spectrograph is equipped with two prisms made of the 23rd grade of glass (L.Z.O.S.).

The linear dispersion of the spectrograph is 16.3 mm. between the D and ρ lines ($\lambda\lambda$ = 589.3 mμ and 939.0 mμ respectively). The region of the spectrum having a wavelength of approximately λ = 1000 mμ was located in the middle of the plate (45 x 55 mm.) and from the direction of the visible region the spectrum begins with a wavelength of about 525 mμ.

The photometric device, as in the previous spectrographs, consists of rotating discs with diaphragms. The discs are placed in holders and can be inserted in the prism box between the collimator lens and the first prism. Between the second prism and the camera lens there is a color filter intended to attenuate the rays in the visible region of the spectrum and thus prevent strong aureoles. The camera is equipped with an "Industar" lens and all the devices for adjustment.

A cardboard cowl is fitted on the slit head to serve as a shutter. Practice showed that because of the low luminosity of the spectrograph and the relatively low sensitivity of the infrared photographic plate, requiring long exposures (up to 3 and more minutes), this shutter did not give any noticeable decrease in the sharpness of the exposures and was completely satisfactory for the work.

The spectrograph was mounted on an angle bracket which was attached to a theodolite tripod. The azimuth circle was mounted on the bracket and the vertical circle on the prism housing of the spectrograph. Because of the angular form of the bracket the spectrograph could be directed towards the lowest possible point. However, this type of bracket required a counter balance. As a result the total weight of the spectrograph was excessive and the spectrograph was not convenient for field work. The spectrograph was used for one season in 1937.

Aerial Spectrograph

8. The Ts.N.I.I.G.A.& K. Aerial Spectrograph - The spectrograph was made according to a design submitted by V. A. Faas in 1935. It was intended primarily to study the spectral properties of atmospheric haze. In contrast with ordinary spectrographs it was made strong and compact and without protruding details (Fig. 3). All the optical parts of the spectrograph are permanently fixed, being located in their proper position during the initial adjustment of the instrument at the time of assembly. The slit of the spectrograph is fixed; however, when necessary the slit width can be changed within small limits. The fixed slit was chosen so that it could be replaced by a similar slit in case of damage or soiling. The photometric device of the spectrograph consisted of a

standard disc with diaphragms and was located between the collimator lens and the prism. The spectrograph has a semi-automatic shutter. The collimator and the camera of the spectrograph are equipped with "Ortagoz" lenses with a relative stop of F 1:4.5 and a focal length of 135 mm. The prism was made of L.Z.O.S. 22-type glass and has a refractive angle of 55°. The linear dispersion of the spectrograph is 9 mm. between the C and H lines. The plate-holders of the spectrograph were made for a 3 x 6.5 cm. plate and up to 24 spectrograms could be placed on one plate. The spectrograph described above was used by the author to obtain spectrograms of natural formations from an aircraft in the summer of 1935.

5. Calibration of the Spectrographs

As stated above the diaphragm method was used in this work to obtain spectrograms of the photometric scale. Therefore, all the spectrographs were equipped with the appropriate devices. Two of the spectrographs, the aerial and field spectrographs made by Ts.N.I.I.G.A.& K., were specially calibrated to check the applicability of the law of proportionality to the square of the diameters of the diaphragms which permit the passage of light rays.

The calibration of both spectrographs was achieved by the same method using a photometric bench. The spectrograph was mounted on one end of the bench and the collimator was directed along the bench. The bench was placed in a dark room and was covered with a black cloth. An opal glass, attached in a cardboard tube with diaphragms, was placed in front of the slit. The inside surface of the tube was blackened to eliminate lateral reflections. The length of the tube was 257 mm. The free end of the tube, located opposite the slit of the spectrograph, was aligned along the axis of the bench. An electric lamp of a projection type, 120 v., 500 w., was placed at the same end of the tube on the moving table of the bench. The filaments of the lamp were arranged in a plane perpendicular to the direction of the spectrograph. By moving the mobile table the lamp could be placed at any desired distance from the slit or, to be more exact, from the opal glass, within the limits, of course, of the bench (4 meters). Ordinary diaphragms of the photometric bench, which eliminated the reflections from the black cloth on the bench, were placed in the path of light passing from the lamp to the tube. The lamp was powered by alternating current from the city power circuit and the power was kept constant with a rheostat and was controlled with an ammeter.

The essential point of the calibration consisted in comparing the spectrograms obtained from various diaphragms with those obtained by varying the distance of the lamp from the opal glass. The distances in the latter case were selected in such a manner that the ratio of intensities of a pencil of light striking the photographic plate from various distances was approximately equal to the ratio of intensities obtained with various diaphragms. It is known that the illuminance E on the opal glass M, coming from the lamp, according to the law of the inverse square, is proportional to $E = 1/R^2$, where R is the distance between the lamp and the opal glass. Therefore the series of spectrograms obtained with the same exposure and with the same diaphragm but at various distances from the lamp represents a photometric scale based on the law of inverse squares of the distance.

Therefore the calibration consisted in obtaining first a series of spectrograms at various distances between the lamp and the opal glass and then in obtaining, on the same photographic plate, a series of spectrograms using various diaphragms but at the same distance from the lamp. To obtain marks on the spectrograms indicating known wavelengths on the continuous unlined spectrum of the lamp, a supplementary line spectrum of mercury vapor was superimposed on the spectrograms by light from a mercury arc before the exposure of the spectrograms. As a result, the following very bright and sharp lines of the mercury spectrum were obtained on the spectrograms: $\lambda\lambda$ 404.7; 407.8; 435.8; 491.6; 546.1 and 577.0 mμ. These lines were used to construct the dispersion curve. The spectrograms were measured on the Moll microphotometer and, as a result, optical densities were obtained in the regions of the spectrum every 20 mμ from λ 400 mμ to λ 600 mμ. From the densities obtained from the scale of distances characteristic curves were plotted separately for each wavelength measured and from the densities of the spectrograms of the diaphragm scale the ratios of intensities were finally found, using the intensity of the smallest diaphragm as unity. Table I shows the average data obtained from all the $\lambda\lambda$ measured where log I corresponds to the logarithms of the intensities calculated from the diameter of the diaphragm, log i was obtained from the calibration and Δ log I from the deviation.

An examination of the results of the calibration gave the following results:

1) The deviation Δ log I remains within the limits of the standard accuracy of photographic spectrophotometry and in case of large diaphragms it was generally insignificant.
2) There was no variation along the spectrum of the value log i.

Thus the calibration showed that the law of the proportionality of intensities to the squares of the diaphragm diameters is correct, and consequently the diaphragm method was completely satisfactory for spectrophotometric research.

6. Microphotometers

In measuring the spectrograms the following five microphotometers were used at various times:

1. A Gartmann visual microphotometer made by the firm Askaniya Verk was obtained by Ts.N.I.I.G.A.& K. on temporary loan.
2. A Martens densitometer belonging to the P. F. Lesgaft State Natural Science Institute.
3. A Moll registering microphotometer belonging to Ts.N.I.I.G.A.& K.
4. A Zigban registering microphotometer belonging to the Institute of Geological Science, Academy of Sciences, USSR.
5. A K. Zeiss objective microphotometer with visual evaluation of the displacement of the galvanometer spot on a scale (simplified model), belonging to the above Institute.

A detailed description of the microphotometers listed is not given since it can be found in the appropriate literature (32, 33). Only certain specific peculiarities of the first three instruments are given because they are of some interest in this work. By far the largest number of spectrograms (several thousand) were measured with the Moll microphotometer. This instrument was very rapid and simple in operation and sufficiently accurate. The other microphotometers were used in relatively few cases. Thus the spectrograms were obtained and measured in a similar way. In all regions the spectrograms were measured every 10 mμ and the blackening was expressed as optical densities D.

The Gartmann visual microphotometer - It is known that this instrument has a photometric wedge and a polarizing system. In this work the wedge was used to measure the spectrograms. Because the manufacturer's wedge was easily damaged, and unsuitable for measuring, the authors made a new wedge from a photographic plate by the usual method. The wedge was calibrated for optical density. For this purpose, sensitometric strips were used which were obtained on a Sheiner sensitometer. The densities of the strips were measured with a Martens densitometer.

Martens densitometer - For this instrument a special carriage was made having a micrometer screw with which it was possible to measure spectrograms although, as is known, the densitometer was not intended for this work. The carriage was mounted in such a manner that the dividing line between the densitometer fields came across the spectrogram (Fig. 4). Thus, by using the micrometer screw, one could bring any portion of the spectrogram to the dividing line between the fields. The measurement itself consisted in making the dividing line disappear by rotating the analyser in that portion where the spectrogram appears. In this case, the optical density D can be found by the formula

$$D = 2(\log \mathrm{ctg}\,\alpha_0 + \log \mathrm{tg}\,\alpha),$$

where α_0 is the reading of the analyser circle when the negative is put on fog and α is the reading when it is put on the portion of the spectrogram to be measured. As a result the optical densities obtained for the spectrogram are free of fog from the negative.

The Martens densitometer is very convenient to use and the accuracy of measurement was in some cases higher than that obtained with the Gartmann microphotometer. Large densities (in the order of 2 - 3) were particularly convenient to measure with the densitometer, whereas when they are measured on a Gartmann microphotometer, as is known, large errors are obtained. With registering microphotometers, e.g. the Moll microphotometer, densities greater than 1.7 - 1.8 generally cannot be measured.

Moll registering microphotometer - The author had at his disposal one of the latest models of this instrument which gave records in two scales: 1:7 and 1:50 at three different rates of motion of the spectrograms. In the present research the spectrograms in the visible region of the spectrum were always measured with the 1:7 scale and the infrared with the 1:50 scale. In both cases the measurements were made at a moderate rate. By a preliminary check of the instrument it was established that at moderate rates the effect of the inertia of the instrument, noticeable when measuring spectral lines, was not observed on the continuous portions of the spectrum. Initially, records were obtained on photographic paper, later aerofilm was used. The latter has the advantage that it is subject to very little deformation during processing (developing, fixing, washing), and any deformation of the record is of substantial importance since it can have a strong effect on the accuracy of measurement.

The essential point of measuring with a Moll microphotometer consists in measuring the amplitudes of the displacement of the galvanometer spot, which, as is known, is proportional to the thermoelectric current and the latter is proportional to the intensity of the pencil of light i_0 passing through the portion of the spectrogram being measured. Therefore, it is easy to obtain the optical density of that portion of the spectrogram. For this purpose, the ordinate α of that point of the record which corresponds to the wavelength of the spectrum is measured from the zero line of the record. Then, in the same abscissa the ordinate β of the fog is measured. Next the amplitude of the spot, when recording the fog β, is taken as the intensity of the bundle of light striking the negative, whereas the amplitude, when recording the given portion of the spectrum α is taken as the intensity of the bundle of light passing through this portion of the spectrogram. In this case, the ratio $\frac{\alpha}{\beta}$ corresponds to the coefficient of transparency of this portion of the spectrogram and the inverse ratio $\frac{\beta}{\alpha}$ corresponds to the opacity, the logarithm of which corresponds to the optical density D.

Thus the optical density is found by the formula:

$$D = \log \beta - \log \alpha,$$

where the value of D, as in the previous case, is corrected for the fog density.

7. Standard Surfaces and Their Testing

Initially, when the method was being developed and tested, Professor G. A. Tikhov used the surface of pressed magnesium oxide powder as a standard. This surface was prepared anew for each new series of negatives. Obviously, such a surface does not have the requirements of a standard. Therefore, the passage from separate experiments to a systematic study required a more perfect surface as a standard, e.g. etched opal glass. Two samples of glass were used: Professor G. A. Tikhov used a glass made by the Pulkovo Astonomical

Observatory and the author used a glass made by the Lesgaft Astonomical Division of the Institute. Soon this standard was replaced by another. The essential deficiency of etched opal glass is that it is to some extent transparent and therefore its reflective property depends on the surface on which the glass is placed.

A test was made with the surface of baryte powder highly compressed in a special metal container. Several such surfaces of so-called test plates were made by the Photometric Laboratory of the All-Union Institute of Metrology and Standardization under the direction of Professor P. M. Tikhodeev. However, even these surfaces, regardless of their good photometric properties, were found to be unsuitable for field work because of their fragility; when shaken or turned over the baryte plate simply falls out of the container as a powder. Moreover, cleaning the surface, which unavoidably becomes soiled under field conditions, is almost impossible.

Continuing the testing of other standard surfaces, under the advice of V. V. Sharonov, the author tested etched gypsum plates made of chemically pure gypsum containing 10% magnesium oxide powder.[*] The gypsum plate used in the test had the dimensions 10 x 10 cm. and a thickness of 1 cm. The tests of the gypsum plate (see below) showed that its surface is sufficiently orthotropic and does not have selective properties in a wide range of wavelengths; at least, in the entire visible range of the spectrum and up to λ 1,000 mμ in the infrared zone. In addition, the gypsum plate was found to be stronger

[*] The gypsum plates were made by V. V. Sharonov who spent a great deal of time in selecting standard surfaces when he made visual and photographic measurements of the integral reflectances of a large number of natural formations and various synthetic surfaces.

than any of the other standards and was more easily cleaned. The gypsum plate could be cleaned of foreign matter and the etching retained by rubbing the plate with etched glass. From the end of 1932 the gypsum plate was used exclusively. However, after 1937, when it was accidentally broken, baryte paper placed under photographic bromosilver paper was used as a standard surface.

Thus the basic standard used to study the majority of natural formations was the gypsum plate. The spectral reflectances of the relatively small number of objects, initially obtained from the etched opal glass, were reduced in relation to the gypsum plate. It was possible to make the reduction after the spectral reflective properties of the gypsum plate, the etched opal glass and several other standard surfaces had been compared.

The surfaces were compared by photographic spectrophotometry in the following manner:

1. Etched opal glass, Pulkovo sample	a) in relation to pressed magnesium oxide powder; b) in relation to the baryte test plate
2. Etched opal glass, sample from the Lesgaft Institute	in relation to the baryte test plate
3. Baryte test plate	in relation to magnesium oxide deposited on a porcelain plate
4. Gypsum plate	
5. Porcelain plate	

The magnesium oxide surface was deposited on the porcelain plate by burning magnesium powder under it. The thickness of the layer obtained in this manner was 1.5 - 2.0 mm.

Table II gives the spectral reflectance obtained for each standard surface in relation to the surface with which the comparison was made. The last column of the table gives the reflectances of etched opal glass obtained by reducing the reflectances obtained in relation to the baryte plate to those in relation to magnesium oxide. The same glass was, moreover, compared directly with magnesium oxide in which case the reflectances are given in the first column of the table. The reflectances obtained from the above two methods are in reasonably good agreement.

The data given in the table shows that none of the standard surfaces has any important selectivity. A certain decrease in reflective property toward the violet end of the spectrum is observed in almost all surfaces. A particularly sharp decrease is shown in the case of the porcelain plate which obviously causes the noticeably yellowish shade of the latter. On the other hand, a certain increase, caused obviously by the bluish tint of the glass, was observed with the etched opal glass supplied by N.I.L. The most "neutral" effect in relation to magnesium oxide was shown by the baryte test plate for which, as in the case of the gypsum plate, the highest reflectances were obtained.

Other than the comparison of standard surfaces a measurement was made of the absolute reflectance of the gypsum plate and the baryte paper. The measurement was made by two different methods; however, in both cases, the Taylor sphere was used. It was obtained by the author on temporary loan from the All-Union Electrotechnical Institute (V.E.I.).

As is known, with the Taylor sphere it is possible to measure the direct-diffuse reflectance ρ , i.e. the ratio of the light F_0 reflected by a given surface in all directions to F, the light falling on this surface, but not the liminance factor r. Keeping in mind that all the standard surfaces used were sufficiently orthotropic the reflectance ρ can be taken as the luminance factor r.

By the first method, the reflectance was measured in the manner outlined below:

The surface to be measured (gypsum plate) was placed under the lower opening of the sphere. A selenium cell was placed at the side opening (Fig. 5). The gypsum plate and the internal surface of the sphere, whitened with magnesium oxide, were illuminated alternately. In both cases, the galvanometer spot was read on the scale through a telescope.

The theory of the Taylor sphere states that the luminance factor of a gypsum plate ρ_g is

$$\rho_g = \frac{E_1}{E_2}$$

where E_1 is equal to the illumination on the photocell when the gypsum plate is illuminated and E_2 - when the sides of the sphere are illuminated.

Suppose that the galvanometer spot η is proportional to the luminance on the photocell, which is close to the actual value, then by moving the scale the required distance from the galvanometer it is easy to find, from the measurement of the reflection, the reflectance ρ_g of the gypsum plate which is obviously

$$\rho_g = \frac{E_1}{E_2} = \frac{\eta_1}{\eta_2}$$

where η_1 is the deflection of the spot when the gypsum is illuminated and η_2 when the inner walls of the sphere are illuminated. The coefficients were measured with white light, then separately at several regions of the spectrum, in which case the appropriate color filters were placed in front of the photocell. The effective wavelength $\lambda_э$ of each color filter was obtained by taking into account the spectral transparency of the color filters and the spectral sensitivity of the photocell. Table III shows the reflective coefficients of the gypsum plate for white light and for each region of the spectrum $\lambda_э$.

The data obtained indicate the following:

1. Within the regiom of the spectrum measured, from λ 550 mμ to λ 630 mμ there was no indication that the gypsum plate had any selective reflection.

2. The reflectance ρ_g, on the average, was 0.89. It was equal to the average absolute value of the luminance factor r of the gypsum plate obtained in relation to magnesium oxide and recalculated with respect to the absolute value. In fact, Table II shows that the average luminance factor r of the gypsum plate is 0.97 in relation to magnesium oxide. If it is assumed that the absolute reflectance ρ_m of magnesium oxide is 0.92, the value obtained by Sharonov, the absolute luminance coefficient r of the gypsum plate is 0.89.

The spectral reflectance of the same gypsum plate and of the baryte paper were measured by the second method. The measurements were made in the following manner. In place of the photocell, a spectrograph (field spectrograph Ts.N.I.I.G.A.& K.) was located in front of the side opening of the sphere, in which case the slit of the spectrograph was located on the cross-sectional plane of the sphere. Thus light rays reflected from the internal opposite wall of the sphere entered the spectrograph. The test surface, as in the first meth d, was placed under the lower opening of the sphere (Fig. 6). Later, the usual method of photographic spectrophotometry was used. For research in the visible region of the spectrum Ilford Soft Gradation Panchromatic Photographic Plates were used and for research in the infrared region Agfa Infrared 950. The photometric scale, consisting of a series of spectrograms, attenuated in sequence with diaphragms of known relationship, was obtained by illuminating the interior surface of the sphere. Table IV gives the average spectral reflectances ρ_λ for each surface measured. The upper line of the table gives the number of negatives and the second line gives the number of spectrograms on these negatives used in calculating the reflectances. The data given in the table permits the following conclusions.

1. The spectral reflectanceof both surfaces is noticeably reduced in the direction of the violet end of the spectrum and the greater decrease occurs with the gypsum plate. The analogous decrease, it is true, was found to be somewhat weaker when the gypsum plate was compared with magnesium oxide (see above).

2. In the regions of the spectra near $\lambda\lambda$ 510, 780 and 810 mμ of both surfaces, shallow minima are observed. However, the occurence of even these waves was not definitely established.

3. Attention is drawn to the fact that the luminance factors of both surfaces were somewhat low and in comparison with the values obtained from the gypsum plate by the first method the difference is very large.

Thus the average reflectance of the gypsum plate, measured by the first method, is 0.89, whereas with the second method the average luminance factor of the same plate was 0.71. It is fully possible that there was some systematic error in the second method of measurement. Regrettably, the author could not repeat the measurements made by the second method because it was necessary to return the Taylor sphere.

Of the three different measurements of the reflectance of the gypsum plate, two, namely the comparison with magnesium oxide and the measurement by the first method on the Taylor sphere, gave the same results. Therefore the values obtained with the Taylor sphere by the first method were taken as the final values of the spectral reflectance of the gypsum plate.

Thus it can be considered that the gypsum plate and the baryte paper do not have very selective properties and that the average absolute luminance factor of the gypsum plate is 0.89 which should be taken as the same for the entire visible and infrared regions of the spectrum. Moreover, considering that the reflectance measured on the Taylor sphere by the second method was almost the same as the reflectance of the gypsum plate and the baryte paper, the same average luminance factor 0.89 can be taken for the baryte paper.

The average luminance factor obtained for the standard surfaces for practical purposes is close to unity. The author, therefore, took all the spectral luminance factors of natural formations measured directly in relation to the gypsum plate or the baryte paper as being practically absolute.

8. Photographic Materials

In measuring the spectral reflectance in the visible region of the spectrum Ilford Soft Gradation Panchromatic photographic plates and Ilford Special Fapid Panchromatic, both with an anti-halation layer (backed), were used. The spectrograms on these plates extended from λ 400 mμ to λ 650 mμ with normal operation.

For studies in the infrared region of the spectrum Agfa infrared 730, 810, 850 and 950 were used (the latter variety was used in 1937). All the types of infrared plates together covered the infrared region of the spectrum from 700 mμ to λ 900 - 1000 mμ. Thus, the spectral reflectance in the region between λ 650 mu and λ 700 mu was not studied. Single cases using photographic plates sensitized by the author to the light of the above indicated portion of the spectrum constitute an exception.

The panchromatic photographic plates used in the work were of differing degrees of contrast. However, the infrared plates were sharp and had good contrast. For this reason many spectrograms in the infrared light were over-exposed in the region of maximum sensitivity and have very weak densities on both sides of it. These spectrograms could be measured only on relatively small portions of the spectrum. To increase the spread of a portion of the spectrum it was often necessary to obtain a new spectrogram at different exposures. Depending on the optical density of the spectrogram, some spectrograms (shorter exposure) were measured in the region of maximum sensitivity whereas others (longer exposure) were measured at the ends of the spectrum.

Other than spectrographing natural formations, for the study of the spectral reflectance, in some cases photographs were taken of these formations with an ordinary camera, "Photokor", in the light of specific regions of the spectrum. In this case, photographic plates having various spectral sensitivities were used in combination with the corresponding color filter made in the Ts.N.I.I.G.A.& K. laboratory and designed by V. A. Faas. The designation of the color filters are given according to Faas. The exposures obtained were then used first as a control for the results obtained from measuring the spectral reflectances, then to check the rational selection of photographic materials for the aerial photography of specific objects based on the spectral reflectance.

The photographs were taken with the following combinations of films and color filters:

Unsensitized plates N.I.K.F.I. without color filters		λ_e = 410 mμ
Orthochromatic - color filters	FO-2	λ_e = 450 mμ
	FO-4	λ_e = 520 mμ
Panchromatic - color filters	FP-5	λ_e = 610 mμ
	FP-8	λ_e = 640 mμ
Infrachromatic - color filters	FI-2	λ_e = 810 mμ

λ_e designates the effective wavelength of each combination.

The spectral transparency of the color filters was measured by the author with a König-Martens spectrophotometer.

Table V gives the spectral transmittance coefficients T_λ of the color filters used and the relative spectral sensitivity S_λ of the plates. In the latter case, the maximum sensitivity is taken as unity for each type of plate. The data concerning the sensitivity was taken from the work of V. V. Sharonov (34). Recently, an atlas of the spectral properties of present photographic material was published by Yu. N. Gorokhovskii and O. D. Berteneva. The atlas gives the sensitivity of twenty different types of photographic materials (35).

CHAPTER III

OBTAINING THE MATERIAL

9. Some Photometric Properties of Natural Formations

The spectral reflectance of natural formations was studied in the following regions of the U.S.S.R.:

i. Tundra, Kola Peninsula, Khibina (1).

ii. The northern forest belt, in the region of Leningrad (2).

iii. The black earth region, Voronezh Province in the region of Usman (3).

iv. Forest-stepps zone, Uk. S.S.R., Poltava Province, near the village of Getmanshchin (4).

v. Steppes

(a) Chkalov Province in the region of Sar, the Khalilov grain sovkhoz (5).

(b) Cherkess autonomous province in the region of Cherkessk (6).

vi. Deserts

(a) Turkmen S.S.R., in the region of Mary (Oasis) (7).

(b) Kara-Kumy, in the region of Uch-Adzhi (8).

vii. Mountainous region, Northern Caucasus, in the region of Teberda (9).

The points listed are shown on the map (Fig. 7), the numbers in brackets correspond to the numbers on the map.

The areas selected were characteristic of specific types of landscapes. On the other hand, attention was paid to accessibility and to the cost of transportation. The natural formations studied in each area comprised a complex of basic geographical elements of a specific type of landscape. In the tundra, mosses and lichens, peat bogs and swamps, dwarf birch and juniper, etc., were studied. In the northern forest belt various types of trees in different stages of growth and phases, many types of grass-covered areas, various field and garden crops, etc., were studied in detail. In deserts, sands, takyr (salt marshes), haloxylon, and other objects characteristic of deserts, were studied. Many objects characteristic of a given landscape were also studied in other regions if they occurred. On the other hand, some objects that are typical of a number of landscapes were studied only in one region. Thus, for example, forests that are widely distributed (pine, birch, aspen and others) growing in extensive areas of the European and Asiatic parts of the Soviet Union were studied only in the northern forest belt. Nevertheless, the data obtained on their spectral reflectance can be considered as characteristic of forests in other areas. The optical properties of natural formations of any one species do not depend on the place in which they are found. However, large differences were observed in the reflectance of individual examples found in one region.

All the natural formations studied can be divided into the following groups:

A. Forests and shrubs
B. Grass
C. Mosses and lichens
D. Field and garden crops
E. Outcrops and soils
F. Roads
G. Water surfaces, water bodies and snow.

Moreover, some man-made objects were studied which comprise still another group:

H. Buildings and building material.

As a rule, the spectral reflectance of natural formations like forests, shrubs, grass-covered areas, and other vegetation, were studied in more or less extensive groups which made up a certain background. In the study of trees continuous growths of one particular species and approximately the same age (Fig. 8) were selected. Exceptions were made in the case of trees or other formations that are not widely distributed (Fig. 9). In the study of grass-covered areas, field and garden crops, outcrops and soils, more or less even and relatively large areas were selected (Fig. 10). Thus the data obtained refer basically to average natural backgrounds.

As regards forests it was first intended to obtain data for the basic races (pine, fir, birch and aspen) on young and fully developed trees, and in each case during the following stages of development: young leaves, fully developed leaves, late summer green, fall coloration, and winter state. The first two phases in the case of coniferous races, the term "young leaves" referred to the appearance of new needles, not yet fully developed and "full leaf" - fully developed young needles. Unfortunately, because of adverse weather conditions, it was not possible to obtain spectrograms in all of these periods.

Grass was studied, firstly, at various stages of growth (young grass, flowering meadows, mowed meadows, etc.) and secondly, by type (dry valley grass, flooded meadow, pastures, alpine meadows, steppes, etc.). Some field and garden crops, e.g. wheat, rye, and others, were also studied in various stages of growth. In some cases the dependence of the spectral reflectance of grass on direction, height of the sun, state, etc., were studied.

Soils and earth roads were studied in almost all the regions listed above. In some cases the objects were studied separately in the dry, moist, and even wet states. Earth roads were studied near inhabited areas where they were made of the same soil as the surrounding area. Usually the roads were dry and well packed and consequently had a strong mirror effect. Snow-covered areas were studied on large level fields. Unfortunately, adverse weather conditions did not permit the study of snow in its various states and in various directions. Relatively little data was obtained for water surfaces because of technical difficulties arising from taking spectrograms in the nadir direction. The study of water surfaces in other directions is of little value because of the strong mirror effect.

Surface of natural formations is highly varied. In some cases, for example, forests, shrubs, and to some extent other vegetation, the concept of surface is arbitrary. In fact, the surface of the listed objects is the sum of separate large or small elements of which the surface can be convex, e.g. roots of trees, or relatively flat, e.g. grass-covered areas, field crops, etc. The disposition of surfaces in relation to the horizontal and the position of the sun is no less varied. All of these factors had to be taken into account in taking the spectrograms, and in obtaining the spectrogram scales it was necessary to place the standard surface in the same relative position as the natural surfaces. It must be stated that in the literature there was hardly any mention of the method of field spectrometry. Thus it was necessary to develop the method during the research.

Natural formations were divided into three groups: horizontal, vertical and inclined. The illumination of these groups is obviously varied. Horizontal surfaces are illuminated from direct rays of the sun and from rays scattered by the entire hemisphere of the sky. The illumination of vertical and inclined surfaces is entirely different and they can also be in the shade.

10. Method of Obtaining Spectrograms

In the case of horizontal surfaces the spectrograph was placed on a tripod and directed at the surface vertically (in nadir) or at an angle of 45° and an azimuth of 90° from the sun. These conditions gave the minimum mirror effect. The azimuths were calculated in the following manner: when the collimator was directed at an object located in the direction of the sun, i.e. when rays reflected by the object in the direction away from the sun entered the spectrograph, the azimuth was considered 0°. The opposite azimuth was considered as 180°. The intermediate azimuth, 90 and 270°, were taken counter-clockwise. The standard surface was placed horizontally and its position was checked with a circular level. The spectrograph was directed toward the standard surface at the same angle and at the same azimuth (Fig. 11) as used in studying the actual formation.

In obtaining spectrograms in the normal (nadir) direction the following method was sometimes used. The spectrograph was held at arm's length and its collimator was directed downwards at the object. The shutter was open and the author walked over the object during the entire exposure, holding the spectrograph in this position. Thus, in this case, the rays entering the spectrograph were reflected by the object for a considerable time (up to 30 and more minutes). A spectrogram obtained in this manner can be considered to be that of an average background. Thus the effect of specific spots of the object having various color shades can be excluded. The direction in which the spectrograph was moved was usually at an azimuth of 90 and 270°, i.e. it was directed at right angles to the sun and consequently the shadow of the observer and the spectrograph did not interfere. This method could only be used on soils, roads, short grass, and some other formations.

When the spectrograph was mounted on the tripod a further method was used: the spectrograph was directed towards the object and was tightened in such a manner that the spectrograph could rotate around the vertical axis but not in relation to the angle of inclination. The shutter was then opened and the spectrograph was rotated continuously to the right and to the left through an azimuth of 5 to 10° during the exposure. This method was used in obtaining spectrograms of shrubs, high grass and some field and garden crops.

With both methods the spectrogram of the standard surface was obtained with a fixed spectrograph. However, the spectrograph was directed at the same angle as that used on the object, i.e. normal or at an angle of 45° and at an azimuth of 90° in relation to the sun. In studying the dependence of the reflectance on direction, the spectrograms were obtained usually in the following directions: normal, 15, 30, 45, 60 and 75°, and at the following four azimuths: 0, 90, 180 and 270° in relation to the sun. The spectrograms of the standard surface were obtained either in the normal direction or at an angle of 45° and an azimuth of 90°.

In taking the spectrograms of natural formations having vertical surfaces, such as trees, high shrubs, some types of field and garden crops (corn, sunflowers, etc.), vertical cliffs, walls and others, the spectrograph was placed at a distance from the object (10 to 30 m. and in the case of forests 50 m. and more). The collimator was directed horizontally, or slightly upward, depending on the height of the object. Moreover, it was directed in such a manner that the reflection of the object entered the spectrograph at an azimuth of about 135°, or 225° in relation to the sun. In this case the sun was behind and somewhat to the side of the observer to give the greatest illumination. During exposure the spectrograph was continually rotated to the right and left through a small angle. The standard surface in this case was placed vertically and perpendicularly to the spectrograph and was, therefore, illuminated in the same manner as the object.

The arrangement of the spectrograph varied in the case of inclined objects, depending on the nature of the object. The standard surface, as much as possible, was placed in the same attitude as the object (Fig. 12).

As stated above, the illumination of the object and the standard surface must be the same. Thus the spectrograms were usually obtained when the sky was clear and seldom when the sky was clouded and then only when the clouds were low (cumulus, strato-cumulus, broken cumulus, etc.) and the total amount of cloud in the sky did not exceed 0.3; in this case exposures were made only when the sun broke through the clouds. In a few cases spectrograms were obtained when there was a continuous even cloud cover extending across the entire sky. Usually the spectrograms were taken near mid-day beginning two hours before noon and ending two hours after noon.

Usually 10 - 15 spectrograms were taken on one photographic plate. Of these, 6 - 7 spectrograms formed a photometric scale and the rest were of the object under study; the latter were obtained either before exposures of the standard surface or after, but in either case both series of spectrograms were obtained continuously one after the other and under equal exposures. With exposures of 10 - 30 seconds the total time of taking spectrograms on one plate, including the time of changing the holder after each subsequent spectrogram, changing the direction of the spectrograph, etc., did not exceed 10 - 15 minutes. It is obvious that in this interval of time the illumination under the conditions mentioned above remain practically constant and consequently the series of spectrograms of a standard surface form a calibration and a standardization of the negative.

Each plate usually included spectrograms of several objects, 2 - 3 spectrograms of each formation with various diaphragms. If a spectrogram is overexposed with the large diaphragm the spectrograms from the other diaphragms will be of normal density. However, it frequently happened that all the spectrograms of each formation were completely satisfactory for measurement. In order to increase the accuracy of the results spectrograms of the same formation were frequently obtained consecutively on several negatives. Thus in the case of some formations 10 or more spectrograms were obtained.

In obtaining spectrograms with the less sensitive Agfa infrared plates the exposures were at times as long as 40 - 80 seconds. Therefore, to decrease the time of the total exposure on one plate the number of spectrograms per plate was reduced to 6 - 8.

Because of the low aperture ratio of the special infrared spectrograph used in 1937 (see above), the exposures in obtaining each individual spectrogram on infrared plates were 3 - 10 minutes. Therefore, the total time for obtaining all the spectrograms on one plate was 1 - 1½ hours. Therefore in order to ensure constant illumination during this time the spectrograms were taken only with a cloudless sky and at mid-day.

The study of the spectral reflectance of natural formations from an aircraft was possible only for a small group of objects which had sufficiently large and uniform surfaces. These included fir forests, pasture meadows, fields, ploughed and with green crops, and finally a cross-section of an area (fields, buildings, roads). The flights were made from one of the airports near Leningrad in an R-5 aircraft (with an open one-place cabin). The spectrograms were taken from an altitude of 300 m. and during the exposure the aircraft passed over the area at minimum speed and the spectrograph was directed with the collimator pointing vertically downward. The time of exposure for each separate spectrogram was 20 seconds. The low altitude of the flights excluded the effect of atmospheric haze. The spectrogram of the standard surface was taken either before the flight or immediately after. Each flight lasted from 20-30 minutes at approximately midday. The standard surface was placed on the ground horizontally and the collimator of the spectrograph was directed vertically.

Table 6 shows the total number of spectrograms obtained during the entire study.

CHAPTER IV

TREATMENT OF MATERIAL

11. Development of Spectrograms

The photographic plates were usually developed with paraminophenolic developer according to the following standard formula (36):

Water	to 1,000 cc.
Sulphite crystals	100 gm.
Paraminophenol	7.25 gm.
Soda crystals	135 gm.

The development of each individual plate took 8 minutes at a temperature of 18-19°C. The above-mentioned formula, adopted by international agreement for sensitometric tests, was the most satisfactory for developing spectrograms giving soft passage from weak to dense optical densities; at the same time it did not cause dense fog or halo. Nevertheless, metol hydroquinone developer according to the standard formula was at times used. This was done when it was known earlier that the spectrograms were underexposed and a more active developer was required. When the spectrograms were over-exposed the developing time was reduced. It should be noted that inasmuch as spectrograms of the scale and of the object were taken on one plate the standard of developing was not obligatory from the photometric point of view. Moreover, the use of different developers had the advantage that it made it possible to correct for known underexposures. As a rule, the spectrograms intended to be measured with a self-recording Moll microphotometer were of relatively weak densities; on the other hand, those measured with a Martens densitometer or a Hartmann microphotometer were of greater density.

The developed spectrograms were fixed with either the standard or acid fixer. After washing and drying the negatives were covered with glass plates (on the side of the light sensitive film). This protected the negative from damage and soiling during measurement and in subsequent storage.

Only those negatives were selected for measuring which did not have extensive defects (side fog, halos, very dense chemical fog, etc.). Rejections did not exceed 15%.

12. Measurement of Spectrograms and Calculation of Reflectance

The majority of the spectrograms were measured with a Moll recording microphotometer. Measurements of the ordinates of the records were made with squared transparent sheets. These were made from graph paper pasted onto cardboard then reproduced on a diapositive photographic plate. The first type of transparent sheet was used in measuring records obtained from aero film. In this case the records were placed on the sheet and the ordinate was read through the transparent celluloid record. The second type of sheet was used for measuring records obtained from photographic paper. In this case the transparent sheet on the plate was placed on the record. In both cases the ordinate was read to

0.1 mm. In order to increase the accuracy a hand magnifier was at times used. In measuring the ordinate difficulties were often encountered because of the teeth appearing on the record, associated with the presence of lines on the spectrograms. In order to eliminate the teeth the negatives were at times brought out of focus. When teeth were present on the record, the ordinates, within known wave lengths, were measured on all the records near the same teeth. This was done very simply. Usually on each sheet of paper or film several records were obtained, i.e. either from all the spectrograms of the scale or from spectrograms of the object. However, since in each series of this type the spectrograms were obtained with different diaphragms and were consequently of different exposure, the records, after measurement of the spectrograms of a given series, were placed one under the other respectively (Fig. 13). Under these conditions it is obvious that it was not difficult to find the same teeth on the records.

On each separate sheet containing records the fog of the negative was recorded once and the fog was passed at the widest interval between the spectrograms. The fog on the records likewise had continuous teeth. However, these teeth have a different cause, i.e. they are caused by the grain of the light sensitive film on the photographic plate which has an effect only with very small densities. In cases where the fog is even the record is more or less parallel to the zero line. The small slant of the record indicates a gradual change in optical density of the fog from one side of the negative to the other. In reading the ordinates of the fog a smooth line was drawn first through the record of the fog. The line was drawn symmetrically in relation to the teeth and the ordinates were read in relation to this line. The ordinates of the fog were measured against each measured point on the record of the spectra. The mathematical mean was taken as the final value.

If several spectrograms were obtained for one object, they were all measured, if suitable, with the microphotometer. The arithmetic mean was taken as the final value of the reflectance factor. It should be noted that the coloration of natural formations is highly varied and frequently not only different objects, for example, trees of the same species and age but even different parts of one object have different shades. It is therefore not surprising if in the processing of different spectrograms of the same object the reflectance factor varies somewhat. The calculation of the average reflectances from many spectrograms in some cases increase the accuracy of the final value, but in other cases reduce them to an average background of the formation.

By measuring the individual spectrograms of a series of objects the average error in the reflectance factor was determined. It turned out that the average error obtained from each individual spectrogram differed from the arithmetic mean of the reflectance factor by 6% but did not show any variation along the spectrum.

SPECTRAL REFLECTANCE OF NATURAL FORMATIONS

PART II

CHAPTER V

GENERAL CHARACTERISTICS OF THE LANDSCAPES STUDIED

13. Regions of Field Work and a Short Description of the Natural Formations

Tundra

The study of natural formations characteristic of tundra landscapes was made in the central part of the Khibina mountain range located on the Kola Peninsula. The Khibina mountain range, consisting of igneous rocks of so-called nepheline syenite, occupies an area of about 1,600 $km.^2$ and rises to an altitude of 1,250 m. above sea level. It forms a sharp break from the surrounding marshy lowlands, the average height of which is 130-140 m. above sea level (37), The western depression of the central lowlands is surrounded by low hills and is one of the areas typical of a tundra landscape. The surface of this area is formed of turf hillocks about 3-4 m. high, held together by permafrost. The basic vegetation found on the surface of the hillocks consists of creeping dwarf birch and heather which in places form a continuous cover. At times one encounters almost continuous lichen with individual turfs of green mosses. On rare occasions one finds reindeer moss, juniper bushes, wild rosemary and bog bilberry. Among the turfs one often meets sedge-cotton, grass-hypnum, sedge-hypnum and sedge-sphagnum bogs, which at times occupy considerable areas. Along the slopes of the surrounding hills, at times comprising wide belts rising to an altitude of about 500 m. there are birch groves with continuous lichen cover, and European blueberry. Frequently one encounters pine-birch and frequently pine forests with a heavy undergrowth of juniper or dwarf birch and at times both in the same area. These forests frequently occupy large areas and are found up to an altitude of 350 m.

Field work in the above area took place in July 1937, i.e. in the period of the most vigorous growth. All the tree and bush vegetation was covered with fully developed leaves or needles on young shoots. Mosses and lichens had bright green or reddish brown young shoots. The grass-covered areas consisted of young juicy stems and leaves having a bright green colour. The heather was covered with continuous almost opened buds of yellowish-red flowers. On all sides there were bright rosy spots of flowering willow herb (Epilobium), which formed a sharp contrast with the general green background. The marshes in most cases were bright green in colour.

Of the natural formations found in the tundra the following were studied:

1. Dwarf birch
2. Juniper
3. Birch groves on mountain slopes
4. Heather
5. Willow herb

6. Turf hillocks covered with grass
7. Turf hillocks, bare
8. European blueberry
9. Lichens
10. Moss, hypnum
11. Moss, sphagnum
12. Moss on crags
13. Moss on turf
14. Reindeer moss
15. Crags, bare, composed of outcrops of khibinite
16. Talus on mountain slopes
17. Surface of bare turf
18. Swampy podsol

In addition to the formations listed, the following were also studied:

19. Oats (bright green before the formation of spikes)
20. Roads, paved, cobblestone
21. Red tile.

Northern Forest Belt

Natural formations characteristic of the northern forest belt were, for the most part, studied in the territory and the surrounding area of the Lisinskii lespromkhoz (timber cutting collective) located 60 km. south of Leningrad. The region of field work, in general, is covered by forests and abundant moist and dry meadows, and in the areas surrounding occasional inhabited areas there are cultivated fields.

Some formations and man-made objects were also studied in the park of the Pulkovo Astronomical Observatory, 12 miles south of Leningrad and in the region of Slutsko, Leningrad Province.

The natural formations studied in this area are characteristic not only of the northern forest belt but a large number of them are widely distributed throughout the European portion of the U.S.S.R. and Siberia. Therefore, in this area a full and systematic study was made of a large number of natural formations extending over a number of years. In particular, studies were made of forests of various types and ages and in their various stages of development. For this purpose areas were selected within the territory of the lespromkhoz which met the above requirements. In each of the points listed a detailed study was made of the dependence of spectral reflectance on direction of some types of meadows, field crops and ploughed fields and also the spectral reflectance was studied from an aircraft.

Below a brief description of the natural formations is given.

Fir, young forest, was studied in the "new" and "full leaf" phases in the visible and infrared regions of the spectrum. In the "young leaf" period the young shoots were 3-5 cm. long and were of a reddish-yellow colour at the time before the needles had developed. In the following phase, i.e. "full leaf", the needles on the young shoots were fully developed and had the usual green shade from which the general background of the forest took on a relatively greener colour. Mature forest was studied in the visible region of the spectrum in the "winter", "young leaf" and "full leaf" phases and in the infrared region in the "young leaf" phase. In the "winter" phase the trees had their old foliage (without snow). In the other phases the state of the forest corresponded to that given for "young forest".

Pine, young forest was studied in the "winter", "young leaf", "full leaf" and "late summer" phases in the visible region of the spectrum and in the "young leaf" and "full leaf" phases in the infrared region. In the "winter" phase the trees had their old foliage (without snow). In the following phase young shoots appeared on the trees up to 2-3 cm. long in which the needles were beginning to show and had a bright green (emerald) colour. In comparison to the "winter" phase the general background was brighter and greener. In the next phase the young trees were covered with new shoots with dense fully-developed needles, bright green in colour, and in the "late summer" phase the young shoots were noticeably darker and were almost the same colour and luminescence as the old foliage. Mature forest was studied in the "winter", "young leaf", "full leaf", and "late summer" phases in the visible region of the spectrum and in the first two phases in the infrared region. The vegetative development of the mature forests did not vary from the young forest.

Birch, young forest was studied in the "winter","young leaf", and "late summer" phases in the visible region of the spectrum and in the "late summer" phase in the infrared region.

In the "winter" phase the crowns of the trees, void of leaves and projected against each other, made a grey background with a barely noticeable reddish-brown shade. In the "young leaf" phase there were newly developed leaves that were not fully unfolded having a bright green colour. In the next phase the young leaves were fully developed and the general background at this time was of a saturated green colour. In the "late summer" phase the leaves were noticeably lighter in colour and showed traces of yellow. Mature forest was studied in the "winter", "young leaf", "full leaf", and "late summer" phases in the visible region of the spectrum and in the first and the last phases in the infrared region. The vegetative development described above for the young forest refers also to the mature forest.

Aspen, young forest was studied in the "winter", "young leaf", "full leaf" phases in the visible region of the spectrum and in the two latter phases in the infrared region. In the "winter" phase the dense crowns of the young trees formed a solid greyish-green background. In the next phase newly-formed leaves that were not yet fully unfolded appeared on the trees and had a brownish-green colour. In the "full leaf" phase the leaves had reached their normal size and form and were of emerald green colour (Fig. 8). Mature forest was studied in the "young leaf", "full leaf", "late summer", and "autumn" phases in the visible region of the spectrum and in the first three phases in the infrared region. In the "young leaf" phase the leaves had an emerald green colour with the complete absence of brownish shades that was observed in the young aspen forest. In the "autumn" phase the leaves became bright orange in colour with the complete absence of green.

Oak, young and mature forests. In the "young leaf" stage the oak leaves were bright green and in the "autumn" phase they were orange-brown.

Linden, mature forest. In the "full leaf" phase when the flower buds have not yet unfolded the crowns of the trees were green with a noticeable whitish shade (weakly saturated). In the "autumn" phase the spectral reflectance was studied of two groups of trees differentiated by color. One was bright yellow and the other noticeably darker, with reddish shades. For the final data on the spectral reflectance of linden the average value of both groups was taken.

Elm, mature forest. In the "young leaf" phase the trees were covered with dense tender-green leaves with a barely noticeable yellowish tint. In the "full leaf" phase the leaves took on a more yellowish shade but were less bright.

Alder, young forest. The leaves of young alder in contrast to other trees in the "young leaf" phase had a noticeably darker green color.

Larch, young forest. In the "winter" phase the spectral reflectance of two groups of trees was studied. In one case the trees were yellowish grey and in the other case they were of a brighter yellow color. As in the case of linden, the average value was taken as the final reflectance. In the "full leaf" phase the trees were covered by a greyish-green foliage.

Grass was studied first immediately after the snow had melted when there was only dry grass. Then the young bright green grass was studied followed by the flowering period and finally at the end of summer - mowed meadows. Grain crops (rye, wheat, oats and others) were studied at the appearance of the first green shoots, soon after the snow had melted, then in the spike-forming period, and some crops were studied in the ripe stage. Soil was studied in ploughed clay loam fields in the region of the village Lisino. Other than the natural formations mentioned above, various buildings and materials, walls and roofs of houses, bridges, paved and earth roads, etc., were studied in this region. Likewise, paved streets, asphalt streets, quays, and other city objects, were studied.

Black Earth Regions

Natural formations characteristic of the black earth region were studied on the farm of the Usman Technical School in the Vornezh Province, 18 km. south of Usman. The area studied was located in the middle of an extensive almost treeless prairie characteristic of many places in the central belt of the European part of the U.S.S.R. The field studies were made in August 1935. The studies were made primarily on soil which was typical rich black earth. It was studied in ploughed fields in the dry, moist and wet (after rain) states. Some field crops were studied: millet before ripening in the bright green stage of abundant growth and with brownish spikes, potatoes after blooming, with dark green leaves, sunflower in the flowering period, tomatoes with dark green dense leaves in the fruit-forming period, and cabbage with large heads. Then straw in sheaves was studied: rye, oats, wheat and lentil, each one separately and finally the stubble fields after the crops were harvested, oat and lentil stubble were studied separately.

Forest Steppe Zone

Field studies were made near the Village Getmanshchin, Poltava Province of the Uk.S.S.R., 40 km. north of Poltava, during the second half of August 1935. The area studied consisted of extensive fields, open and somewhat hilly towards the east. In this direction, almost along the meridian they bordered on a belt of forest which extended far to the south and which became gradually thin and ended a short distance to the north.

In this region virgin steppes which at the time of study were covered with grass half-dried by the sun were included. Then bushes of flowering wormwood and weeds (senecio) were studied in the seed ripening period and in the brown (dried) period. Growths were studied of reeds and sedge which grow abundantly in this region along the shores of the many lakes and swamps found at the edge of forests. Finally, the sand loam soil of the fields was studied in detail.

Steppes

Natural formations characteristic of steppes were studied in two regions: in the Chkalov Province and in the Kuban Valley. The first point of field study was located on an extensive plateau, about 50-100 km. in radius, near the Khalilov grain sovkhoz in the Ora region. On the east, north and west side the plateau borders on the southern spurs of the Ural mountain range. On the south side there is a gradual drop to the virgin steppes of the Kazak SSR. The characteristic objects of this region are: extensive fields of typical podsol grey desert soil, in places changing to black earth, and in places to chestnut brown soil, covered with crops of rye, wheat, oats and other field crops. Among the fields and particularly along the wide earth roads there are frequent growths of wormwood and other weeds. Because the field crops growing in this area were studied in detail in other regions attention in this case was paid primarily to the study of soils and some other objects.

Field work in this area was carried out in June 1936.

The second point was located near the city Cherkessk, Cherkess Autonomous Province and extended along the right bank of the River Kuban. It is characteristic of the steppe areas of the Kuban bordering on the foothills of the southern Caucasus. The landscape in this area is relatively uniform. Large areas consist of leached and podsol black earth. In many places the fields are bordered by large pasture areas located mainly along the slopes of hills and terraces and are covered by low sparse grass. In places the slopes are bare and in these cases they are distinguished by sand-yellow spots on a monotonous greenish-grey background. The valley of the River Kuban with its bright green areas covered by high water, in places covered by willow bushes, introduces some variation to the landscape. The following objects were studied in this area: ploughed fields of leached black earth, pastures and bare slopes, some field crops in the ripening period, general background and separate objects of the basin and high water areas of the Kuban and certain other formations. The work in this area was carried out in September 1937.

Deserts

The natural formations of the desert were studied in two places. The first, exactly characteristic of desert landscapes, was located near the railroad station of Uch-Adzhi approximately 100 km. east of the city Mary, Turkmen SSR in the eastern part of the Kara-Kum desert. The typical objects of this area are drifting sands and haloxylon. Occasionally one finds sparse grass, ilyas and selin (Aristida karelini). The first of these covers the sand dunes in places and serves as almost the only fodder for the many flocks of karakul sheep bred by the animal husbandry Sovkhoz of Uch-Adzhi. Selin occurs less frequently in the form of single high yellowish clumps (Fig. 9). The haloxylon growing in this area is a low bushy type (Fig. 14), and among the growing bushes there are many dry bushes. The sand dunes have on their surface a sharply defined microrelief resembling shallow ripples (Fig. 15). Among the sand dunes there are frequent takyrs and wind-eroded areas of solid clay soil covered with a hard crust on which whitish iridescence is observed. Work in this area was carried out in August 1936, when the grass was dry and had a sand-yellowish colour almost indistinguishable from the sand. The entire landscape was distinctly uniform in colour and only the haloxylon bushes made distinct dark spots. Other than the usual spectrographs we studied the dependence of the reflectance of sand dunes on the direction, light and position of the sun in relation to the microrelief.

A number of desert objects such as sand, silt, sandstone, clay, limestone and some others were studied under laboratory conditions.

The second point was located near the city Mary and is characteristic of oases (Merv oasis). The basic objects in this area are cotton and wheat fields. The Merv oasis extends 100-120 km. from north to south and about 60 km. from east to west. It is covered by a dense network of ponds fed by the river Murgab. The cotton fields were studied before blooming and in the blooming period. Then, the spectral reflectance was studied of Black elm, which is a widely distributed type of tree with a dense crown, camel grass having a greyish-green colour, earth roads covered with a thick layer (5-7 cm.) of loess, and finally, the muddy brown water of the ponds. The studies were made in June 1936.

Mountain Region

The field work was carried out near the Teberda Health Resort in the Klukhar region, Georgian SSR, in September 1937. The Teberda Health Resort is located in the valley of a mountain river by the same name and is about 1,300 m. above sea level (38). It is surrounded by high mountain ridges reaching in altitude to 3,500 m. and more. In the valley along both banks of the river there are forests, mainly coniferous (fir and pine), in the northern part of the valley and primarily deciduous in the south, where the forest thins out and disappears near the Klukhor Pass. In the forest there are frequent dry and damp meadows which become pastures on the slopes. The mountain slopes are mostly covered with dense primarily pine forest which rise to an altitude of 1,000 m. In a few places there are outcrops of mountain rock. Above the forest belt to the top of the ridges there are alpine meadows. The following formations were studied in this region:

1. Alpine meadow. Because of the approach of Autumn the grass was mostly dried and some types of grass were covered with ripening seed.
2. Alpine meadow, mowed.
3. Alpine meadow (pasture) with sparse vegetation.
4. Moist meadow in low places covered with bright green dense grass.
5. Dry meadow on high places in the valley covered with sparse low drying grass.
6. Mountain slopes covered with grass from a distance of several kilometers.
7. The general background of the valley from the same distance.
8. Ravines, almost perpendicular cliffs along the valley composed of light grey sandstone and falling sand.
9. Tops of the ravines covered with low sparse drying grass.
10. Hay piled in stacks.
11. Dry detritus in the valley of the River Dzhemagat.
12. The same, wet.
13. Water of the same river.
14. Bare cliffs on the mountainsides, reddish-brown in color.
15. Separate outcrops of mountain stone on the mountain heights, grey with a greenish shade.
16. Rubble on mountain slopes.
17. Earth road, dry, little used, chestnut brown.

CHAPTER VI

SUMMARY OF DATA ON THE SPECTRAL REFLECTANCE OF NATURAL FORMATIONS

The spectral reflectances r_λ of the natural formations studied are contained in the appended catalogue (see Appendix 1), and the spectral curves plotted from these reflectances are given in the appended atlas (see Appendix 2).

14. Forests and Shrubs

The spectral reflectance of forests and shrubs, as one would expect, is subject to many changes, depending on the season and the phase of vegetation. However, no great difference in the reflectance of separate types or ages of forests in any given vegetative phase was observed. Therefore, all the curves of forests and shrubs were combined in the following four groups (Fig. 16).

Type 1. The reflectance increases gradually but very slowly from the violet to the red end of the spectrum, remaining almost without change over the entire infrared region and retaining the same level which it reached in the red portion. Thus the curves of this type correspond to an almost neutral gray background with a barely noticeable yellowish or brown tint.

Type 2. The reflectance in all the visible regions of the spectrum ($\lambda\lambda$400-650 mμ) remains at a relatively low level (r_λ = 0.02-0.05); at about λ 500 mμ a weak maximum is observed. In the infrared region the reflectance is higher, however, the reflectances do not exceed 0.10-0.20, which is not high for vegetation (see below). Thus curves of the second type correspond to a dark green lightly saturated background.

Type 3. The reflectance in the visible region of the spectrum is noticeably higher than in the previous case. Nevertheless it remains generally low. The maximum of yellow-green rays, about $\lambda 550$ mμ, is caused by the saturated green color of the vegetation and is expressed more sharply. The reflectance in the infrared region, beginning at $\lambda 700$ mμ, increases sharply and remains very high across the entire region of the spectrum, i.e. the manifestation of the so-called Wood effect, whereupon the reflectance reaches 0.6-0.7.

Type 4. The spectral reflectance in the short wave region of the visible spectrum (from $\lambda 400$ mμ to $\lambda 550$ mμ) remains generally the same as in the previous case. However, further along the spectrum the reflectance increases more or less and remains high across the entire orange-red portion of the visible spectrum and in the infrared region. The curves of the fourth type correspond to the orange-red background.

Thus on the basis of the subdivisions of the reflectance curves of forest and shrubs their reflectance can be described in the following way.

In the winter period the reflectance of all deciduous growth can be considered as being of the first type. In this period all trees and shrubs have a general gray tone with a slight yellowish or brownish tint. Nevertheless the difference in the total luminance of the various growths can be very large. Thus in a comparison of the reflectance curve of individual species and various ages shows that young birch and larch are the darkest, the average luminance coefficient of which is approximately 0.5. Young oak, whose luminance coefficient is on the average 0 06 is brighter. Brighter still are mature linden and young aspen growths, whose average luminance coefficient is 0.08. Finally, the brightest, with a luminance coefficient of 0.09, is mature birch. The relatively high reflectance of mature birch is explained, apparently, by the white bark covering the limbs and thick branches. Measurements showed that the spectral reflectance of the bark is, in fact, very high and its average luminance coefficient reaches 0.22.

Coniferous forests in winter time can be considered as belonging to the second type according to their reflectance curves. Reflectance curves of coniferous growths have a weak maximum in yellow-green rays corresponding to the weak saturation of green color of old needles. By reflectance curves it is noted that mature pine is the darkest; its luminance coefficient even at the maximum (λ550 mμ) is equal to only 0.021. Thus pine can be considered one of the darkest natural formations.

With the approach of the vegetative period when new leaves and young needles appear the reflectance varies considerably and can be considered as being of the third type. In this period all growths regardless of species and age have sharply expressed maxima in the yellow-green rays, about λ550 mμ. At the same time there is a sharp increase in reflectance in the entire infrared region of the spectrum. If the reflectance curves of the various species are compared the following facts are discovered.

1. In the visible region of the spectrum ($\lambda\lambda$ 400-650 mμ) all of the curves regardless of the species, age and vegetative phase have more or less the same path along the spectrum. Thus beginning at the violet end of the spectrum (λ 400 mμ) to λ500 mμ the curves have a very gradual upward slant. Then from λ500 mμ to λ550 mμ there is a very sharp upswing, reaching a maximum at about λ550 mμ. After this the curves have a more or less gradual slant downwards remaining higher in the entire long-wave half of the visible spectrum (to λ650 mμ) than in the short-wave region. Further it can be seen that, on the average, the reflectance curves of coniferous species are lower than curves of deciduous species (Fig. 17). Thus coniferous species have, on the average, a lower reflectance or appear darker than deciduous species.

2. The maximum in the visible region of the spectrum in the case of all growths regardless of species and age lies at about λ550 mμ.

3. The reflectance of growths regardless of species and age in the "young leaf" phase is higher than in the following "full leaf" phase (Fig. 18). Hence it follows that as the young leaves and needles mature the growths become somewhat darker. However, the spectrum in both cases remains more or less the same. Consequently, the coloration changes very little with variations in the vegetative phases.

In the next phase "late summer" the reflectance of deciduous species again becomes high, even higher than in the "new leaf" phase. Thus in the late summer (before the appearance of autumn color) deciduous forests become brighter. On the other hand, coniferous species as shown by the curves become darker approaching the "winter" phase.

4. On many reflectance curves, e.g. oak, birch, linden, and others in the "young leaf" and "full leaf" phases there are distinct waves which correspond to absorption bands of chlorophyll, about $\lambda\lambda$585 mμ and 615 mμ.

5. The reflectance in the infrared region of the spectrum beginning at λ700 mμ varies with the species. Thus the lowest reflectance is shown by fir. The reflectance of pine is somewhat higher and that of birch is still higher. Finally, the highest reflectance is shown by aspen (Fig. 19).

It should also be added that in the vegetative period the usual maximum in the visible region of the spectrum at about λ550 mμ in the case of mature and young pine forests is not expressed as sharply as in the other species. Moreover, in the case of young pine forests in the "young leaf" phase the reflectance along the entire orange-red portion of the spectrum remains generally the same, at the level of the maximum at about λ500 mμ. Mature fir forests, which are generally darker than other species, in the "young leaf" phase have a reflectance that is unexpectedly high, not only by comparison with fir in the winter period, but also in comparison with all deciduous species in this phase. Obviously this is explained by the effect of young needles which are very bright.

With the approach of autumn color all growths of the deciduous species can be considered as belonging to the fourth type.

It is noted above that the study of the spectral reflectance of forests showed that there are no large differences in reflectance in the visible region of the spectrum in any particular phase. It is noted only that in some cases young forests are somewhat brighter than mature forests.

Table VII gives the spectral reflectance separately for each type described above. For the third type the values are given separately for deciduous and coniferous species. The same table also gives the average luminances for some phases of deciduous and coniferous species. Table VIII gives the luminances of the summer period in the infra-red region of the spectrum for four main species. The tables show the gradation, mentioned above, of the reflectance in the infra-red region depending on the species.

The study of the spectral reflectance of mature fir forest from the air showed that along the entire visible region of the spectrum the reflectance is substantially lower than that obtained from the ground (Fig. 20). This effect can apparently be explained by the fact that spectrographs from the air were taken in the nadir direction and the reflections reaching the spectrograph included the space between the trees as well as the trees themselves. The space between the trees, reflecting only scattered light from the sky, should not only attenuate the general luminance of the forest but should also affect the spectral distribution of light in the direction of increasing reflectances in the short-wave portion of the spectrum. In fact, reflectance curves of forests plotted from aerial data shows an increase in reflectance in the short wave portion of the spectrum in relation to curves obtained from the ground. The effect of atmospheric haze is scarcely noticeable because the spectrographs were taken from an altitude of 300 m. It should be noted that when the spectrographs were taken from the air the human eye could see intensive blue color in the shaded areas between trees.

15. Grass

Grass-covered areas can be subdivided into two basic groups by their spectral reflectance. One group includes areas whose reflectance curves are typical of vegetation. They have the usual maximum in the yellow-green rays and high reflectance in all infrared regions. The other group included grass covered areas whose spectral reflectance increases gradually from the violet to the red end of the spectrum. Each group can be divided further into two sub-groups, depending on the nature of the maximum in the yellow-green rays and the slope of the curve, respectively. Thus the curves of grass covered areas are divided into four types (Fig. 21).

Type 1. The average curve has a rather steep upward slant from the violet to the red end of the spectrum and the slope of the curve (the ratio of the reflectance in the red region of the spectrum, λ 650 mμ to the reflectance in the violet region λ 400 mμ) is equal to 2.6 and the luminance increases from 0.082 to 0.216. Near λ 600 mμ, i.e. in the orange region, a maximum is observed. In the infra-red region the curve continues to slant upwards and near λ 830 mμ the luminance reaches 0.386. To this type belong curves of dry desert grass. A generally higher reflectance along the entire spectrum is also characteristic of these curves. Therefore, these areas have a relatively high luminance and a sand-yellow color. Of the formations studied selin (see Fig. 9) and ilyas belong to this type. At the time of study these grasses were dry and were bright sand-yellow in color. Selin appeared in the form of isolated high (up to 1 m.) clumps, whereas ilyas appeared as low clumps on the surface of drifting sands covering large areas.

Type 2. The average curve of this type, as in the previous case, slopes gradually upwards from the violet to the red end of the spectrum. However, in contrast to the previous type, the slope is more gentle, γ is 2.00 and the average luminance increases from 0.053 to 0.106. Consequently, the curve is considerably lower across the spectrum than in the previous case. Thus formations of this type are darker than the previous type and are brownish-gray in color. In the infra-red region of the spectrum the reflectance is likewise lower than in the previous case and the luminance near λ 830 mμ reaches the maximum value, 0.276. The second type includes last year's (brown) grass after the snow has melted, growths of wormwood and weeds at the end of summer, i.e. when they have begun to dry, and some others.

<u>Type 3</u>. This reflectance curve is somewhat similar to the previous type but differs by the presence of a maximum at about λ560 mμ, which is characteristic of vegetation. The luminance coefficient at this maximum reaches 0.081. However, in the infra-red region of the spectrum this type of curve is somewhat higher than the second type and the reflectance at the maximum near λ850 mμ reaches 0.423. Consequently natural formations belonging to the third type differ by their green color and have the Wood effect, although to a small degree. To this type belong dry meadows of short grass, at times very sparse; high water areas of rivers and virgin steppes at the end of the summer period, when the grass is drying and losing its initial bright green color; dusty grass along roads; heather, etc. The third type to some extent forms a transition from the second to the fourth types.

<u>Type 4</u>. The average reflectance curve has a well-expressed maximum in yellow-green rays near λ550 mμ. On both sides of the maximum the curve slants downwards and the slant in the direction of the violet end of the spectrum is the steeper. In the infra-red region beginning at λ700 mμ the curve slants sharply upward and near λ850 mμ it reaches a maximum where the reflectance is 0.594. Thus natural formations of this type are bright green and

have a substantial Wood effect. To this type belong all dense moist vegetation such as lush meadows, sedge, reeds, etc.

The reflectance curve plotted as a medium between the third and fourth curve types and which can be regarded as a reflectance curve of average summer vegetation has a relatively sharp maximum in the yellow-green rays near λ550 mμ and a high reflectance in the entire infra-red region, where the reflectance reaches 0.40-0.55.

Table IX gives the reflectance for the individual types and for the above-indicated average coefficient of summer vegetation.

An examination of the individual reflectance curves of various grass covers (see atlas) shows a continuous transition from the flat curves of the first type to the curves with sharply expressed maxima in the yellow-green rays and with very sharp upward slants in the infra-red region, i.e. to curves of the fourth type. This indicates that grass-covered areas have a large difference in their reflective properties. For this reason it is not always possible to establish a distinct boundary between the various types. Moreover, in some cases, reflectance curves were obtained which did not belong to any of the four types, e.g. the curve of flowering willow herb, which has maxima near $\lambda\lambda$440, 540, and 620 mμ and the curve is almost parallel to the axis of the abscissa. Further, on individual curves, one can observe a shift of the usual maximum within the range of λ540 mμ to λ575 mμ (see diagram XIX, No. 43 and diagram XXXIX, No. 90). A curious reflectance curve was obtained from a stream covered with water grass and sedge. It had two equal maxima in the visible region of the spectrum near $\lambda\lambda$500 and 560 mμ.

A comparison of reflectance curves obtained for grasses and forests revealed an intrinsic fact. The reflectance curve of the fourth type of grass in the visible region of the spectrum is almost completely congruent with the reflectance curve of deciduous forests in the summer period and the curve for grasses of the second type coincides with the curve of coniferous forests for the same period (Fig. 22). This means that in the summer both the above pairs of natural formations have similar reflective properties in the visible region of the spectrum and consequently cannot be clearly distinguished in aerial photographs obtained with visible light.

On the basis of the data obtained the following variation in the reflectance, depending on the vegetative phase, can be noted: in the spring, when the new green shoots appear, grass-covered areas have curves of the fourth type; as the vegetation fades and dries toward the end of summer, the curve passes to the third type; completely dry grass at the end of autumn or early spring has reflectance curves of the second type.

As in the case of forests, on some reflectance curves of grass, the same chlorophyll absorption bands can be noted near 585 and 615 mμ (see dry meadow, diagram XLI, No. 100, and others).

16. Mosses and Lichens

This group is represented by a small number of formations. Nevertheless they have large variations in reflectance which can be described by the following four main types (see the reflectance curves in the atlas).

Type 1. These reflectance curves slope gradually upward from the violet end of the spectrum to the red and the curve is relatively low along the entire visible red region which corresponds to the low luminance of the formation. To the first type belong dark greenish-brown lichens which are abundant on turf, mosses on bare areas, wet mosses which differ somewhat from the previous two samples by their reddish shade, and others.

Type 2. The reflectance curve has a well defined maximum in the yellow-green rays near λ565 mμ, however, as in the previous case, the curve is low. Consequently formations of this type are dark green, such as moss on outcrops of khibinite on mountain slopes.

Type 3. The reflectance curve resembles the typical curve of vegetation having a sharply expressed maximum in the yellow-green rays which is displaced somewhat toward the red and is near λ570 mμ. Moreover, the curve is also similar in that it is high in the infra-red region of the spectrum, where the luminance coefficient reaches 0.50-0.75. An example of this type is sphagnum moss, which differs from lush grass by being somewhat brighter and yellower.

Type 4. This type is characterized by a particular type of reflectance curve having two maxima in the visible region of the spectrum, near λλ470 and 540 mμ. In the infra-red region of the spectrum the curve is relatively high. This reflectance curve was obtained from reindeer moss (dried).

17. Field and Garden Crops

The spectral reflectance of field and garden crops, as expected, is very similar to that of grass. Consequently the subdivisions made above for grass can be applied to field and garden crops. One should note that formations of this group in the majority of cases belong to the fourth type, that is, they have a well expressed maximum in the yellow-green rays and a generally high reflectance in the infra-red region of the spectrum. In individual cases the maximum in yellow-green rays is more sharply expressed than in the case of grass, which is explained by the higher saturation of green in field crops.

With the approach of the ripening period, coinciding with disappearance of green coloration and the appearance of golden yellow color, the reflectance curve becomes very similar to grass of the first type. A similar curve was obtained for straw of various grains.

The spectral reflectance of fields after the crops have been harvested is similar to that of grass of the second type.

18. Bare Areas and Soil

The characteristic property of the reflectance curve of this group of formations is their gradual upward slant from the violet to the red end of the spectrum. Individual curves differ among themselves mainly in their slant from the axis of the abscissa and in their height above the abscissa. There is a continuous transition from very flat curves, almost parallel to the axis of the abscissa, to curves with a very steep upward slant (see black earth, diagram CXIX, Nos. 304-310 and clays, diagram XCV, No. 234).

All the reflectance curves of this group can be subdivided with respect to their slope into three types. Moreover, a fourth type should be noted in the case of curves representing formations of high luminance (Fig. 23).

Type 1. This type includes reflectance curves of the darkest bare areas and soils. The average curve slants gradually upward from the violet to the red end of the spectrum and γ is equal to 1.5. The highest reflectances are 0.024 and 0.036, respectively. In the infra-red region of the spectrum the curve continues to slant upwards and near λ 840 $m\mu$ the reflectance reaches 0.071. A typical example of this group is rich black earth in the dry state. Other examples of this type are moist soils such as marsh soils, podzol, sandy soils, gray podzol and turf.

Type 2. The reflectance curve is similar to the previous one. However, the curve is substantially higher and γ equals 1.7. The reflectances at the ends of the spectrum are 0.078 and 0.135, respectively. In the infra-red region of the spectrum the reflectance reaches 0.258. Examples of this type are dry turf mounds, dry silt at the bottom of a canal (Central Asia), talus, and rocks (outcrops of mountain rock, e.g. khibinite), slopes of hills, and river banks, wet shallows of rivers, sand, edges of river banks, dry boulders, and others.

Type 3. The curve slopes upwards even more steeply and γ is equal to 2.6, the reflectance - 0.134 and 0.346. In the infra-red region of the spectrum a drop in the curve is observed. This type includes formations mainly from Central Asia, e.g. brick-red sand, saline soil, wind erosion, conglomerates, sand, and others.

Type 4. This type, as mentioned above, gives a curve relatively high above the axis of the abscissa which slants sharply upwards from the violet to the red end of the spectrum and γ equals 2.0, reflectance - 0.357 and 0.697. This type includes desert formations (Central Asia) e.g., clay, limestone, light gray sandstone, and shale, all in the dry state. Excluding snow, these formations are apparently the brightest on the earth's surface.

Table X gives the average reflectances for each type.

It is interesting to note that the darkest of all the natural formations studied was wet (after rain) ploughed black earth (Voronezh Province), the reflectance of which is 0.016 in the violet end of the spectrum and 0.025 in the red (see the curve on diagram CXIX, No. 304). The brightest formation, excluding snow, was clay the reflectance of which is 0.365 to 0.757 and shale (0.451-0.738), both in the dry state.

One should note also that the average reflectance curve of bare areas and soils of the second type, grass of the second type and forests of the first type are very similar. On this basis one can conclude that in the late Fall before snow and in the early Spring after the snow has melted, when the reflectance of this group of formations can be characterized by curves of the above-mentioned types, the contrast of the average landscape is very low.

19. Roads

The spectral reflectance of earth roads in general differs very little from that of the previous group. The average reflectance curve is fully congruent with that of bare areas and soils of the second type. The reflectance curve of roads in areas of chestnut-brown soil found in the northern Caucasus is somewhat different. It is almost parallel to the axis of the abscissa in the visible region of the spectrum and is somewhat lower at the red end of the spectrum.

The average reflectance curve of cobblestone roads differs from that of earth roads by a relatively steep upward slant in the direction of the red. Hence it follows that cobblestone roads are noticeably browner than earth roads while earth roads are comparable with neutral gray surfaces.

The spectral reflectance of roads in winter studied at the end of winter during a rapid thaw, when the road was a muddy yellowish-brown color, is generally very high with a relatively small upward slant in the direction of the red end of the spectrum.

20. Water Surfaces, Water Bodies and Snow

The spectral reflectance of water surfaces studied in three different regions was more or less the same and comparable with that of soils and bare areas of the second type and of earth roads. In all cases the reflectance curve of water slants gradually upward from the violet to the red end of the spectrum. This is explained by the muddiness of the water studied.

Attention is drawn to a clearly expressed maximum near λ580 mu on the reflectance curve of very muddy water in a reservoir (Central Asia) and also a drop in the reflectance in the infra-red region of the water in the River Kuban.

The spectral reflectance of snow was studied at the end of the winter in 1935. The snow was studied when it had just fallen, then snow covered with a layer of ice, and finally, snow covered with a hard dry crust having an opaque surface. In the first two cases measurements were taken with a cloudy sky and the fresh snow was measured in the normal (vertical) direction and the snow with an ice film was measured at an angle of 45° from the normal. The snow with a crust was measured with a cloudless sky in bright sunshine near midday and at three azimuths: 0, 90 and 180° and at the angles: 20, 40, 60 and 80° at each azimuth.

The data obtained gives the following conclusions:

1. The reflectance of fresh snow increases gradually with direction from the infra-red to the violet end of the spectrum. The reflectances are: 0.58 and 0.84, respectively. Thus fresh snow (cloudy sky) has a somewhat bluish tint.

2. The spectral reflectance of snow covered with a film of ice is almost the same across the visible and infra-red regions of the spectrum. One can notice a certain very slight rise in the direction of long waves. Thus this type of snow is similar to neutral surfaces having a very weak yellowish tint.

3. The spectral reflectance of snow with a crust was studied from various directions and it was found that the reflectance had a strong dependence on direction which fact will be dealt with in detail below. At this point we note that in the 0° azimuth the snow is the most neutral and at 90° it is somewhat blue and at 180° it is yellowish. The reflectance curves for the first two azimuths at all angles show clearly expressed maxima. At 0° the maxima is near $\lambda\lambda$ 460 and 580 mμ and at 90° it is near $\lambda\lambda$ 520 and 620 mμ, i.e. exactly where the minima are found in the first case. At 180° there were no waves in the curve. To what extent these waves are real it is difficult to say since the material obtained was not sufficient to make any conclusions. It is therefore necessary to make a special study of this problem.

21. Buildings and Building Materials

The spectral reflectance of this group was generally similar to that of bare areas and soils. Therefore, the subdivisions made for the latter group are applicable to buildings and building materials. It should, however, be noted that the reflectance curve of red brick had a very steep upward slant in the red end of the spectrum and, conversely, the reflectance curve of asphalt surfaces was almost neutral.

22. Spectrophotometric Classification of Natural Formations

The results of spectrographic studies given in the foregoing sections and the atlas of reflectance curves show that regardless of the various slopes of the reflectance curves one can note a limited number of typical curves to which all the others can be related. Thus it is possible to make a specific classification. For this purpose all the curves are divided into three fundamental groups which we call classes.

The first class takes in curves which have a gradual upward slant from the violet to the red end of the spectrum. Individual curves differ in slant which we designated earlier as γ and defined it as the ratio of the reflectance near λ 650 mμ to the reflectance near λ 400 mμ. Curves of this class are characteristic of various bare areas, soils, buildings and also various dry vegetation.

The second class takes in curves having a characteristic maximum in the visible region of the spectrum near λ560 mμ ($r_{m\chi}$) and the relatively high reflectance in the entire infra-red region of the spectrum (the Wood effect). Individual curves differ in the size of the maximum ($r_{m\chi}$) and the general reflectance in the infra-red region of the spectrum (r_{uk}). Curves of the second class are characteristic of vegetative formations (forests, grass, etc.) in the growing period.

The third class takes in curves that have a slant opposite to the curves of the first class, i.e. they slant upwards from the red to the violet end of the spectrum and the value of γ is less than unity. These curves are characteristic of snow and water surfaces. Moreover, this class also includes one type of curve having a neutral spectral distribution.

The curves of each class can be subdivided by types, depending on the parameter value of each individual class.

Below a description is given of a spectrophotometric application made up on the basis of the observations made above (Fig. 24).

√ The Spectrophotometric Classification of Natural Formations

Class 1. Bare Areas and Soil

Type 1. The curve slopes uniformly upwards toward the red end of the spectrum (r_λ = 0.022-0.071); γ = 1.64. Typical examples of this type are black earth, sand loam, earth roads, and others.

Type 2. The curve has a uniform upward slope in the same direction as above in the visible region of the spectrum and a steeper slant in the infra-red region. Moreover, the entire curve is above the first type (r_λ = 0.064-0.270); γ = 1.67. Typical examples of this type are podzol, clay loam and other soils, paved roads and some buildings, etc.

Type 3. The curve has a steeper upward slant and is convex from $\lambda\lambda$ 550-650 mμ. Moreover, the entire curve is higher than the previous type (r_λ = 0.168-0.341); γ = 2.71. Typical examples of this type are sands, various bare areas in the desert, some mountain outcrops, and others.

Type 4. The curve is convex with a steep upward slant and is much higher than the three previous types (r_{λ} = 0.357-0.753); γ = 1.95. Formations of this type are limestone, clay and other bright objects.

Class 2. Vegetative Formations

Type 1. The curve has a very weak maximum in the visible region of the spectrum ($r_{m\lambda}$ = 0.031) and is very low showing a very slight upward slope in the infra-red region of the spectrum (r_{uk} = 0.189). Typical examples of this type are coniferous forests in winter.

Type 2. The curve has a more distinct maximum in the visible region of the spectrum ($r_{m\lambda}$ = 0.088) and is higher than the previous curve and has a noticeable upward slant in the infra-red region (r_{uk} = 0.305). Typical examples are coniferous forests in the summer period, dry meadows and grass in general, excluding lush grass.

Type 3. The curve has a clearly expressed maximum in the yellow-green rays ($r_{m\lambda}$ = 0.134) and a very high upswing in the infra-red region (r_{uk} = 0.542). Typical examples are deciduous forests in the summer period and all lush grass.

Type 4. The curve has an upward slant in the entire green-orange-red portion of the spectrum ($r_{m\lambda}$ = 0.190) and a high upswing in the infra-red region (r_{uk} = 0.564). Typical examples of this type are forests in the autumn period and ripe field crops.

Class 3. Water Surfaces, Water Bodies and Snow

Type 1. The curve is neutral and high (r_{λ} = 0.720-0.760. Typical examples are snow covered with a film of ice.

Type 2. The curve has a gradual uniform upward slant in the direction of the violet end of the spectrum (r_{λ} = 0.830-0.630); γ = 0.88. The curve is high in relation to the axis of the abscissa. A typical example is fresh snow.

Type 3. The curve has a steep upward slant in the violet end of the spectrum and a very gradual downward slope in the red portion (r_{λ} = 0.150-0.007); γ = 0.19. Typical examples are water surface at a relatively large angle from the vertical, that is, reflecting the blue sky.

Table XI gives the spectral reflectances for each type.

CHAPTER VII

THE EFFECT OF VARIOUS FACTORS ON THE SPECTRAL REFLECTANCE OF NATURAL FORMATIONS

23. The Effect of Direction on the Spectral Reflectance

The research shows that the reflectance of many natural formations varies substantially with the position of the source of light (sun) in relation to the observer and the observed surface and with the direction from which the surface is observed. Particularly large variations were established in the case of field crops: wheat, rye, oats and others, mainly in the period when these crops are high and have spikes. A larger variation was observed in the case of snow.

The present work includes studies of the effect of direction on the reflectance of the following formations.

1. Dry meadow with dense high grass when the sun was at $(h_{\odot}) = 25^{\circ}$.
2. The same when $(h_{\odot}) = 45^{\circ}$.
3. Wheat, dense high growth before formation of spikes, $(h_{\odot}) = 40^{\circ}$.
4. Moist podsol (ploughed field), $(h_{\odot}) = 40^{\circ}$.
5. Drifting sand with clearly expressed microrelief with the presence of shadows from the ridges $(h_{\odot}) = 50^{\circ}$.
6. The same without shadows, $(h_{\odot}) = 50^{\circ}$.
7. Crusted snow $(h_{\odot}) = 25^{\circ}$.

Reflectance was measured, as a rule, in four azimuths (0, 90, 180 and 270° in relation to the sun) and at the following angles for each azimuth: 0, 15, 30, 45, 60 and 75° from the normal. Wheat was measured at the angles 45, 65 and 85° and snow at 20, 40, 60 and 80°. It should, however, be noted that because some spectrograms could not be developed the reflectance values do not apply to all the above directions.

Further treatment of the data obtained was as follows. From the reflectance values obtained, measured at 10 mμ intervals in the visible and infra-red regions of the spectrum, we calculated the average luminances for the following regions of the spectrum λλ 400-500 mμ, 510-600 mμ, 610-650 mμ, 730-800 mμ, and 810-850 mμ The values obtained are given in Table XII, which also gives calculated average reflectances for the entire visible region of the spectrum and also for the infra-red region. From the tables we plotted indicatrices of the distribution of reflectance (Fig. 25-27). These indicatrices suggest the following conclusions.

1. The reflectance of all the formations studied, as a rule, increased with the angle in the visible region of the spectrum.

2. The increase in the reflectance of wheat in the azimuths 0 and 180°, i.e. along the sun's meridian, was more or less the same (Fig. 25). This can be explained by the fact that at 0° the increase in luminance caused by increasing the angle is effected by the mirror reflections from the various surface elements. In

the opposite azimuth the reflectance increases because of the gradual decrease of shaded areas as the angle is increased. It is curious that in both cases the reflectance curves are about the same. Regrettably data could not be obtained for the 90 and 270° azimuths.

3. In the case of meadows the reflectance values varied with the angle much the same as in the case of wheat. However, when the altitude of the sun was 25° the variation in reflectance was expressed more clearly than at 45° (Fig. 26). Hence it follows that as the sun rises above the horizon the dependence of reflectance on direction decreases. It then turned out that at various heights of the sun the greatest reflectance of meadows was observed in the 180° azimuth and the lowest in the 0° azimuth. Thus a meadow does not apparently have the mirror effect observed on wheat.

4. Soils studied in 0, 90 and 270° azimuths showed the highest reflectance in the 270° azimuth, two to three times as high as in other azimuths. This unexpected result, since the reflectance in the 90 and 270° azimuths should, theoretically, be the same, is explained apparently by the direction of shallow furrows in relation to the sun.

5. Drifting sands with shadows from ridges (see Fig. 15) oriented perpendicular to the sun's meridian showed a dependence of reflectance on direction similar to that of soils. As in the case of soil the highest reflectance was in the 270° azimuth and

the lowest in the 180° azimuth. Moreover, one could have expected the highest reflectance in the 180° azimuth because of the very low shadow effect. Thus these studies show that the reflectance of soils and sand is relatively complex and depends not only on direction but also on the structure of the surface, the presence of microrelief and its orientation in relation to the sun, the height of the sun, etc.

6. In the case of snow in all azimuths except 0° the reflectance was almost the same. Thus in these directions a snow surface appears opaque. However, in the 0° azimuth the luminance increases sharply with the angle and at 80° it is approximately fifteen times greater than the reflectance at 20° Consequently in this azimuth there is a strong mirror effect on snow surfaces.

7. In all the formations studied the variation of reflectance was generally the same in all regions of the spectrum. This means that the color of a surface does not change with direction. On this basis average reflectances were calculated for the entire visible region of the spectrum and separately for the infra-red. From these data reflectance indicatrices were plotted (Fig. 27) from which reflectance values were obtained at 10° intervals from the perpendicular. These values, therefore, correspond to average reflectances and cannot be used for individual considerations. These reflectances are given in Table XIII.

From the data given in this table we calculated the ratios (δ) of reflectances in various directions to the reflectance in the normal direction which was taken as unity for all formations. The values obtained are given in Table XIV. These values can be used in calculating average reflectances for various natural formations and in various directions.

In addition to the dependence of reflectance on direction we carried out experiments on the reflectance of some formations from the air with the aim of comparing aerial data with those obtained on the ground. Regrettably reliable and complete data (for the visible region of the spectrum) were obtained only for two objects: mature fir forest and dry meadow with low sparse grass. In comparing the results it was found that the reflectance of the meadow was almost the same under both conditions. On the contrary, the reflectance of the fir forest obtained from the air in the entire visible region of the spectrum was substantially lower than that obtained from the ground (see Fig. 20). As mentioned above, the decrease in reflectance of forests obtained from the air is caused by the shadows between individual trees.

The data obtained in the foregoing experiments can be used in passing from ground observations to aerial observations. Thus in the case of horizontal surfaces the reflectance can be considered the same in both cases. On the other hand, in the case of vertical formations (forests, shrubs, and others) the reduction factor μ should be considered to be approximately 0.3. One should, however, keep in mind that in the case of deciduous growths the value of μ can be different and one can expect a certain increase in this factor.

24. The Dependence of Reflectance on the State of the Surface

The reflectance of some soils, bare areas, and other formations were studied in the dry, moist or wet state. The results obtained make it possible to explain the extent to which the reflectance depends on the wetness of the surface. It turned out that, as a rule, moist surfaces were less bright than dry surfaces and the degree to which the reflectance decreased with wetness varied with different formations. However, in individual cases moist surfaces were brighter than dry surfaces. In studying the dependence o1 reflectance on the wetness of a surface we calculated the ratios ζ of the luminance of dry surfaces to that of moist surfaces or wet surfaces. In explaining the appearance of the spectrograms values were calculated for four wave lengths $\lambda\lambda$ 400, 500, 600 and 650 mμ. The data obtained are given in Table XV.

The tables show primarily that there was no systematic deviation on the spectrogram. There were only small, chance deviations. Therefore, the average values of ζ were calculated for the entire visible spectrum which are given in the same table.

The table also shows that in some cases the values of ζ are large and in others they are much smaller. From this natural formations can be clearly divided into two groups. Moreover, one can also see another group for which the values of ζ are less than unity, i.e. these formations are brighter in the wet or moist state than in the dry state.

Thus all formations were divided into the following three groups:

	Dry Surfaces	Compared with	
I.	Podsol, azimuth 0°, angle 45°	Moist; average ζ	2.6
	Paved road, " "	Wet; " "	2.4
	Cobblestone street, azimuth 0°, angle 45°	Wet; " "	2.8
	Boulders, normal	Wet; " "	3.0
		Average ζ	2.7
II.	Sandy loam, azimuth 90°, angle 45°	Moist; average	1.4
	Black earth, normal	Wet; " "	1.4
		Average ζ	1.4
III.	Sandy loam, azimuth 0°, angle 45°	Moist; average ζ	0.8
	Black earth, " "	Wet; " "	0.7
	" " " 180°, "	" " "	0.8
		Average ζ	0.8

This subdivision, as expected, shows that there is a large difference in reflectance between wet and dry surfaces. The reflectance of wet surfaces is 2.7 times less than that of dry surfaces. As regards the third group the increase in reflectance of moist and wet surfaces in two of the three cases took place in the 0° azimuth, that is, against the sun. Therefore, the increase in reflectance can be explained as mirror effect which increases substantially when the surface is wet.

Our studies showed that the spectral reflectance of dry sphagnum moss is 2.7 times higher than that of wet moss.

Later, the reflectance of a meadow before mowing was compared with that obtained after mowing, which showed that in the latter case the spectral reflectance was 1.6 times less.

CONCLUSIONS

This work was carried out by the author mainly to obtain factual data on the spectral reflectance of natural formations. Such data were completely absent in the literature. At the same time there were no published methods or procedures on photographic spectrophotometry applicable to use in the field. Therefore, the entire work is an attempt to solve a new problem. A great deal of time and effort was spent in this work, particularly in collecting the spectrograms. The development of the many thousands of spectrograms was, likewise, a vast undertaking in which an entire collective of laboratory technicians and statisticians took part.

The author did not attempt to solve the problem of putting the data obtained on spectral reflectance to practical use. Such an undertaking can only be successfully completed by a group of workers from various scientific and technical fields. As regards the possibility of making practical use of these data, the author believes that it can be done in many cases. First of all, the data can be used in solving various aerial photographic and camouflage problems. The data can also be of value in astrophysics to study the physical properties of planets and asteroids where they have already been used by many authors (39, 40, 43, 44). Other applications are geophysics (45), illumination engineering, etc. Data on the spectral reflectance of vegetation can also be of use in the study of the photophysiology of plants[41].

The catalogue given in the appendix of the reflectances and the atlas of reflectance curves can be used as source material for various research projects.

Moscow, April 1946.

Literature

1. Tikhov, G. A., Optical intensification of Contrast in Aerophotography. 1st All-Union Conference on Aerophotography, 14-16, VI, 1929. Transactions of the State Institute of Geodesy and Cartography. No. 1, pp. 196-200.
2. Markov, A. V., Spectrophotometric Research and Its Application to Improving the Results of Aerophotography and Aero-observation. Transactions of the State Institute of Geodesy and Cartography, No. IV, 1931.
3. Sharonov, V. V., Light Scatter by Natural Formations and the Aerophotometric Method of Determining the Scatter. Collection of articles on Aerophotometry. "Study of Reflectance". Ed. G. A. Tikhov, pp. 3-28, 1934.
4. Sharonov, V. V., Problems of Exponometry in Aerophotography. "Aerophotography". Collection of articles, I, pp. 33-34, 1934. Gorgeonefteizdat.
5. Angström, A., The Albedo of Various Surfaces of Ground. Geogr. Annaler. H. 4, 1925.
6. Hibben, S. G., Trans. illum. Cng. Sec. 24, 752-756, 1929; sc. (27), 61, 1930.
7. Kimball and Hand, Month. Weth. Rev. 57, No. 7, 1929; 58, No. 7, 1930.
8. Seybold, A., Über die optischen Eigenschaften der Zaublatter. Planta, Arch. für Wiss. Bot. I, II, III, IV, 16, 195; 20, 77, 21, 251, 1933.

9. Stutchey und Wegener. Nachr. d. K. Ges. d. Wiss. zu Göttingen. Math. phys. Kl. 1911.

10. Tonzig, S. and Vitesli, E. Am. R. Inst. Veneto Sc. (2), 114, 143-159, 1934-35; Sc. (2), 6, 226, 1925.

11. Bloch, O., Lichttechnik. 1921.

12. Wilsing, J. and Schneiner, J., Vergleichende Spektralfotometrische beobachtungen am monde und an gesteinen nebst albedobestimmungen an letzteren. Publik. des Astrophys. Observat. zu Potsdam. No. 61, B. XX, 4, 1-68, 1909.

13. Bylov, M. V., The Reflection of Light from Natural Surfaces. Transactions of the State Institute of Geodesy and Cartography, IV, 1931.

14. Kalitin, N. N. Some Data on the Reflection of Solar Radiation from the Earth's Surface for Southern Resorts. Kurortnosanatornoe delo, No. 1, 1929.

15. Kulebakin, V. S. The Reflection of Light from the Earth's Surface. Transactions of the State Experimental Electrotechnical Institute, No. 17, p. 5.

16. Sharonov, V. V. Reflectance of Some Natural Formations. Collection of articles on Aerophotometry, No. 2 "Research in Reflectance". Ed. G. A. Tikhov, p. 53, 1934.

17. Sharonov, V. V. Visual Luminance Coefficients of Some Natural Objects. Tekhbyulleten "Aerophotography" Izd. TsNIIGA and K., No. 6-7, 1934.

18. Sharonov, V. V. and Sytinskaya, N. N. An Experiment in the Aerophotometric Determination of Scatter Coefficients of the Earth's Surface by Simultaneous Measurements of Luminance and Illumination. Journal of Geophysics, 1934, IV, No. 1, pp. 40-45.

19. Kalitin, N. N. The Measurements of the Albedo of a Snow-cover. Monthly Weather Rev., No. 2, 1930.

20. Tikhov, G. A. Light Properties of Vegetation. Transactions of the State Institute of Geodesy and Cartography, IV, 1931.

21. Tikhov, G. A. Spectral Coefficients of Scatter. Collection of articles on aerophotometry, No. 1, pp. 113-116, 1934.

22. Tikhov, G. A. Some Spectral Properties of Several Botanical and Zoological Objects. The P. F. Lesgaft Institute of Science Publication, Vols. XVII and XVIII, pp. 475-482, 1934.

23. Krinov, E. L. Spectral Reflectance of Some Natural Formations. Collection of articles on aerophotometry, No. 2. "Research in Reflectance". Ed. Prof. G. A. Tikhov, pp. 29, 1934.

24. Krinov, E. L. Spectral Reflectance of Natural Objects Observed from the Air. Tekhbyulleten "Aerophotography". Izd. TsNIIGA and K, Nos. 8-9. 1934.

25. Krinov, E. L. The Dependence of the Spectral Reflectance of Natural Objects on Direction. Izd. TsNIIGA and K, Nos. 5-6, 1935.

26. Martynov and Sokolov. Light Engineering Terminology. Transactions of the II All-Union Light Technology Conference, No. 13, pp. 29-31.

27. Sharonov, V. V. Characteristics of the Reflectance of Heavenly Bodies. Astronomical Journal. XI, No. 5, pp. 478-483, 1934.

28. Sharonov, V. V. Photometric Observations from the Stratostate and Problems Involved. Transactions of the All-Union Conference on the Study of the Stratosphere. Izd. AN USSR. pp. 211-215, 1935.

29. Vavilov, S. I. and Savost'yanova, M. V., Ed. A Reference Book on Military Optics. OGIZ, M.-L. 1945.

30. Fabry, Charles. General Introduction to Photometry. Translated from French. ONTI, 1934.

31. Geodesy. A reference handbook T.V. Aerophotography, pp. 40, Izd. NARKOMKHOZA RSVSR. 1939.

32. Ambartsumyan, V. A. et al. A Course in Astrophysics and Stellular Astronomy. Part I, ONTI, pp. 228-235 and 276-291, 1934.

33. Filippov, A. N. Spectral Analysis. ONTI, pp. 205-244, 1937.

34. Sharonov, V. V. 1. Research in the Spectral Sensitivity of Some Photographic Materials. Transactions of TsNIIGA and K, No. 20. Research in Photometry, Prof. K. V. Chibisov, ed., pp. 3-12, 1937.

35. Gorokhovskii, Yu. N. and Barteneva, O. A. Atlas of the Spectral Properties of Present Photographic Materials. GOI. L. 1941.

36. Neblit. General Course in Photography. Books 1, 2 and 3, Zhurn.-Gaz. ob'ed, M. 1932.

37. Travel Guide for the Khibina Tundra. Izd. An USSR, 1932.

38. Teberda Travel Guide. Izd. Mosk. Doma uchenykh, 1934.

39. Krinov, E. L. An Experiment in Studying the Spectral Reflectance of Mars and Jupiter. Astronomical Journal, XII, No. 6, pp. 557-563, 1935.

40. Krinov, E. L. Spectrophotometric Study of 40 Rock Meteorites. Astronomical Journal, XVII, No. 4, pp. 40-67, 1940.

41. Makarevskii, N. I. Reflectance, Transmittance and Absorption of Solar Radiation by Plant Leaves. Transactions of the Photophysiological Laboratory of the Physico-agronom. Inst., No. 1, pp. 111-119, 1938.

42. Vavilov, S. I. and Savost'yanova, M. V., Ed. Military Optics. Collection of articles 3rd. ed. AN USSR, Vol. 1, 1945.

43. Fesenkov, V. G. Cosmogony of the Solar System. Izd. of the Kazak Branch of AN USSR Alma-Ata, pp. 52, 1945.

44. Tikhov, G. A. New Data on Mars. DAN USSR, Vol. XLIX, No. 2, pp. 95-97, 1945.

45. Sharonov, V. G. Visibility of Distant Objects and Lights. Voenmorizdat, 1944.

Table I

Calibration of the photometric scales of the spectrographs

Diaphragm No.	log I	log i	Δ log I	%
		Aerial spectrograph		
0	2.568	2.568	0	-
1	2.292	2.264	- 0.028	1.2
2	2.168	2.174	+ 0.006	0.3
3	1.698	1.680	- 0.018	1.1
4	1.366	1.366	0	-
5	1.112	1.074	- 0.038	3.5
6	0.861	0.790	- 0.071	9.0
7	0.426	0.368	- 0.058	10.3
		Average deflection		5.1
		Field spectrograph		
0	2.436	2.436	0	-
1	2.144	2.138	- 0.006	0.3
2	1.849	1.842	- 0.007	0.4
3	1.570	1.536	- 0.034	2.2
4	1.263	1.234	- 0.029	2.3
5	0.940	0.930	- 0.010	1.1
6	0.613	0.634	+ 0.021	3.3
7	0.342	0.306	- 0.036	11.7
		Average deflection		3.2

TABLE II

λ	Pulkovo etched opal glass	N.I.L. etched opal glass		Baryte test plate	Gypsum plate	Porcelain plate	Pulkovo etched opal glass
mμ	In relation to MgO powder	In relation to baryte test plate		In relation to magnesium oxide deposited on a porcelain plate			Reduced in relation to magnesium oxide
400	0.79	0.79	0.79	0.92	0.94	0.45	0.73
410	0.80	0.81	0.78	0.93	0.94	0.50	0.75
420	0.82	0.83	0.77	0.93	0.94	0.55	0.77
430	0.82	0.84	0.76	0.93	0.94	0.59	0.78
440	0.83	0.85	0.76	0.93	0.94	0.63	0.79
450	0.84	0.85	0.75	0.93	0.94	0.66	0.79
460	0.84	0.86	0.74	0.93	0.94	0.69	0.80
470	0.84	0.86	0.74	0.94	0.94	0.72	0.81
480	0.85	0.87	0.74	0.94	0.95	0.74	0.82
490	0.85	0.87	0.74	0.94	0.97	0.77	0.82
500	0.85	0.88	0.74	0.95	0.98	0.78	0.84
510	0.85	0.88	0.73	0.95	0.98	0.80	0.84
520	0.85	0.88	0.73	0.95	0.99	0.81	0.84
530	0.85	0.88	0.73	0.95	0.99	0.82	0.84
540	0.85	0.88	0.72	0.95	1.00	0.83	0.84
550	0.85	0.88	0.72	0.95	1.00	0.84	0.84
560	0.85	0.88	0.72	0.95	1.00	0.84	0.84
570	0.85	0.88	0.72	0.95	1.01	0.85	0.84
580	0.85	0.88	0.72	0.94	1.01	0.85	0.83
590	0.84	0.87	0.72	0.94	1.01	0.85	0.82
600	0.84	0.87	0.72	0.94	1.00	0.85	0.82
610	0.83	0.86	0.72	0.94	0.99	0.85	0.81
620	0.82	0.86	0.72	0.93	0.98	0.85	0.80
630	0.82	0.85	0.72	-	0.96	0.84	-
640	0.82	0.84	0.72	-	0.94	0.84	-
650	0.82	0.82	0.72	-	0.92	-	-

TABLE III

Direct-diffuse reflectance of the gypsum plate

	White light	Through color filter					average
		FO-1	FO-4	FP-2	FP-5	FP-8	
λ_3	560	550	570	580	610	630	-
ρ_r	0.89	0.88	0.90	0.87	0.88	(0.91)	0.89

TABLE IV

Spectral reflectance of the gypsum plate and baryte paper

λ(mμ)	Gypsum plate	Baryte paper	λ(mμ)	Gypsum plate	Baryte paper
Visible region of spectrum			Infrared region of spectrum		
H	3	3	H	2	2
C	6	8	C	6	6
420	0.58	0.68	760	0.66	0.66
430	0.61	0.72	770	0.64	0.63
440	0.64	0.74	780	0.67	0.64
450	0.65	0.74	790	0.72	0.70
460	0.68	0.75	800	0.74	0.72
470	0.70	0.76	810	0.76	0.71
480	0.71	0.76	820	0.77	0.72
490	0.69	0.76	830	0.76	0.71
500	0.68	0.75	840	0.75	0.70
510	0.68	0.75	850	0.74	0.71
520	0.70	0.76	860	0.76	0.74
530	0.72	0.77	870	0.78	0.77
540	0.73	0.77	880	0.81	0.79
550	0.74	0.77	890	0.81	0.79
560	0.75	0.77	900	0.81	0.79
570	0.76	0.78	910	0.81	0.79
580	0.78	0.78	920	0.81	0.80
590	0.78	0.78	930	0.82	0.81
600	0.78	0.77	940	0.83	0.81
610	0.78	0.76	950	0.83	0.82
620	0.77	0.76	960	0.84	0.82
630	0.77	0.77	970	0.85	0.84
640	0.76	0.75	980	0.86	0.85
			990	0.87	0.86

TABLE V

Spectral transparency of color filters and spectral sensitivity of photographic plates

λ mμ	Color filters					Plates		
	FO-2	FO-4	FP-5	FP-8	FI-2	N.	O.	P.
400	0.000	0.000	0.000	0.000	0.000	0.94	0.98	1.00
410	0.000	0.000	0.000	0.000	0.000	1.00	1.00	0.97
420	0.000	0.000	0.000	0.000	0.000	0.94	0.99	0.81
430	0.000	0.000	0.000	0.000	0.000	0.87	0.85	0.68
440	0.100	0.004	0.000	0.000	0.000	0.74	0.66	0.59
450	0.170	0.012	0.000	0.000	0.000	0.64	0.54	0.50
460	0.168	0.019	0.000	0.000	0.000	0.51	0.35	0.40
470	0.392	0.030	0.000	0.000	0.000	0.40	0.23	0.28
480	0.540	0.056	0.000	0.000	0.000	0.26	0.13	0.15
490	0.688	0.124	0.000	0.000	0.000	0.12	0.083	0.12
500	0.755	0.300	0.000	0.000	0.000	0.062	0.038	0.024
510	0.797	0.600	0.000	0.000	0.000	0.026	0.025	0.008
520	0.824	0.788	0.004	0.000	0.000	0.013	0.021	0.004
530	0.844	0.860	0.010	0.000	0.000	0.002	0.023	0.004
540	0.860	0.890	0.039	0.000	0.000	0.001	0.024	0.004
550	0.873	0.901	0.118	0.000	0.000	-	0.027	0.006
560	0.884	0.905	0.300	0.000	0.000	-	0.037	0.006
570	0.893	0.907	0.537	0.000	0.000	-	0.039	0.006
580	0.900	0.911	0.710	0.003	0.000	-	0.022	0.006
590	0.904	0.915	0.810	0.018	0.000	-	0.002	0.010
600	0.908	0.918	0.857	0.065	0.000	-	0.001	0.011
610	0.909	0.920	0.888	0.270	0.000	-	-	0.011
620	0.910	0.920	0.907	0.538	0.000	-	-	0.011
630	0.911	0.920	0.920	0.700	0.000	-	-	0.014
640	0.912	0.920	0.930	0.800	0.000	-	-	0.014
650	0.914	0.920	0.940	0.838	0.000	-	-	0.011
660	0.916	0.920	0.940	0.860	0.000	-	-	-
670	0.918	0.920	0.940	0.870	0.002	-	-	-
680	-	-	-	-	0.003	-	-	-
690	-	-	-	-	0.010	-	-	-
700	-	-	-	-	0.033	-	-	-
710	-	-	-	-	0.053	-	-	-
720	-	-	-	-	0.084	-	-	-
730	-	-	-	-	0.087	-	-	-
740	-	-	-	-	0.080	-	-	-
750	-	-	-	-	0.089	-	-	-
λ Maximum sensitivity						410	411	403

N - non-sensitized plates, O - orthochromatic and

P - panchromatic.

TABLE VI

Number of Negatives (N) and Spectrograms (S) obtained by various spectrographs during the entire period of study

Year	Laboratory spectrograph NIL		Quartz spectrograph TsNIIGA and K		Zeiss spectrograph		Pulkovo quartz spectrograph		NIL field spectrograph		TsNIIGA and K field spectrograph		Infra-red spectrograph		TsNIIGA and K aerial spectrograph		Total	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
1932	-	-	-	-	-	-	-	-	23	272	-	-	-	-	-	-	23	272
1933	-	-	-	-	-	-	11	164	174	1930	-	-	-	-	-	-	185	2094
1934	11	110	-	-	-	-	-	-	245	2910	-	-	-	-	-	-	256	3020
1935	-	-	-	-	-	-	-	-	106	1123	70	843	-	-	34	282	210	2248
1936	-	-	-	-	-	-	-	-	-	-	102	1213	-	-	-	-	102	1213
1937	-	-	8	103	-	-	-	-	-	-	81	944	23	218	-	-	112	1265
1942	-	-	-	-	17	204	-	-	-	-	-	-	-	-	-	-	17	204
Total	11	110	8	103	17	204	11	164	548	6235	253	3000	23	218	34	282	905	10316

TABLE VII

Average Reflectances of Forests

λ mμ	Types					Young leaf		Full leaf	
	1	2	3 Decid-uous	3 Conif-erous	4	Decid-uous	Conif-erous	Decid-uous	Conif-erous
400	0.061	0.017	0.043	0.034	0.051	0.037	0.034	0.033	0.033
410	0.061	0.017	0.043	0.035	0.053	0.037	0.038	0.033	0.032
420	0.060	0.017	0.044	0.037	0.056	0.039	0.038	0.034	0.036
430	0.060	0.018	0.046	0.038	0.060	0.040	0.042	0.036	0.033
440	0.060	0.018	0.047	0.038	0.061	0.041	0.042	0.038	0.033
450	0.060	0.018	0.050	0.039	0.062	0.043	0.043	0.040	0.034
460	0.060	0.018	0.052	0.040	0.064	0.044	0.045	0.041	0.035
470	0.060	0.018	0.054	0.042	0.069	0.045	0.047	0.041	0.037
480	0.060	0.017	0.055	0.043	0.076	0.046	0.048	0.041	0.038
490	0.061	0.017	0.058	0.044	0.079	0.048	0.049	0.041	0.038
500	0.062	0.016	0.063	0.047	0.083	0.052	0.053	0.044	0.042
510	0.063	0.019	0.073	0.054	0.091	0.060	0.062	0.051	0.046
520	0.065	0.024	0.090	0.064	0.112	0.078	0.072	0.069	0.056
530	0.068	0.027	0.113	0.079	0.134	0.101	0.088	0.089	0.070
540	0.070	0.031	0.126	0.089	0.151	0.114	0.101	0.102	0.078
550	0.072	0.031	0.135	0.095	0.168	0.123	0.108	0.111	0.083
560	0.074	0.031	0.132	0.095	0.178	0.115	0.108	0.107	0.082
570	0.074	0.031	0.125	0.088	0.191	0.111	0.101	0.095	0.076
580	0.076	0.028	0.115	0.081	0.193	0.100	0.094	0.083	0.068
590	0.077	0.027	0.108	0.079	0.196	0.092	0.092	0.075	0.066
600	0.078	0.028	0.104	0.078	0.195	0.085	0.092	0.075	0.065
610	0.079	0.026	0.098	0.080	0.191	0.080	0.094	0.068	0.066
620	0.079	0.026	0.095	0.078	0.193	0.075	0.090	0.063	0.065
630	0.080	0.027	0.092	0.076	0.193	0.072	0.088	0.061	0.064
640	0.080	0.026	0.089	0.075	0.190	0.069	0.087	0.060	0.063
650	0.080	0.022	0.087	0.074	0.193	0.067	0.086	0.058	0.062

TABLE VIII

Average Reflectance of Forests in the Infra-red Region of the Spectrum (Summer Period)

λ mμ	Fir	Pine	Birch	Aspen
700	-	-	-	-
710	-	0.114	-	-
720	0.088	0.150	-	-
730	0.141	0.210	-	-
740	0.165	0.250	-	-
750	0.174	0.269	-	-
760	0.178	0.281	-	0.542
770	0.177	0.290	-	0.562
780	0.176	0.299	-	0.578
790	0.174	0.304	0.398	0.589
800	0.173	0.309	0.405	0.596
810	0.172	0.310	0.411	0.601
820	0.173	0.310	0.418	0.606
830	0.177	0.310	0.420	0.609
840	0.180	0.310	0.421	0.610
850	0.182	0.310	0.422	0.611
860	-	0.310	0.422	0.612
870	-	0.310	0.422	0.613
880	-	-	-	0.614

TABLE IX

Average Reflectance of Grasses

λ mu	Types				Average r_λ for summer grass
	1	2	3	4	
400	0.082	0.053	0.032	0.035	0.034
410	0.088	0.054	0.033	0.039	0.036
420	0.095	0.054	0.036	0.041	0.038
430	0.102	0.055	0.039	0.043	0.041
440	0.109	0.056	0.042	0.045	0.044
450	0.115	0.057	0.043	0.047	0.045
460	0.123	0.059	0.045	0.048	0.046
470	0.129	0.062	0.047	0.049	0.048
480	0.136	0.064	0.049	0.049	0.049
490	0.142	0.068	0.050	0.051	0.050
500	0.150	0.070	0.052	0.056	0.054
510	0.159	0.074	0.056	0.066	0.060
520	0.165	0.076	0.062	0.080	0.071
530	0.173	0.078	0.071	0.103	0.087
540	0.184	0.081	0.077	0.121	0.099
550	0.194	0.085	0.080	0.134	0.107
560	0.202	0.085	0.081	0.132	0.106
570	0.210	0.086	0.080	0.121	0.100
580	0.218	0.088	0.078	0.111	0.094
590	0.224	0.090	0.076	0.103	0.090
600	0.225	0.093	0.077	0.098	0.088
610	0.224	0.097	0.079	0.095	0.087
620	0.222	0.098	0.080	0.091	0.085
630	0.220	0.101	0.082	0.085	0.084
640	0.218	0.103	0.082	0.082	0.082
650	0.216	0.106	0.080	0.081	0.080
720	-	-	-	0.304	-
730	-	0.210	0.216	0.365	0.290
740	-	6.217	0.259	0.438	0.348
750	-	0.223	0.275	0.486	0.380
760	-	0.225	0.295	0.510	0.402
770	0.314	0.229	0.350	0.528	0.439
780	0.323	0.236	0.360	0.542	0.451
790	0.330	0.248	0.368	0.535	0.451
800	0.333	0.257	0.369	0.548	0.458
810	0.350	0.265	0.379	0.571	0.475
820	0.371	0.269	0.386	0.590	0.488
830	0.386	0.276	0.394	0.578	0.486
840	-	-	0.424	0.594	0.509

TABLE X

Average Reflectance of Bare Areas and Soils

λ mμ	Types				λ mμ	Types			
	1	2	3	4		1	2	3	4
400	0.024	0.078	0.134	0.357	600	-	-	-	-
410	0.023	0.080	0.143	0.378	670	-	-	-	-
420	0.022	0.082	0.150	0.402	680	-	-	-	-
430	0.023	0.084	0.164	0.430	690	-	-	-	-
440	0.023	0.086	0.174	0.453	700	-	-	-	-
450	0.023	0.088	0.184	0.475	710	-	-	-	-
460	0.023	0.091	0.194	0.494	720	-	-	-	-
470	0.024	0.093	0.200	0.514	730	-	0.168	-	-
480	0.025	0.095	0.207	0.530	740	-	0.175	-	-
490	0.026	0.096	0.215	0.545	750	-	0.184	0.302	-
500	0.026	0.098	0.222	0.558	760	-	0.192	0.304	-
510	0.026	0.100	0.228	0.572	770	0.018	0.203	0.309	-
520	0.026	0.103	0.240	0.585	780	0.050	0.214	0.310	-
530	0.027	0.107	0.249	0.598	790	0.053	0.223	0.308	-
540	0.028	0.110	0.259	0.609	800	0.059	0.230	0.303	-
550	0.029	0.113	0.271	0.622	810	0.061	0.238	0.297	-
560	0.030	0.115	0.282	0.632	820	0.065	0.242	0.291	-
570	0.030	0.117	0.294	0.640	830	0.069	0.251	0.287	-
580	0.030	0.119	0.306	0.649	840	0.071	0.258	0.286	-
590	0.030	0.121	0.314	0.659	850	-	-	0.283	-
600	0.030	0.123	0.321	0.667	860	-	-	-	-
610	0.031	0.124	0.327	0.675	870	-	-	-	-
620	0.033	0.126	0.336	0.682	880	-	-	-	-
630	0.034	0.128	0.342	0.687	890	-	-	-	-
640	0.036	0.133	0.346	0.692	900	-	-	-	-
650	0.035	0.135	0.346	0.697	910	-	-	-	-

TABLE XI

Reflectances of Spectrophotometric Classifications of Natural Formations

λ mμ	Class I				Class II				Class III		
	1	2	3	4	1	2	3	4	1	2	3
400	0.022	0.064	0.018	0.357	0.017	0.033	0.039	0.051	0.720	0.830	0.150
410	0.022	0.065	0.116	0.378	0.017	0.034	0.041	0.053	0.722	0.828	0.130
420	0.023	0.065	0.122	0.402	0.017	0.036	0.042	0.056	0.725	0.825	0.118
430	0.023	0.066	0.133	0.430	0.018	0.038	0.044	0.060	0.728	0.823	0.108
440	0.023	0.067	0.142	0.453	0.018	0.040	0.046	0.061	0.730	0.821	0.100
450	0.023	0.068	0.150	0.475	0.018	0.041	0.048	0.062	0.733	0.820	0.091
460	0.023	0.070	0.158	0.494	0.018	0.042	0.050	0.064	0.735	0.815	0.088
470	0.024	0.072	0.164	0.514	0.018	0.044	0.052	0.069	0.738	0.810	0.082
480	0.025	0.073	0.172	0.530	0.017	0.046	0.052	0.076	0.740	0.806	0.079
490	0.025	0.075	0.178	0.545	0.017	0.047	0.054	0.079	0.741	0.800	0.074
500	0.026	0.077	0.186	0.558	0.016	0.050	0.060	0.083	0.743	0.798	0.070
510	0.026	0.079	0.194	0.572	0.019	0.055	0.069	0.091	0.744	0.795	0.066
520	0.026	0.081	0.202	0.585	0.024	0.063	0.085	0.112	0.745	0.790	0.062
530	0.027	0.084	0.211	0.598	0.027	0.075	0.108	0.134	0.746	0.785	0.060
540	0.028	0.087	0.221	0.609	0.031	0.083	0.124	0.151	0.747	0.780	0.058
550	0.029	0.090	0.232	0.622	0.031	0.088	0.134	0.168	0.748	0.775	0.054
560	0.030	0.091	0.242	0.632	0.031	0.088	0.132	0.178	0.749	0.770	0.051
570	0.030	0.092	0.252	0.640	0.031	0.084	0.123	0.191	0.750	0.765	0.048
580	0.030	0.094	0.262	0.649	0.028	0.080	0.113	0.193	0.751	0.760	0.045
590	0.030	0.096	0.269	0.659	0.027	0.078	0.106	0.196	0.753	0.758	0.042
600	0.030	0.098	0.273	0.667	0.028	0.078	0.101	0.196	0.765	0.756	0.040
610	0.031	0.100	0.276	0.675	0.026	0.080	0.096	0.191	0.766	0.750	0.035
620	0.033	0.101	0.279	0.682	0.026	0.079	0.093	0.193	0.757	0.748	0.032
630	0.034	0.103	0.281	0.687	0.027	0.079	0.088	0.193	0.758	0.745	0.030
640	0.035	0.105	0.282	0.692	0.026	0.078	0.085	0.190	0.759	0.740	0.029
650	0.036	0.107	0.281	0.697	0.022	0.077	0.084	0.193	0.760	0.735	0.027
660	0.037	0.115	0.283	0.700	0.023	0.077	0.084	0.212	0.760	0.730	0.025
670	0.038	0.124	0.284	0.704	0.027	0.084	0.095	0.234	0.760	0.725	0.021
680	0.039	0.132	0.286	0.709	0.033	0.099	0.113	0.259	0.760	0.720	0.020
690	0.040	0.142	0.288	0.712	0.042	0.116	0.142	0.285	0.760	0.715	0.018
700	0.041	0.165	0.290	0.718	0.059	0.140	0.176	0.315	0.760	0.710	0.017
710	0.042	0.169	0.292	0.721	0.078	0.167	0.222	0.345	0.760	0.705	0.015
720	0.043	0.179	0.295	0.723	0.099	0.189	0.268	0.378	0.760	0.700	0.014
730	0.044	0.189	0.299	0.727	0.119	0.209	0.318	0.409	0.760	0.695	0.013
740	0.045	0.196	0.302	0.730	0.132	0.225	0.360	0.443	0.760	0.690	0.012
750	0.046	0.204	0.306	0.732	0.144	0.239	0.397	0.460	0.760	0.685	0.011
760	0.047	0.208	0.309	0.736	0.152	0.251	0.429	0.581	0.760	0.680	0.010
770	0.048	0.216	0.312	0.738	0.162	0.272	0.455	0.500	0.760	0.675	0.010
780	0.050	0.225	0.316	0.740	0.167	0.278	0.480	0.518	0.760	0.670	0.010
790	0.053	0.236	0.319	0.742	0.170	0.282	0.507	0.528	0.760	0.660	0.009
800	0.059	0.244	0.318	0.744	0.172	0.284	0.516	0.540	0.760	0.655	0.009
810	0.061	0.252	0.324	0.748	0.178	0.287	0.528	0.549	0.760	0.650	0.008
820	0.065	0.256	0.331	0.750	0.181	0.290	0.538	0.555	0.760	0.640	0.008
830	0.069	0.264	0.336	0.752	0.184	0.294	0.536	0.561	0.760	0.635	0.008
840	0.071	0.270	0.341	0.753	0.189	0.305	0.542	0.564	0.760	0.630	0.008

TABLE XII

Dependence of Reflectance on Direction and Height of the Sun

λ mμ	In normal direction	Azimuth = 0°					Azimuth = 90°					Azimuth = 180°					Azimuth = 270°				
		<=15°	<=30°	<=45°	<=60°	<=75°	<=15°	<=30°	<=45°	<=60°	<=75°	<=15°	<=30°	<=45°	<=60°	<=75°	<=15°	<=30°	<=45°	<=60°	<=75°
1. Dry meadow $h_\odot$ = 25°																					
400-500	0.028	-	-	-	-	-	0.029	0.030	0.032	0.037	0.047	0.026	0.033	0.040	0.052	0.073	-	-	0.051	0.053	0.052
510-600	0.086	-	-	-	-	-	0.106	0.112	0.125	0.145	0.183	0.073	0.092	0.105	0.142	0.199	-	-	0.144	0.159	0.163
610-650	0.061	-	-	-	-	-	0.080	0.087	0.094	0.103	0.159	0.058	0.072	0.083	0.112	0.170	-	-	0.097	0.105	0.120
Av.values	0.058	-	-	-	-	-	0.797	0.076	0.084	0.095	0.130	0.052	0.066	0.076	0.102	0.147	-	-	0.097	0.106	0.112
730-800	0.573	[illegible]	0.562	0.548	0.656	0.834	0.797	0.823	0.917	0.933	0.861	0.544	0.576	0.546	0.780	-	-	-	0.691	0.805	0.823
810-850	0.673	0.638	0.646	0.645	0.702	0.836	0.688	0.901	0.962	0.969	0.920	0.636	0.700	0.725	0.929	-	-	-	0.819	0.952	0.966
Av.values	0.623	0.595	0.605	0.596	0.679	0.835	0.842	0.862	0.940	0.951	0.890	0.590	0.688	0.636	0.854	-	-	-	0.755	0.878	0.894
2. Dry meadow $h_\odot$ = 45°																					
400-500	0.036	0.033	0.033	0.025	0.026	0.032	0.027	0.033	0.034	0.036	0.044	0.047	0.052	0.052	0.055	0.055	0.037	0.039	0.042	0.044	0.044
510-600	0.099	0.099	0.102	0.096	0.110	0.134	0.081	0.091	0.104	0.116	0.136	0.121	0.136	0.141	0.157	0.175	0.113	0.127	0.143	0.144	0.141
610-650	0.072	0.058	0.064	0.086	0.076	0.093	0.066	0.081	0.072	0.081	0.105	0.089	0.108	0.128	0.131	0.141	0.076	0.091	0.077	0.098	0.099
Av.values	0.069	0.063	0.066	0.069	0.071	0.086	0.058	0.068	0.070	0.078	0.095	0.086	0.099	0.107	0.114	0.124	0.075	0.086	0.087	0.095	0.095
3. Wheat $h_\odot$ about 40°																					
400-500	-	-	-	0.048	0.111	0.150	-	-	-	-	-	-	-	0.055	0.118	0.159	-	-	-	-	-
510-600	-	-	-	0.094	0.287	0.388	-	-	-	-	-	-	-	0.112	0.297	0.394	-	-	-	-	-
610-650	-	-	-	0.071	0.225	0.275	-	-	-	-	-	-	-	0.111	0.266	0.341	-	-	-	-	-
Av.values	-	-	-	0.071	0.208	0.271	-	-	-	-	-	-	-	0.093	0.227	0.298	-	-	-	-	-
4. Soil $h_\odot$ about 40°																					
400-500	0.048	0.052	0.051	-	0.045	-	0.047	0.063	0.047	0.047	0.053	-	-	-	-	-	0.109	0.123	0.113	-	-
510-600	0.059	0.064	0.065	-	0.055	-	0.066	0.096	0.065	0.062	0.071	-	-	-	-	-	0.145	0.179	0.164	-	-
610-650	0.075	0.081	0.073	-	0.061	-	0.079	0.116	0.092	0.092	0.091	-	-	-	-	-	0.192	-	-	-	-
Av.values	0.061	0.066	0.063	-	0.054	-	0.064	0.092	0.068	0.064	0.072	-	-	-	-	-	0.149	0.151	0.138	-	-
810-850	0.206	-	-	-	-	-	0.183	0.194	0.178	0.207	0.249	-	-	-	-	-	-	-	-	-	-
5. Drifting sands without shadows $h_\odot$ about 50°																					
400-500	0.166	-	-	-	0.199	0.231	-	0.175	-	0.215	0.206	-	0.136	-	0.176	0.188	-	0.157	-	0.270	0.205
510-600	0.291	-	0.182	-	0.326	0.330	-	0.290	-	0.328	0.304	-	0.246	-	0.265	0.274	-	0.294	-	0.456	0.297
610-650	0.292	-	0.173	-	0.374	0.371	-	0.318	-	0.346	0.353	-	0.273	-	0.274	0.289	-	0.265	-	0.489	0.298
Av.values	0.246	-	0.178	-	0.300	0.311	-	0.261	-	0.296	0.288	-	0.218	-	0.238	0.250	-	0.239	-	0.405	0.266
730-800	0.253	-	-	-	-	-	-	0.330	-	0.321	0.343	-	0.400	-	0.318	0.391	-	0.376	-	0.360	0.343
810-850	-	-	-	-	-	-	-	0.356	-	0.323	0.349	-	0.344	-	0.305	0.363	-	0.407	-	0.405	0.380
Av.values	0.253	-	-	-	-	-	-	0.343	-	0.322	0.346	-	0.372	-	0.312	0.377	-	0.392	-	0.382	0.362
6. Drifting sands without shadows $h_\odot$ about 50°																					
400-500	0.171	-	-	-	-	-	-	0.228	-	0.216	0.243	-	-	-	-	-	-	0.134	-	0.168	0.167
510-600	0.253	-	-	-	-	-	-	0.388	-	0.344	0.358	-	-	-	-	-	-	0.220	-	0.228	0.223
610-650	0.261	-	-	-	-	-	-	0.468	-	0.409	0.405	-	-	-	-	-	-	0.280	-	0.257	0.223
Av.values	0.228	-	-	-	-	-	-	0.361	-	0.323	0.335	-	-	-	-	-	-	0.211	-	0.218	0.204
730-800	0.647	-	-	-	-	-	-	0.412	-	0.342	0.314	-	-	-	-	-	-	0.588	-	0.547	0.603
810-850	0.656	-	-	-	-	-	-	0.474	-	0.298	0.364	-	-	-	-	-	-	0.641	-	0.592	0.694
Av.values	0.652	-	-	-	-	-	-	0.443	-	0.370	0.339	-	-	-	-	-	-	0.614	-	0.570	0.648
7. Snow with crust $h_\odot$ about 20°																					
400-500	-	0.432	-	2.675	4.493	7.461	-	-	0.678	0.756	0.830	-	-	0.530	0.599	0.659	-	-	-	-	-
510-600	0.861	0.457	-	2.350	3.941	6.902	-	-	0.580	0.765	0.770	-	-	0.579	0.728	0.636	-	-	-	-	-
610-650	-	0.526	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Av.values	0.861	0.485	-	2.512	4.217	7.182	-	-	0.629	0.760	0.800	-	-	0.554	0.664	0.648	-	-	-	-	-
730-800	0.702	-	-	-	-	-	0.446	-	0.363	0.457	0.376	0.626	-	0.688	0.637	0.688	-	-	-	-	-
810-850	0.611	-	-	-	-	-	0.474	-	0.377	0.464	0.376	0.706	-	0.662	0.561	0.738	-	-	-	-	-
Av.values	0.656	-	-	-	-	-	0.460	-	0.370	0.460	0.376	0.666	-	0.675	0.599	0.713	-	-	-	-	-

TABLE XIII

Average Reflectances for Various Directions

Azimuth	Angle	Meadow $h_\odot = 25^\circ$	Meadow $h_\odot = 45^\circ$	Wheat	Soil	Sand with shadow	Sand without shadow
0°	0°	0.050	0.060	0.027	0.061	0.210	0.220
0	10	-	0.062	0.027	0.058	0.212	-
0	20	-	0.064	0.031	0.067	0.214	-
0	30	-	0.065	0.040	0.063	0.223	-
0	40	-	0.068	0.058	0.059	0.243	-
0	50	-	0.071	0.099	0.055	0.272	-
0	60	-	0.075	0.178	0.054	0.300	-
0	70	-	0.080	0.228	0.060	0.309	-
0	80	-	0.085	0.253	0.070	0.312	-
90°	10	0.072	0.065	-	0.065	0.243	0.247
90	20	0.073	0.066	-	0.068	0.251	0.272
90	30	0.075	0.068	-	0.069	0.262	0.304
90	40	0.079	0.070	-	0.070	0.276	0.327
90	50	0.087	0.072	-	0.070	0.286	0.337
90	60	0.100	0.079	-	0.070	0.292	0.339
90	70	0.119	0.089	-	0.070	0.294	0.336
90	80	0.149	0.105	-	0.069	0.293	0.330
180°	10	0.054	0.078	0.029	-	0.214	-
180	20	0.056	0.088	0.036	-	0.218	-
180	30	0.062	0.098	0.048	-	0.221	-
180	40	0.072	0.106	0.071	-	0.226	-
180	50	0.086	0.112	0.119	-	0.232	-
180	60	0.103	0.116	0.191	-	0.238	-
180	70	0.130	0.121	0.255	-	0.245	-
180	80	0.166	0.125	0.280	-	0.253	-
270	10	0.074	0.074	-	0.080	0.239	0.221
270	20	0.079	0.079	-	0.112	0.238	0.215
270	30	0.085	0.085	-	0.135	0.238	0.214
270	40	0.093	0.089	-	0.148	0.240	0.214
270	50	0.100	0.092	-	0.156	0.244	0.214
270	60	0.106	0.095	-	0.162	0.250	0.214
270	70	0.111	0.095	-	-	0.261	0.212
270	80	0.115	0.094	-	-	0.278	0.209

TABLE XIV

Ratio of Reflectances in Various Directions to the

Reflectance in Normal Direction (δ)

Azimuth	Angle	Meadow $h_{\odot} = 25^{\circ}$	Meadow $h_{\odot} = 45^{\circ}$	Wheat	Soil	Sand with shadow	Sand without shadow
0°	0°	1.00	1.00	1.00	1.00	1.00	1.00
0	10	-	1.10	1.00	1.11	1.01	-
0	20	-	1.07	1.15	1.10	1.02	-
0	30	-	1.08	1.48	1.05	1.06	-
0	40	-	1.14	2.14	0.97	1.16	-
0	50	-	1.18	3.67	0.90	1.28	-
0	60	-	1.25	6.59	0.89	1.41	-
0	70	-	1.34	8.45	1.00	1.46	-
0	80	-	1.42	9.37	1.17	1.47	-
90°	10°	1.44	1.08	-	1.07	1.16	1.12
90	20	1.46	1.10	-	1.11	1.19	1.24
90	30	1.50	1.14	-	1.13	1.25	1.39
90	40	1.58	1.17	-	1.15	1.31	1.49
90	50	1.74	1.20	-	1.15	1.36	1.53
90	60	2.00	1.32	-	1.15	1.40	1.54
90	70	2.38	1.48	-	1.15	1.40	1.53
90	80	2.98	1.75	-	1.13	1.40	1.50
180°	10°	1.08	1.30	1.07	-	1.02	-
180	20	1.12	1.47	1.33	-	1.04	-
180	30	1.24	1.64	1.78	-	1.05	-
180	40	1.44	1.77	2.63	-	1.08	-
180	50	1.72	1.87	4.41	-	1.10	-
180	60	2.06	1.94	7.08	-	1.13	-
180	70	2.60	2.02	9.44	-	1.17	-
180	80	3.32	2.08	10.70	-	1.20	-
270°	10	1.48	1.24	-	1.31	1.13	1.00
270	20	1.58	1.32	-	1.83	1.13	0.98
270	30	1.70	1.42	-	2.21	1.13	0.97
270	40	1.87	1.48	-	2.42	1.14	0.97
270	50	2.00	1.54	-	2.56	1.16	0.97
270	60	2.12	1.58	-	2.67	1.19	0.97
270	70	2.22	1.58	-	-	1.24	0.96
270	80	2.30	1.57	-	-	1.32	0.95

TABLE XV

Ratio of Reflectances of Dry Surfaces to Reflectances of Moist or Wet Surfaces (ζ)

Dry surfaces and conditions of study	State of Comparative Surface	Value of $\xi\xi$				ξ Average
		λ 400	λ 500	λ 600	λ 650	
Podzol, Azimuth 90° Angle 45°	Moist	2.4	2.7	2.6	2.7	2.6
Sand loam, Azimuth 0° Angle 45°	"	0.7	0.8	0.8	0.9	0.8
Sand loam, Azimuth 90° Angle 45°	"	1.2	1.6	1.4	1.5	1.4
Black earth, Normal	Wet	1.5	1.3	1.4	1.4	1.4
Black earth, Azimuth 0° Angle 45°	"	0.7	0.6	0.7	0.7	0.7
Black earth, Azimuth 180° Angle 45°	"	0.9	0.8	0.8	0.8	0.8
Paved road, Azimuth 90° Angle 45°	"	2.1	2.2	2.4	2.5	2.4
Cobblestone street, Azimuth 90° Angle 45°	"	3.1	3.0	2.7	2.3	2.8
Boulders, Normal	"	3.0	3.1	2.5	3.2	3.0

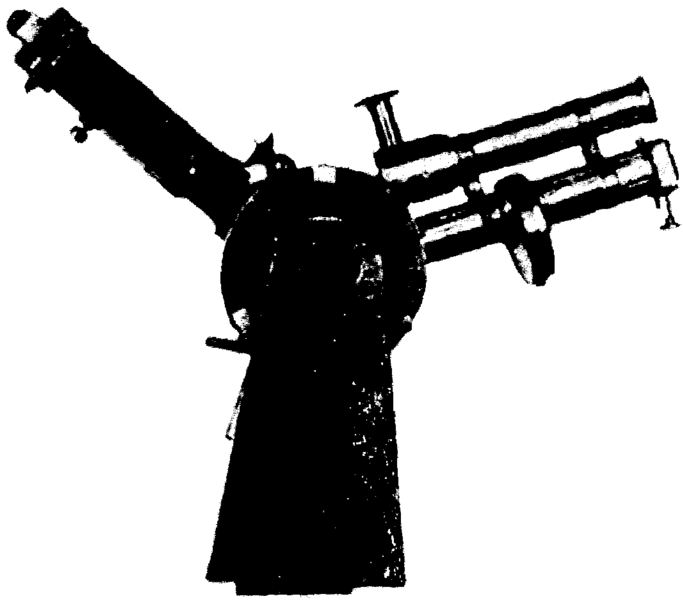


Fig. 1. N.I.L. Field Spectrograph.

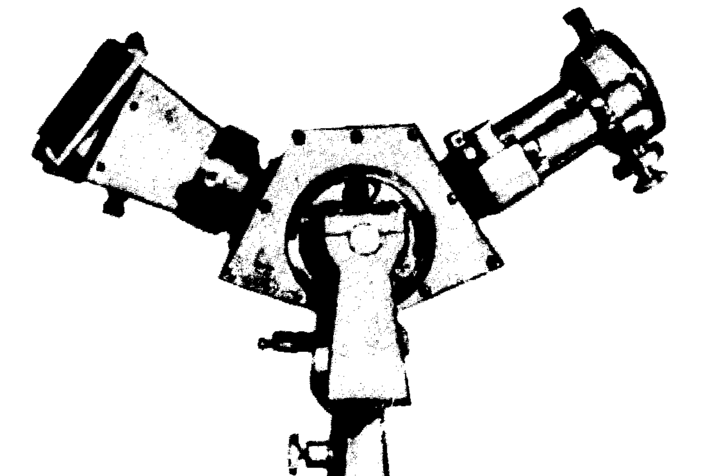


Fig. 2. Ts.N.I.I.G.A.& K. Field Spectrograph

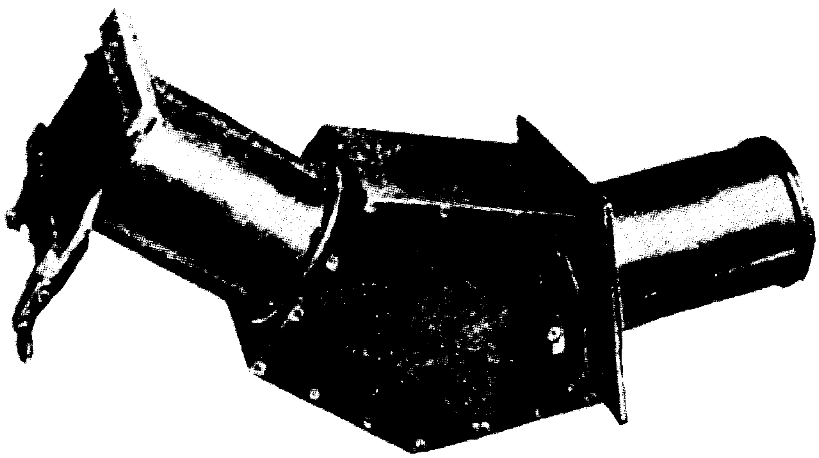


Fig. 3. The Ts.N.I.I.G.A.& K. aerial spectrograph

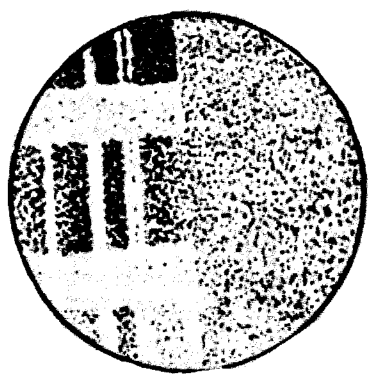


Fig. 4. Field of view of the Martens densitometer

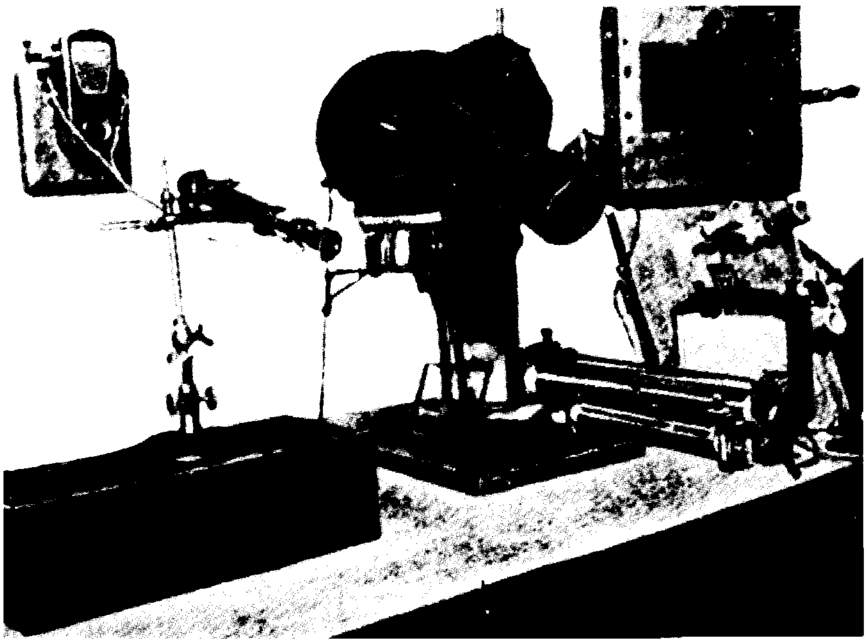


Fig. 5. Assembly of the Taylor sphere to measure reflectances.

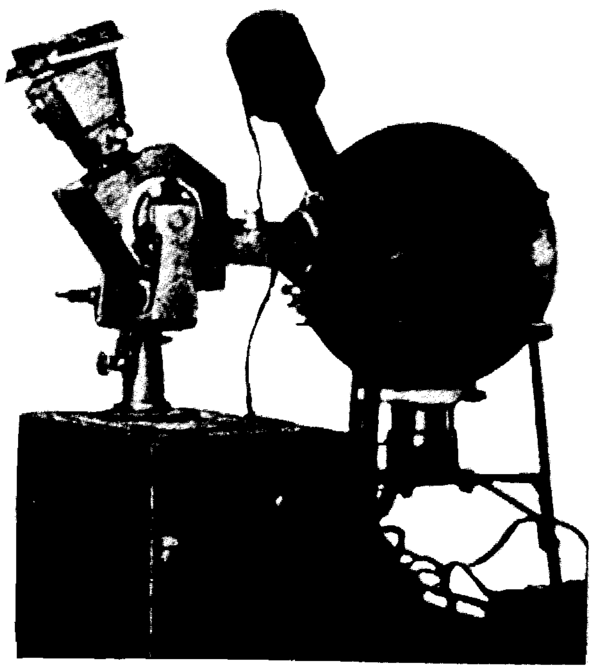


Fig. 6. Assembly of the Taylor sphere and spectrograph to measure the spectral reflectances.

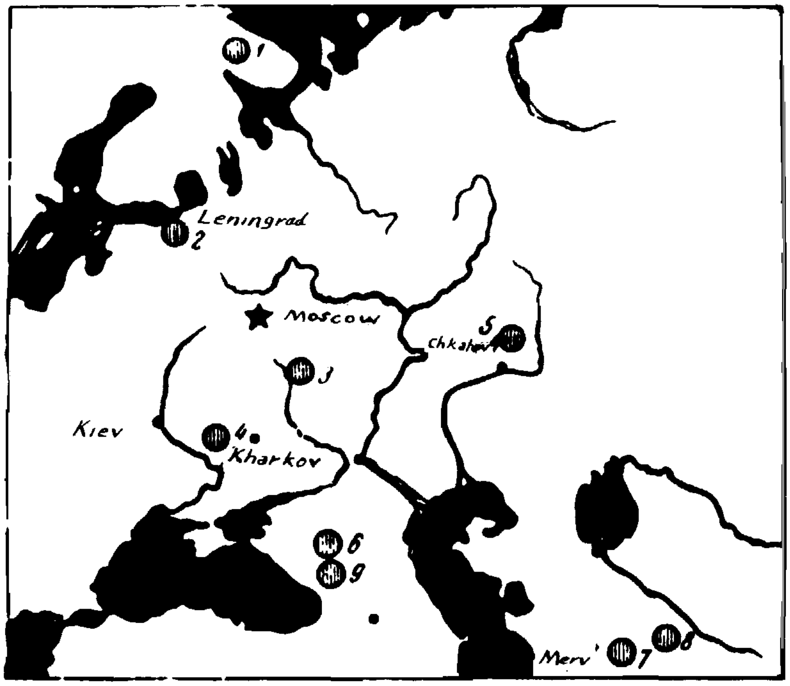


Fig. 7. Schematic map of the areas studied

1. Khibina
2. Leningrad
3. Usman
4. Kharkov
5. Chkalov
6. Mary
7. Merv
8. Uch-Adzhi
9. Teberda

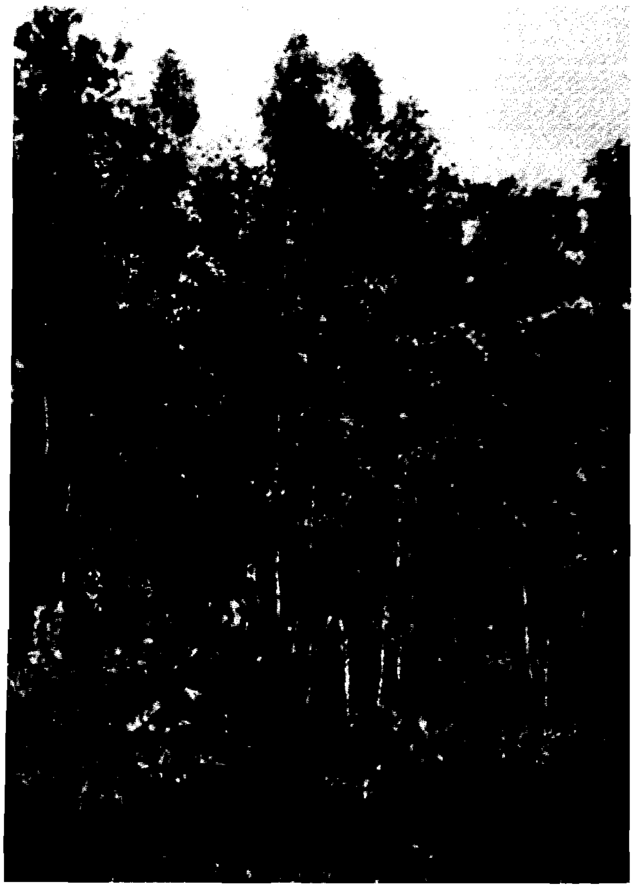


Fig. 8. Growth of young aspen

Fig. 9. Clump of selin (Aristida karelini)

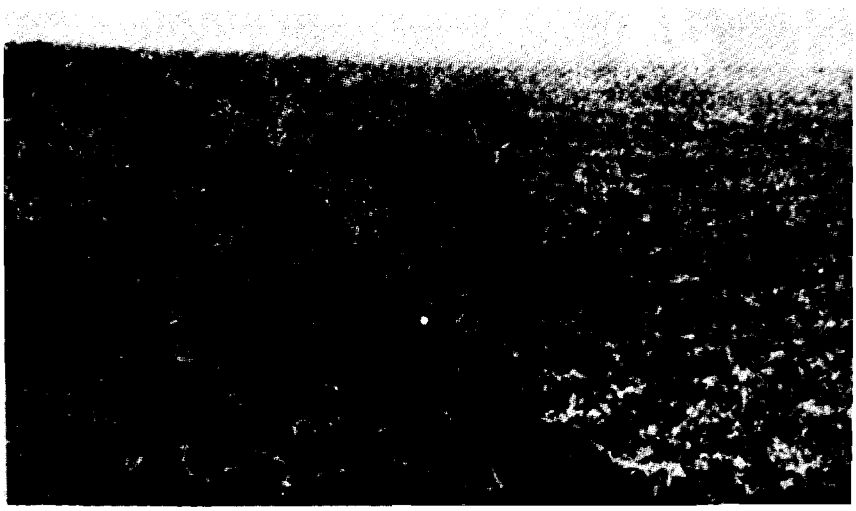


Fig. 10. Ploughed field (to the left) and pasture meadow (to the right).

Fig. 11. Spectrographing horizontal formations

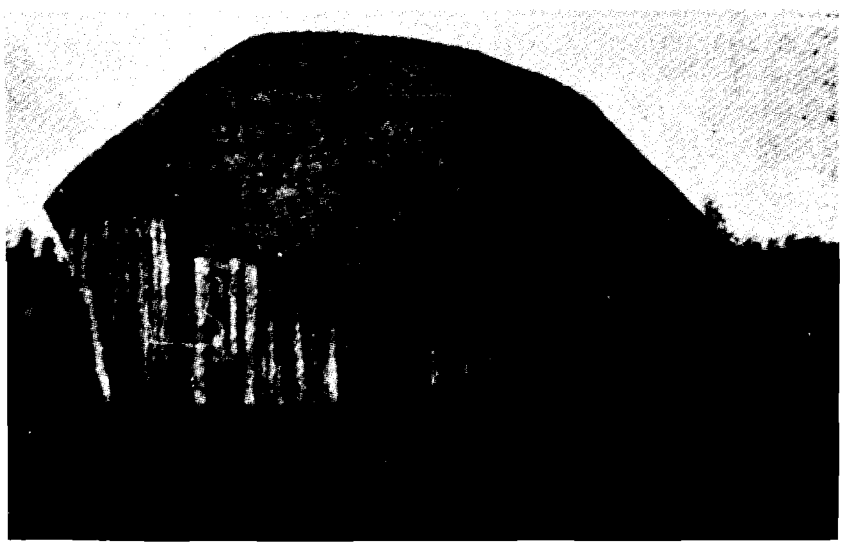


Fig. 12. Barn - an object with a slanting surface

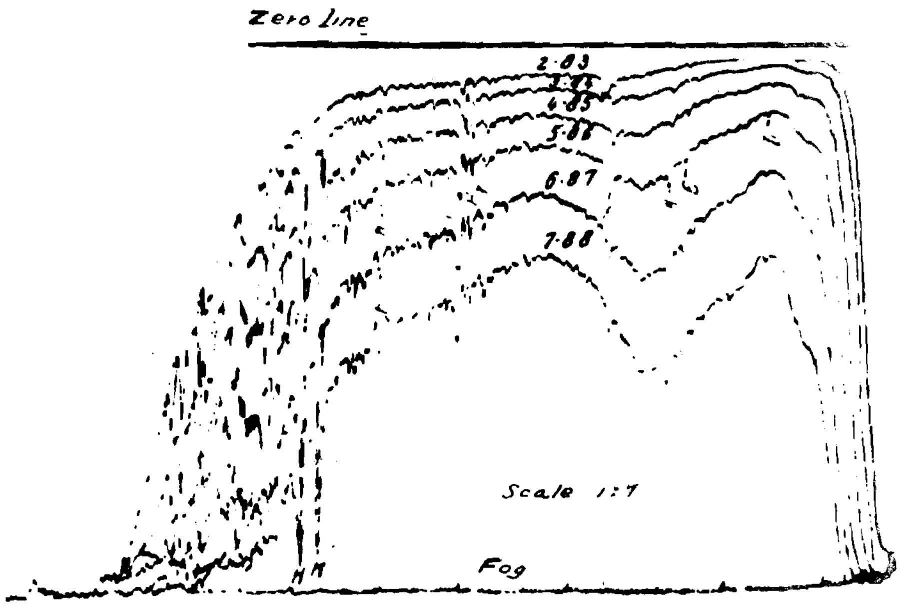


Fig. 13. Record sample

Fig. 14. Haloxylon bush

Fig. 15. Drifting sand

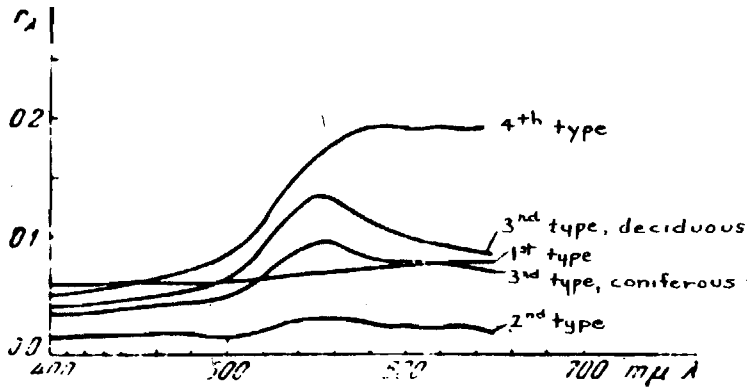


Fig. 16. Typical reflectance curves for forests

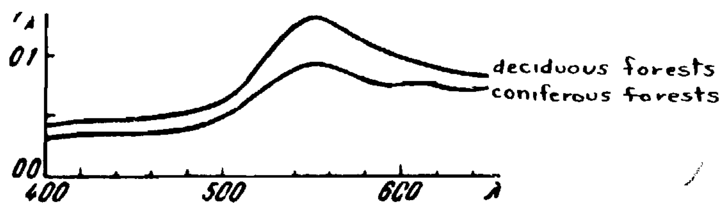


Fig. 17. Average reflectance curves of deciduous and coniferous forests in the summer period

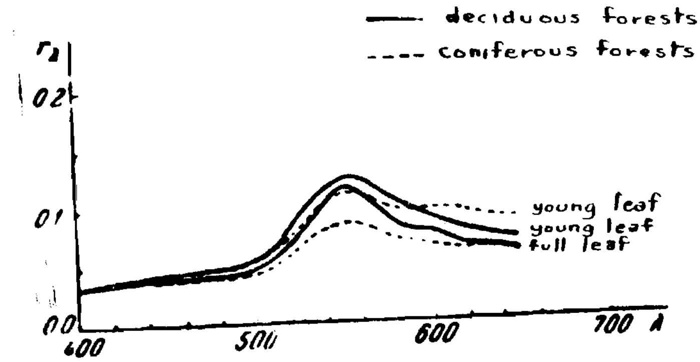


Fig. 18. Spectral reflectance curves of deciduous and coniferous forests in the "young leaf" and "full leaf" periods

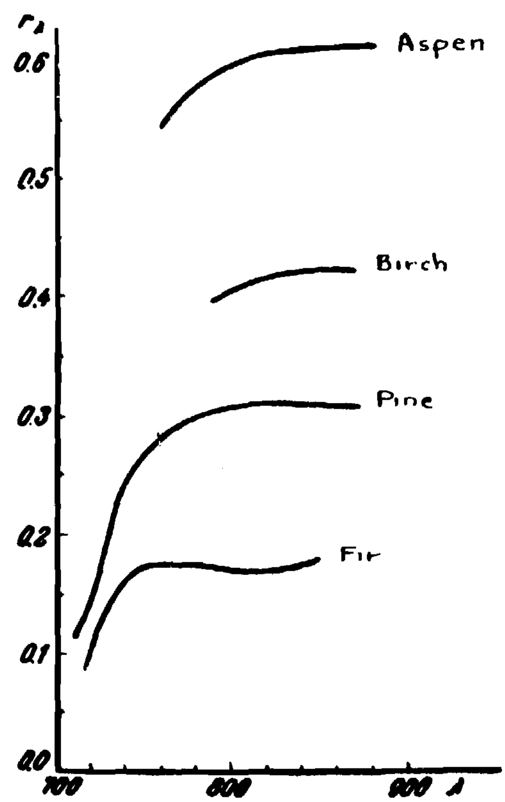


Fig. 19. Reflectance curves of forests in the summer in the infra-red region of the spectrum

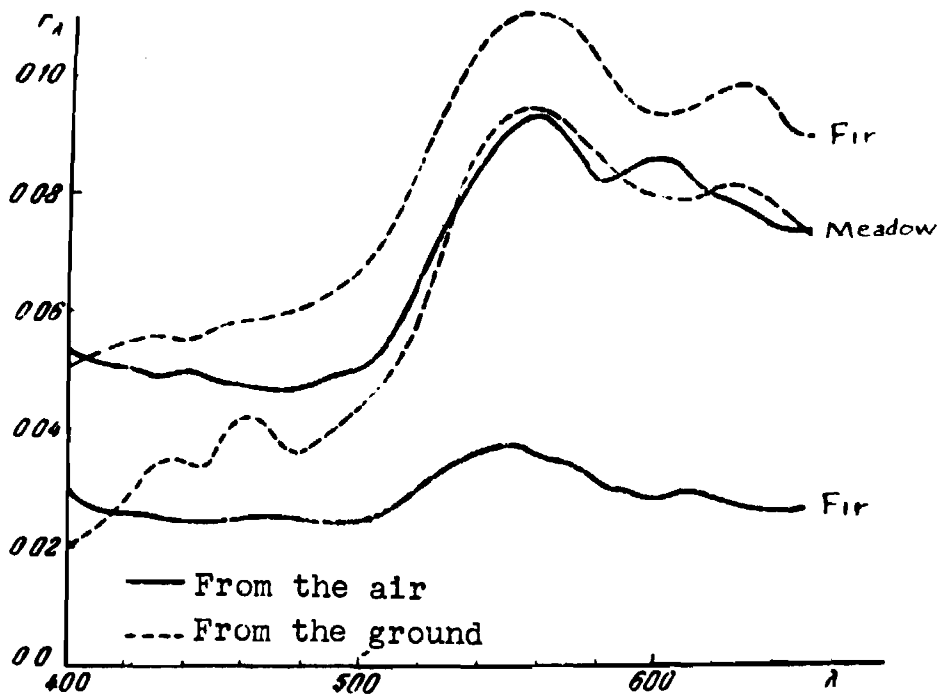


Fig. 20. Reflectance curves of a fir forest and a meadow obtained from the air and from the ground

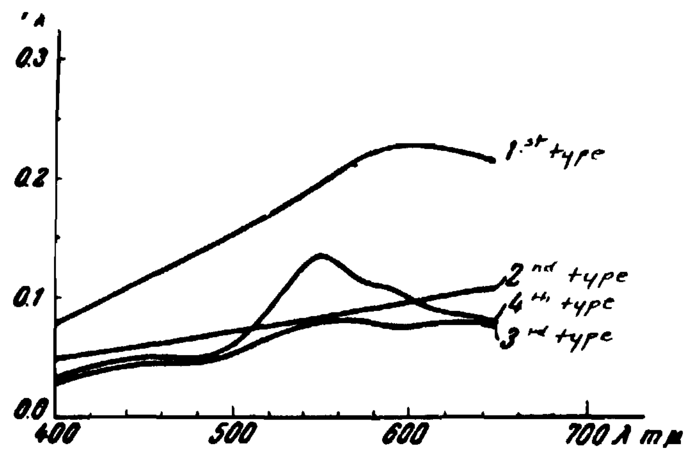


Fig. 21. Typical reflectance curves for grasses

Fig. 22. Spectral reflectance of forests and grasses in the summer period

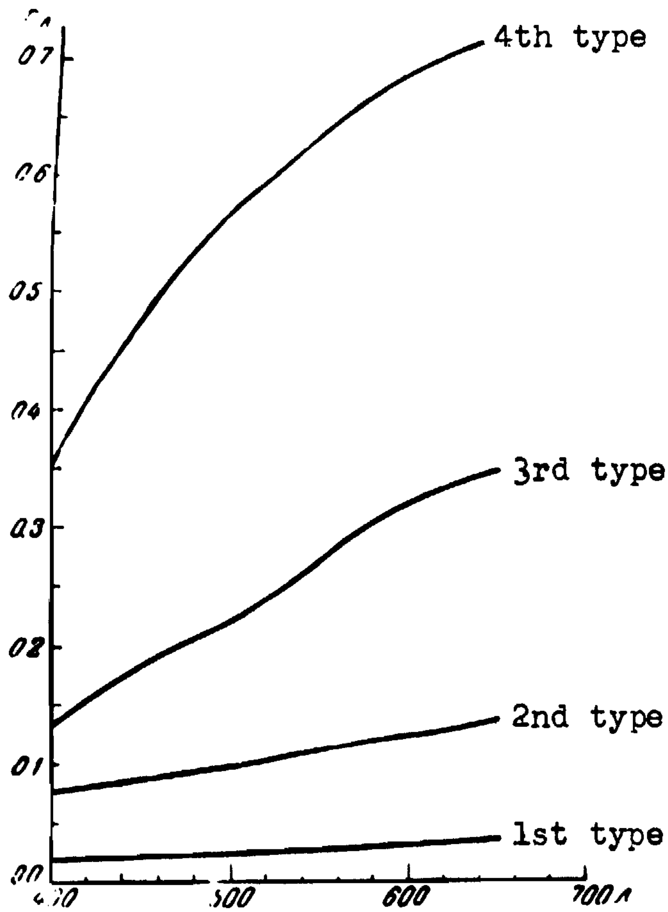


Fig. 23. Typical reflectance curves of bare areas and soils

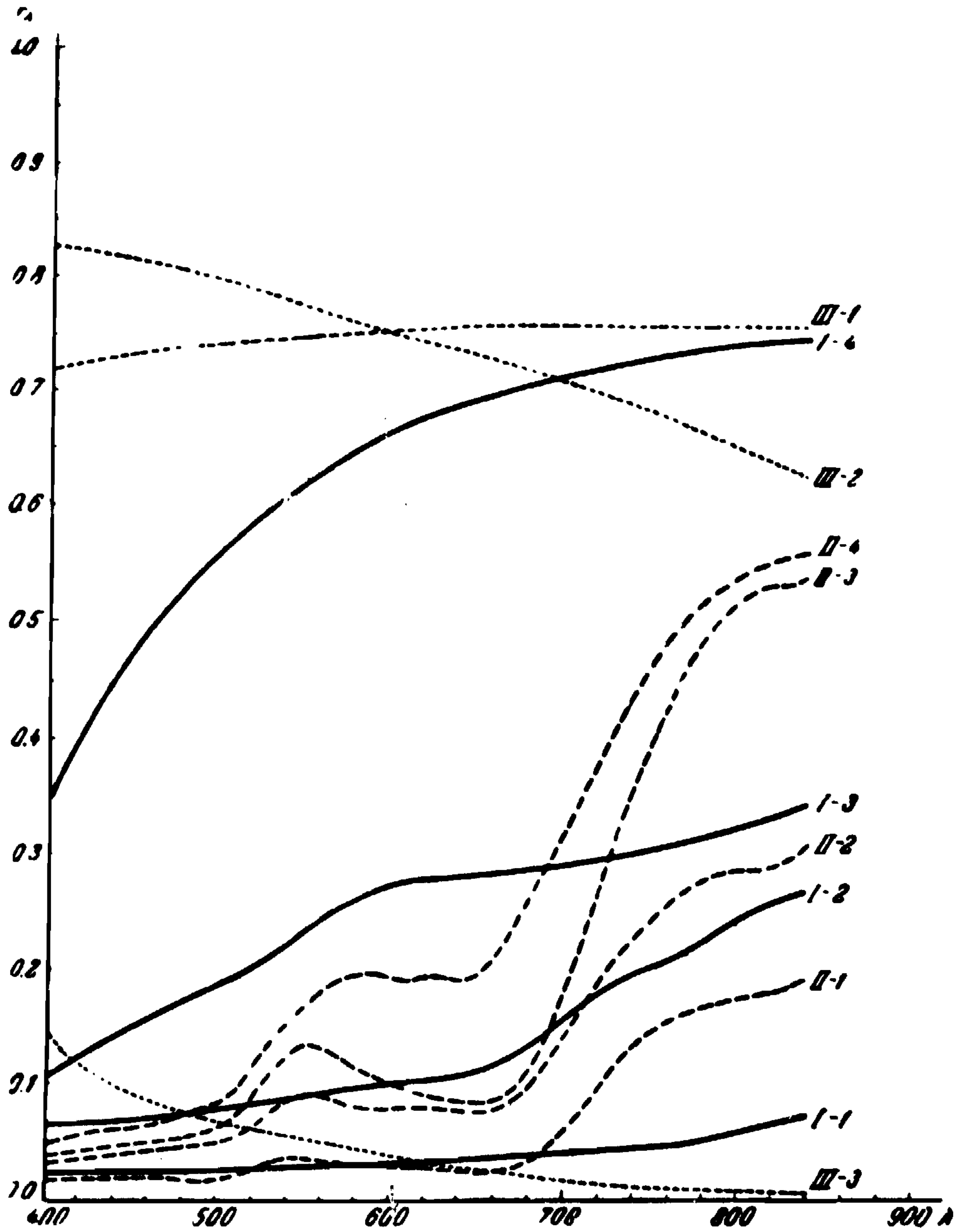


Fig. 24. Spectrophotometric classification of natural formations

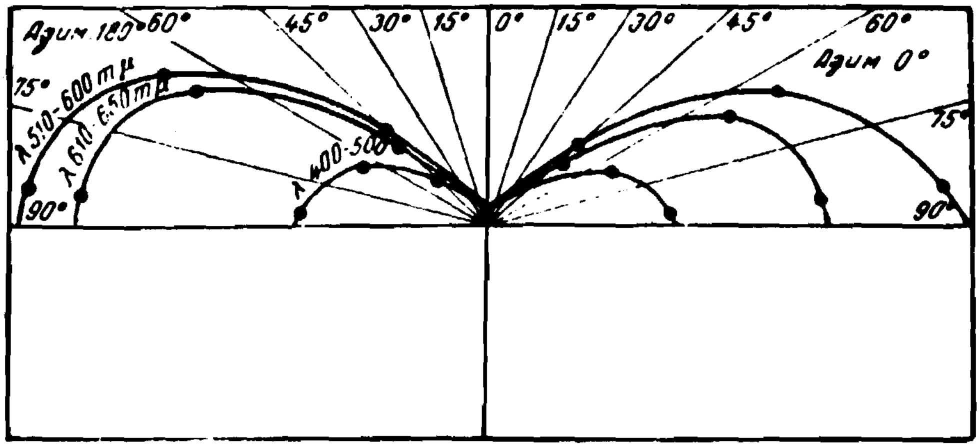


Fig. 25. Indicatrices of the monochromatic reflectance of wheat

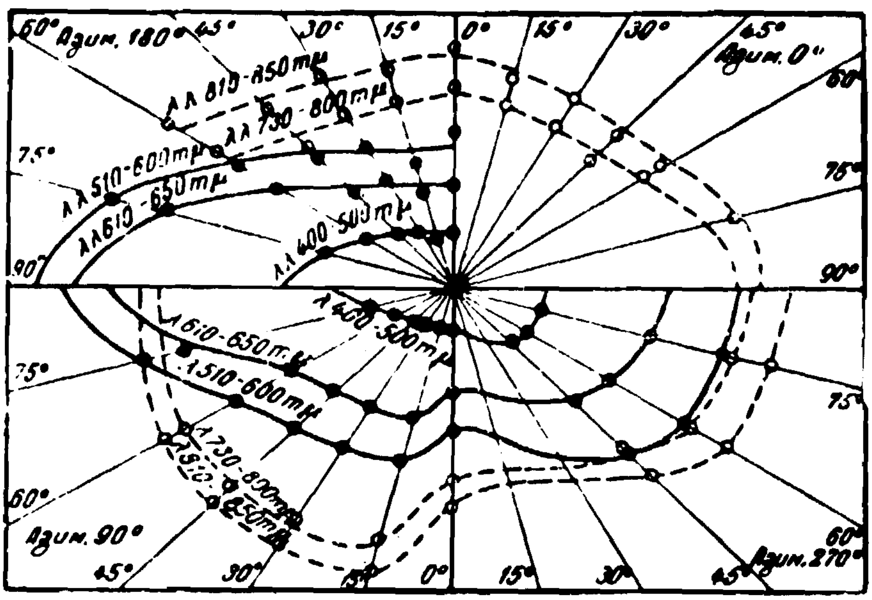


Fig. 26. Indicatrices of the monochromatic reflectance of a meadow

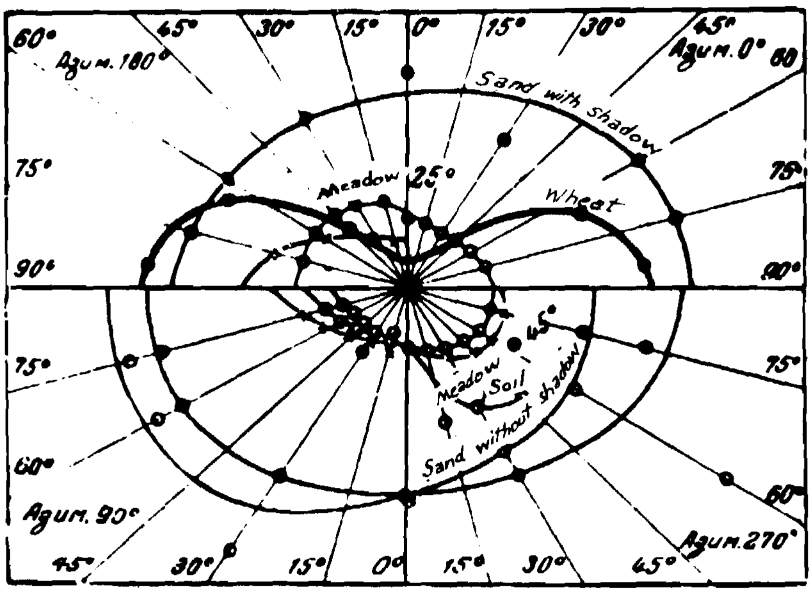


Fig. 27. Indicatrices of the integral reflectance of various grasses and soils

APPENDIX I

Catalogue of the Reflectances of Natural Formations

The catalogue contains the spectral reflectances of 370 natural formations and man-made objects which were measured in the region of the spectrum from λ 400 mμ to λ 900 mμ. The catalogue contains brief notes on the nature and state of each object. These notes are placed in groups. Column 5 shows the landscapes in which the natural formations were studied and the words "northern forest belt" is abbreviated as n.f.b. From the number of the object in the index it is easy to find the reflectance of a desired object in the catalogue of tables. The numbers of the objects in the catalogue of tables are given in the first line. The next three lines of the tables have the abbreviations: "S" - standard in relation to which the reflectance was studied, "N" - the number of negatives and "Sp" - the number of spectrograms used in the work. Abbreviations of the standards are: "G" - gypsum plate, "B" - baryte plate, "P" - baryte paper and "M" - magnesium oxide. In fractional expressions the numerator represents the visible region of the spectrum (λ λ400 - 650 mμ) and the denominator represents the infra-red (λ λ600 - 900 mμ). The reflectances given in the catalogue of tables, calculated to the third decimal point, are arithmetic means obtained from all the individual spectrograms.

For all the objects contained in the catalogue there is an atlas (see Appendix II) giving reflectance curves plotted by the reflectances given in the catalogue. All the curves, with a few exceptions, are plotted on one scale and the numbering is the same as used in the index. Moreover, Roman numerals in the index refer to numbers of diagrams showing the respective curves.

Index to Tables

No. of object	Name of object	Characteristic of the object	Azimuth (A) & angle ($<$)	Landscape	Region of the spectrum in mμ	Diagram in the atlas
1	2	3	4	5	6	7
		1. Forests and Shrubs				
1	Birch	Shoots, full leaf	A = 45°; $<$=45°	n.f.b.	400-650	I
		Young forest				
2	Birch	Winter stage	A = 225°	"	400-650	II
3	"	Young leaf	A = 225°	"	400-650	II
4	"	Full leaf	A = 225°	"	400-650	II
5	"	Late summer	A = 225°	"	400-650 780-870	II
		Mature forest				
6	"	Winter stage	A = 225°	"	400-900	III
7	"	Young leaf	A = 25°	"	400-650	III
8	"	Full leaf	A = 225°	"	400-650	III
9	"	Late summer	A = 225°	"	400-650 790-870	III
		Dwarf				
10	"	Full leaf	A normal	tundra	400-650 700-900	IV
11	"	Fresh bark on a mature tree	A = 225°	n.f.b.	400-650 730-850	V

		<u>Mature forest</u>				
12	Elm	Young leaf	A = 225°	n.f.b.	400-650	VI
13	"	Full leaf	A = 225°	"	400-650	VI
		<u>Young forest</u>				
14	Oak	Winter stage	A = 225°	"	400-650	VII
		<u>Mature forest</u>				
15	"	Full leaf	A = 225°	"	400-650	VII
16	"	Autumn color	A = 225°	"	400-650	VII
		<u>Young forest</u>				
17	Fir	Winter stage	A = 225°	"	400-650	VIII
18	"	Young leaf	A = 225°	"	{400-650 {710-750	VIII
19	"	Full leaf	A = 225°	"	{400-650 {730-830	VIII
20	"	Late summer	A = 225°	"	520-650	VIII
		<u>Mature forest</u>				
21	"	Winter stage	A = 225°	"	{400-650 {710-880	IX
22	"	Young leaf	A = 225°	"	{400-650 {720-850	IX
23	"	Full leaf	A = 225°	"	400-650	IX
24	"	Late summer	A = 225°	"	400-650	IX
25	"	" "	from the air alt. = 300 m.	"	400-650	X

		Shrubs				
26	Willow	Late summer	A = 45°, at about 1.5 km.	steppe	400-650 720-850	XI
		Mature forest				
27	Black elm	Late summer, heavily coated with dust	A = 225°	desert	750-870	XII
		Mature forest				
28	Linden	Winter stage	A = 225°	n.f.b.	400-650	XIII
29	"	Full leaf	A = 225°	"	400-650	XIII
30	"	Autumn color	A = 225°	"	400-650	XIII
		Young forest				
31	Larch	Winter stage	A = 225°	"	400-650	XIV
32	"	Young leaf	A = 225°	"	400-650	XIV
33	"	Full leaf	A = 225°	"	400-650	XIV
		Mature forest				
34	Juniper	Full leaf	A normal	tundra	400-650 720-900	XV
		Young forest				
35	Alder	Young leaf	A = 225°	n.f.b.	400-650 710-870	XVI
		Young forest				
36	Aspen	Winter stage	A = 225°	"	400-650	XVII

37	Aspen	Young leaf	$A = 225^{\circ}$	n.f.b.	400-650 700-880	XVII
38	"	Full leaf	$A = 225^{\circ}$	"	400-450 720-800	XVII
		<u>Mature forest</u>				
39	"	Young leaf	$A = 225^{\circ}$	"	400-650 710-750	XVIII
40	"	Full leaf	$A = 225^{\circ}$	"	400-650 710-880	XVIII
41	"	Late summer	$A = 225^{\circ}$	"	400-650 760-880	XVIII
42	"	Autumn color	$A = 225^{\circ}$	"	400-650	XVIII
		<u>Mature trees</u>				
43	Haloxy-lon	Late summer green	$A = 45^{\circ}; < = 45^{\circ}$	desert	400-650 770-830	XIX
44	"	Dry	$A = 45^{\circ}; < = 45^{\circ}$	"	400-650 770-830	XIX
		<u>Young forest</u>				
45	Pine	Young leaf	$A = 135^{\circ}$	n.f.b.	400-650 700-750	XX
46	"	Full leaf	$A = 135^{\circ}$	"	400-650 730-840	XX
		<u>Mature forest</u>				
47	"	Winter stage	$A = 225^{\circ}$	"	400-650	XXI
48	"	Young leaf	$A = 225^{\circ}$	"	400-650 710-870	XXI
49	"	Full leaf	$A = 225^{\circ}$	"	400-650	XXI

2. Grass

50	Weeds	Dense growth, drying and brownish (beginning of autumn)	Cloudy sky. Normal	forest steppe	400-650	XXII
51	"	The same	The same The same <= 30°	"	400-650	XXII
52	"	The same	A = 90°; <= 45°	steppe	400-650 730-830	XXII
53	Heather	Dense growth, before flowering	Normal	tundra	400-650 750-900	XXIII
54	River valley with meadows	General view from a distance of about 3 km.; covered with trees and meadows, end of summer	A = 90°	mountainous	400-650 730-850	XXIV
55	Willow herb	Dense growth, in the flowering period	A = 90°; <= 45°	tundra	400-650 770-900	XXV
56	Ilyas	Sparse and dry (yellowish) grass on sand at the end of summer	Normal	desert	400-650 740-860	XXVI
57	"	The same	A = 0°; <= 30°	desert	400-650 740-860	XXVII
58	"	" "	A = 0°; <= 60°	"	400-650 740-860	XXVII
59	"	" "	A = 0°; <= 75°	"	400-650 740-860	XXVII
60	"	" "	A =90°; <= 30°	"	400-650	XXVII
61	"	" "	A =90°; <= 60°	"	400-650	XXVII
62	"	" "	A =90°; <= 75°	"	400-650	XXVII
63	"	" "	A=180°; <= 30°	"	400-650	XXVIII
64	"	" "	A=180°; <= 60°	"	400-650	XXVIII

65	Ilyas	Sparse and dry (yellowish) grass on sand at the end of summer	$A = 180^\circ; \angle = 75^\circ$	desert	400-650	XXVIII
66	"	The same	$A = 270^\circ; \angle = 30^\circ$	"	400-650 740-860	XXVIII
67	"	" "	$A = 270^\circ; \angle = 60^\circ$	"	400-650 720-860	XXVIII
68	"	" "	$A = 270^\circ; \angle = 75^\circ$	"	400-650 730-860	XXVIII
69	Reeds	In a lake near the bank; bright green (beginning of autumn)	$A = 90^\circ$	forest steppe	400-650 720-840	XXIX
70	Turf hillocks	Covered with grass (European blueberry, etc.) in the summer	Normal	tundra	400-650 790-900	XXX
71	Edge of ravine	Covered with sparse grass almost dry (beginning of autumn)	"	mountainous	400-650	XXXI
72	Edges of river bank	The same	"	steppe	400-650 720-840	XXXII
73	Alpine meadow	On mountain tops, covered with sparse grass, dried (beginning of autumn)	"	mountainous	400-650 720-850	XXXIII
74	" "	The same, mowed	"	"	400-650 720-850	XXXIII
75	Pasture meadow	At end of summer	"	black earth	400-650 720-850	XXXIV
76	" "	" " " "	$A = 90^\circ; \angle = 45^\circ$	" "	400-650	XXXIV
77	" "	" " " "	$A = 180^\circ; \angle = 45^\circ$	" "	400-650	XXXIV

78	Pasture meadow	At end of summer, wet after rain	Cloudy sky normal	forest steppe	{400-650 720-780	XXXV
79	" "	" " " " " " "	Cloudy sky $< = 30^{\circ}$	" "	{400-650 720-780	XXXV
80	" "	The same	The same $< = 60^{\circ}$	" "	{400-650 730-830	XXXV
81	" "	At the beginning of autumn	Normal	mountainous	400-650	XXXVI
82	Meadow with clover and timothy	Dense growth, with flowers, mid-summer	$A = 90^{\circ}$; $< = 45^{\circ}$	n.f.b.	400-650	XXXVII
83	The same	The same	$A = 90^{\circ}$; $< = 65^{\circ}$	"	400-650	XXVII
84	" "	" "	$A = 90^{\circ}$; $< = 85^{\circ}$	"	400-650	XXXVII
85	" "	Mowed	$A = 90^{\circ}$; $< = 45^{\circ}$	"	{400-650 750-850	XXXVII
86	" "	" , wet after rain	Cloudy sky $< = 45^{\circ}$	"	400-650	XXXVIII
87	" "	" " " "	The same $< = 65^{\circ}$	"	400-650	XXXVIII
88	" "	" " " "	The same $< = 85^{\circ}$	"	400-650	XXXVIII
89	Meadow with crow foot	Dense grass with abundant flowers	$A = 90^{\circ}$; $< = 45^{\circ}$	"	{400-650 720-850	XXXIX
90	The same	The same	$A = 90^{\circ}$; $< = 65^{\circ}$	"	{400-650 750-850	XXXIX

91	Meadow with crow foot	Dense grass with abundant flowers	$A = 90^\circ; \angle = 85^\circ$	n.f.b.	400-650 750-850	XXXIX
92	Sedge meadow	Dense grass in mid-summer	$A = 90^\circ; \angle = 45^\circ$	"	400-650 710-850	XL
93	Meadow with daisies	In the period of abundant bloom	$A = 90^\circ; = 45^\circ$	"	400-650 740-850	XL
94	Lush meadow (flood land)	With lush dense grass at the beginning of autumn before mowing	Normal	mountainous	400-650 730-900	XL
95	Dry meadow	With dense short grass in mid-summer	Normal; altitude of sun 25°	n.f.b.	400-650 730-850	XLI
96	The same	The same	$A = 0^\circ; \angle = 15^\circ$	"	400-650 730-850	XLI
97	" "	" "	$A = 0^\circ; \angle = 30^\circ$	"	400-650 730-850	XLI
98	" "	" "	$A = 0^\circ; \angle = 45^\circ$	"	400-650 730-850	XLI
99	" "	" "	$A = 0^\circ; \angle = 60^\circ$	"	400-650 730-850	XLI
100	" "	" "	$A = 0^\circ; \angle = 75^\circ$	"	400-650 730-850	XLI
101	" "	" "	$A = 90^\circ; \angle = 15^\circ$	"	400-650 720-850	XLII
102	" "	" "	$A = 90^\circ; \angle = 30^\circ$	"	400-650 720-850	XLII
103	" "	" "	$A = 90^\circ; \angle = 45^\circ$	"	400-650 720-810	XLII

104	Dry meadow	With dense short grass in mid-summer	$A = 90^\circ; \angle = 60^\circ$	n.f.b.	400-650 720-780	XLII
105	The same	The same	$A = 90^\circ; \angle = 75^\circ$	"	400-650 720-850	XLII
106	" "	" "	$A = 180^\circ; \angle = 15^\circ$	"	400-650 720-850	XLIII
107	" "	" "	$A = 180^\circ; \angle = 30^\circ$	"	{400-650 720-850	XLIII
108	" "	" "	$A = 180^\circ; \angle = 45^\circ$	"	{400-650 720-850	XLIII
109	" "	" "	$A = 180^\circ; \angle = 60^\circ$	"	{400-650 720-850	XLIII
110	" "	" "	$A = 180^\circ; \angle = 75^\circ$	"	{400-650 720-750	XLIII
111	" "	" "	$A = 270^\circ; \angle = 45^\circ$	"	{400-650 720-750	XLIV
112	" "	" "	$A = 270^\circ; \angle = 60^\circ$	"	{400-650 720-750	XLIV
113	" "	" "	$A = 270^\circ; \angle = 75^\circ$	"	{400-650 720-750	XLIV
114	" "	" "	Normal; alt. of sun = 45°	"	{400-650 730-840	XLV
115	" "	" "	$A = 0^\circ; \angle = 15^\circ$	"	{400-650 730-760	XLV
116	" "	" "	$A = 0^\circ; \angle = 30^\circ$	"	400-650 730-760	XLV

117	Dry meadow	With dense short grass in mid-summer	$A = 0^{\circ}; < = 45^{\circ}$	n.f.b.	400-650 730-760	XLV
118	The same	The same	$A = 0^{\circ}; < = 60^{\circ}$	"	400-650 720-760	XLV
119	" "	" "	$A = 0^{\circ}; < = 75^{\circ}$	"	400-650 720-760	XLV
120	" "	" "	$A = 90^{\circ}; < = 15^{\circ}$	"	400-650	XLVI
121	" "	" "	$A = 90^{\circ}; < = 30^{\circ}$	"	400-650	XLVI
122	" "	" "	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	XLVI
123	" "	" "	$A = 90^{\circ}; < = 60^{\circ}$	"	400-650	XLVI
124	" "	" "	$A = 90^{\circ}; < = 75^{\circ}$	"	400-650	XLVI
125	" "	" "	$A = 180^{\circ}; < = 15^{\circ}$	"	400-650	XLVII
126	" "	" "	$A = 180^{\circ}; < = 30^{\circ}$	"	400-650	XLVII
127	" "	" "	$A = 180^{\circ}; < = 45^{\circ}$	"	400-650	XLVII
128	" "	" "	$A = 180^{\circ}; < = 60^{\circ}$	"	400-650	XLVII
129	" "	" "	$A = 180^{\circ}; < = 75^{\circ}$	"	400-650	XLVII
130	" "	" "	$A = 270^{\circ}; < = 15^{\circ}$	"	400-650	XLVIII
131	" "	" "	$A = 270^{\circ}; < = 30^{\circ}$	"	400-650	XLVIII
132	" "	" "	$A = 270^{\circ}; < = 45^{\circ}$	"	400-650	XLVIII
133	" "	" "	$A = 270^{\circ}; < = 60^{\circ}$	"	400-650	XLVIII
134	" "	" "	$A = 270^{\circ}; < = 75^{\circ}$	"	400-650	XLVIII

135	Dry meadow	With sparse low grass	Normal	n.f.b.	400-650	XLIX
136	The same	The same	$A = 90^{\circ}; \angle = 45^{\circ}$	"	400-650	XLIX
137	" "	" "	$A = 90^{\circ}; \angle = 75^{\circ}$	"	400-650	XLIX
138	" "	With more dense low grass	Normal	"	400-650	L
139	" "	The same	$A = 90^{\circ}; \angle = 45^{\circ}$	"	400-650	L
140	" "	" "	$A = 180^{\circ}; \angle = 45^{\circ}$	"	400-650	L
141	" "	With sparse dry grass on hills beginning of autumn	Normal	mountainous	400-650 730-900	LI
142	Meadow	With dense but low grass beginning of autumn	From aircraft alt. 300 m.	n.f.b.	400-650	LII
143	The same	With more sparse grass, grazed	From aircraft alt. 300 m.	"	400-490 710-850	LII
144	Lake partially covered with vegetation	Surface of water is almost completely covered with vegetation (duckweed, sedge and others)	$A = 90^{\circ}; \angle = 60^{\circ}$	forest steppe	400-650 730-840	LIII
145	Sedge	Dense near lake shore	$A = 90^{\circ}; \angle = 45^{\circ}$	forest steppe	400-650 720-820	LIV
146	Shallows of river (in high water)	Covered with grass	Almost plumb	steppe	400-650 720-850	LV
147	Plantain	Individual leaf (top surface)	Normal	n.f.b.	400-800	LVI
148	Wormwood	Dense growth, flowering, at end of summer	Cloudy sky Normal	steppe and forest steppe	400-650 720-830	LVII
149	The same	The same	The same; $\angle = 30^{\circ}$	The same	400-650 720-830	LVII

150	Wormwood	Dense growth, flowering, at end of summer	Cloudy sky Normal; $\angle = 60^\circ$	steppe and forest steppe	400-650 720-830	LVII
151	Stream	Surface covered with water weeds and sedge	$A = 90^\circ$; $\angle = 45^\circ$	n.f.b.	400-650	LVIII
152	Duckweed	Dense bunched growth, light green, beginning of summer	$A = 90^\circ$; $\angle = 45^\circ$	"	400-650 700-870	LIX
153	Selin	Individual clumps dried and yellowish on sand dunes at the end of summer	Normal	desert	400-650 700-830	LX
154	Mountain side	With low sparse grass at the beginning of autumn	"	mountainous	400-650	LXI
155	Virgin steppe	With low grass burnt by the sun, beginning of autumn	Cloudy sky Normal	forest steppe	400-650 720-830	LXII
156	The same	The same	The same; $\angle = 30^\circ$	The same	400-650 720-790	LXII
157	" "	" "	" " ; $\angle = 60^\circ$	" "	400-650 720-830	LXII
158	" "	" " , but fresher and wetter after rain	" " ; Normal	" "	400-620 730-850	LXIII
159	" "	The same	" " ; $\angle = 30^\circ$	" "	400-620 730-820	LXIII
160	" "	" "	" " ; $\angle = 60^\circ$	" "	400-620 730-850	LXIII
161	Grass	Near road, dusty	Normal	steppe	400-880	LXIV

162	Grass	Young, green	$A = 90^{\circ}; \measuredangle = 45^{\circ}$	n.f.b.	400-350 710-340	LXIV
163	The same	Last year's (dry), spring	$A = 90^{\circ}; \measuredangle = 45^{\circ}$	"	400-650 700-870	LXIV
164	" "	Summer green	$A = 90^{\circ}; \measuredangle = 45^{\circ}$	"	400-780	LXIV
165	Yantak (camel grass)	Road side, heavily dusted	Normal	desert	400-650 770-870	LXV
166	Fallow, green	Flowering	"	steppe	400-760	LXVI
167	Hillside	Short grass	"	"	400-650 710-840	LXVII
168	Hay	In stack, dry	$A = 110^{\circ}$	mountainous	400-650 780-900	LXVIII

3. Mosses and Lichens

169	Lichens	Greenish brown, on roadsides and foot paths over turf, dry	Normal	tundra	400-650 840-900	LXIX
170	Moss	Reddish brown, wet	"	"	400-650 770-900	LXX
171	Sphagnum moss	In marshy lowland, wet	"	"	400-650 710-900	LXX
172	The same	The same, on bank of bog, dry	"	"	400-650 690-780	LXX
173	Moss on rocks	Dark green on mountain outcrops, dry	"	"	400-650	LXXI
174	Moss on turf	Reddish brown, dry	"	"	400-650 820-900	LXXI

175	Reindeer moss	On turf, dry	Normal	tundra	400-650 820-900	LXXII

4. Field and Garden Crops

176	Vetch	Dense, bright green, before flowering	$A = 90^\circ; \angle = 45^\circ$	n.f.b.	400-650	LXXIII
177	Peas	To a considerable extent yellowed with bright green spots before ripening	$A = 90^\circ; \angle = 45^\circ$	"	400-650	LXXIV
178	Buckwheat	Before blooming	$A = 90^\circ; \angle = 45^\circ$	"	400-650	LXXV
179	Cabbage	With well-developed heads	$A = 90^\circ; \angle = 45^\circ$	black earth	400-650 700-850	LXXVI
180	Potatoes	After flowering, dark green	$A = 90^\circ; \angle = 45^\circ$	" "	400-650 700-850	LXXVII
181	White clover	Flowering period	$A = 90^\circ; \angle = 45^\circ$	n.f.b.	400-650	LXXVIII
182	Red clover	The same	$A = 90^\circ; \angle = 45^\circ$	"	400-650	LXXVIII
183	The same	Young grass after first mowing	$A = 90^\circ; \angle = 45^\circ$	black earth	400-650	LXXVIII
184	Corn	Ripening period somewhat yellowish	$A = 90^\circ$	steppe	400-650	LXXIX
185	Oats	Spike-forming period	Normal	tundra	400-650 700-900	LXXX
186	The same	With spikes	$A = 90^\circ; \angle = 45^\circ$	n.f.b.	400-650 710-880	LXXX
187	" "	The same	$A = 90^\circ; \angle = 65^\circ$	"	400-650 710-880	LXXX

188	Oats	With spikes	A = 90°; < = 85°	n.f.b.	400-650 710-880	LXXX
189	The same	With spikes, lighter in color	Cloudy; < = 45°	"	400-650 710-810	LXXX
190	" "	The same	" < = 65°	"	400-650 700-770	LXXX
191	" "	" "	" < = 85°	"	400-650	LXXX
192	Sunflower	In bloom	A = 90°	black earth	400-650 700-850	LXXXI
193	Oat field	Stubble	Normal	" "	400-650 720-850	LXXXII
194	Lentil field	The same	"	" "	400-650 760-850	LXXXII
195	Barley field	" "	"	n.f.b.	400-650	LXXXII
196	Tomatoes	Dense vegetation	A = 90°; < = 45°	black earth	400-650 720-850	LXXXIII
197	Millet	Ripening	Normal	" "	400-650 720-850	LXXXIV
198	The same	"	A = 0°; < = 45°	" "	400-650 720-850	LXXXIV
199	" "	"	A = 90°; < = 45°	" "	400-650 720-850	LXXXIV
200	" "	"	A = 180°; < = 45°	" "	400-650 720-850	LXXIV
201	Wheat	Before harvesting	A = 0°; < = 45°	n.f.b.	400-650	LXXXV

202	Wheat	Before harvesting	$A = 0^{\circ}; < = 65^{\circ}$	n.f.b.	400-650	LXXXV
203	The same	The same	$A = 0^{\circ}; < = 85^{\circ}$	"	400-650	LXXXV
204	" "	" "	$A = 180^{\circ}; < = 45^{\circ}$	"	400-650	LXXXV
205	" "	" "	$A = 180^{\circ}; < = 65^{\circ}$	"	400-650	LXXXV
206	" "	" "	$A = 180^{\circ}; < = 85^{\circ}$	"	400-650	LXXXV
207	" "	In the flowering period	$A = 0^{\circ}; < = 45^{\circ}$	"	400-650 730-850	LXXXVI
208	" "	The same	$A = 0^{\circ}; < = 65^{\circ}$	"	400-650 730-850	LXXXVI
209	" "	" "	$A = 0^{\circ}; < = 85^{\circ}$	"	400-650 730-850	LXXXVI
210	" "	" "	$A = 90^{\circ}; < = 65^{\circ}$	"	400-650 720-870	LXXVI
211	" "	" "	$A = 90^{\circ}; < = 85^{\circ}$	"	400-650 740-870	LXXXVI
212	" "	After mowing	$A = 90^{\circ}; < = 65^{\circ}$	"	400-650 700-870	LXXXVI
213	" "	The same	$A = 90^{\circ}; < = 85^{\circ}$	"	400-650 720-820	LXXXVI
214	Winter rye	Spiked	$A = 90^{\circ}; < = 70^{\circ}$	"	400-650 720-850	LXXXVII
215	The same	Flowering	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	LXXXVII
216	Summer rye	Spiked	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	LXXXVII

217	Oat straw	In sheaves	Normal	black earth	400-650 720-830	LXXXVIII
218	Wheat straw	In sheaves	"	" "	400-650 720-830	LXXXVIII
219	Rye straw	The same	"	" "	400-650 720-830	LXXXVIII
220	Lentil straw	" "	"	" "	400-650 720-850	LXXXVIII
221	Cotton	Heavily coated with dust before flowering	$A = 90^{\circ}; < = 45^{\circ}$	desert	400-650 700-860	LXXXIX
222	The same	Flowering	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	LXXXIX
223	Barley	Before spikes	$A = 90^{\circ}; < = 45^{\circ}$	n.f.b.	400-650	XC
224	The same	Spiked	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650 710-850	XC
225	" "	The same	$A = 90^{\circ}; < = 65^{\circ}$	"	400-650 720-850	XC
226	" "	" "	$A = 90^{\circ}; < = 85^{\circ}$	"	400-650 720-850	XC
227	" "	Golden yellow-ripe	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	XC
228	Field	With ripe crop, buildings and roads	From the air; alt. = 300 m.	"	420-480 710-850	XCI
229	Field	With green crops	From the air; alt. = 300 m.	"	400-490 710-850	XCI

5. Bare Areas and Soils

230	Ravines	Sandy, light gray, dry	$A = 90^\circ$	mountainous	400-650	XCII
231	River bank	Slope, dry	$A = 90^\circ$	steppe	400-650 700-850	XCIII
232	Boulders	In canyon of mountain stream, dry	Normal	mountainous	400-650	XCIV
233	The same	The same, wet	"	"	400-650	XCIV
234	Clay	Dry, individual sample	$A = 90^\circ; < 45^\circ$	desert	400-640	XCV
235	Bottom of reservoir	Sandy, moist	Normal	"	400-650 700-870	XCVI
236	Limestone	Dry, single sample	$A = 90^\circ; <= 45^\circ$	"	400-650	XCVII
237	Silt	From bottom of canal, dry	$A = 90^\circ; <= 45^\circ$	"	400-650 750-850	XCVIII
238	Conglomerate	Dry, individual sample	$A = 90^\circ; <= 45^\circ$	"	400-650	XCIX
239	Turf hillock	Bare, dry	Normal	tundra	400-650 840-900	C
240	Edge of river bank	" "	"	steppe	400-650 720-840	CI
241	Wind eroded place	Dry	"	desert	400-650 750-860	CII
242	The same	Individual sample	$A = 90^\circ; <= 45^\circ$	"	400-650 750-850	CII
243	Talus	Mountain slopes, dry	$A = 100^\circ$	mountainous	400-650	CIII
244	The same	The same	$A = 100^\circ$	tundra	400-650	CIII
245	" "	" " , partly in shade	$A = 100^\circ$	"	400-650	CIII

246	Shallows	Sand with pebbles, moist	Almost plumb	steppe	400-650 710-850	CIV
247	Sand	Individual sample	$A = 90^\circ; \angle = 45^\circ$	desert	400-650	CV
248	Sand dunes	With sharply expressed microrelief, dry	No shadows, Normal	"	400-650 700-870	CVI
249	The same	The same	$A = 90^\circ; \angle = 30^\circ$	"	400-650 770-880	CVI
250	" "	" "	$A = 90^\circ; \angle = 60^\circ$	"	400-650 770-880	CVI
251	" "	" "	$A = 90^\circ; \angle = 75^\circ$	"	400-650 770-880	CVI
252	" "	" "	$A = 270^\circ; \angle = 30^\circ$	"	400-650 700-800	CVI
253	" "	" "	$A = 270^\circ; \angle = 60^\circ$	"	400-650 700-800	CVI
254	" "	" "	$A = 270^\circ; \angle = 75^\circ$	"	400-650 700-800	CVI
255	" "	" "	Shadows right-angles to mountain, Normal	"	400-650 700-840	CVII
256	" "	" "	$A = 0^\circ; \angle = 30^\circ$	"	400-650 700-840	CVII
257	" "	" "	$A = 0^\circ; \angle = 60^\circ$	"	400-650 700-880	CVII
258	" "	" "	$A = 0^\circ; \angle = 75^\circ$	"	400-650 700-770	CVII

259	Sand dunes	With sharply expressed microrelief, dry	$A = 90^\circ; \angle = 30^\circ$	desert	400-650 700-870	CVII
260	The same	The same	$A = 90^\circ; \angle = 60^\circ$	"	400-650 700-870	CVII
261	" "	" "	$A = 90^\circ; \angle = 75^\circ$	"	400-650 700-870	CVII
262	" "	" "	$A = 180^\circ; \angle = 30^\circ$	"	400-650 720-870	CVII
263	" "	" "	$A = 180^\circ; \angle = 60^\circ$	"	400-650 710-860	CVII
264	" "	" "	$A = 180^\circ; \angle = 75^\circ$	"	400-650 720-850	CVII
265	" "	" "	$A = 270^\circ; \angle = 30^\circ$	"	400-650 700-870	CVII
266	" "	" "	$A = 270^\circ; \angle = 60^\circ$	"	400-650 700-870	CVII
267	" "	" "	$A = 270^\circ; \angle = 75^\circ$	"	400-650 700-870	CVII
268	Sandstone, brick red	Dry, individual sample	$A = 90^\circ; \angle = 45^\circ$	"	400-650	CVIII
269	Sandstone, light grey	The same	$A = 90^\circ; \angle = 45^\circ$	"	400-650	CVIII
270	Iridescence in places of wind erosion	Whitish, with barely noticeable rosy shade, dry	Normal	"	400-650 800-860	CIX
271	Soil, boggy	In boggy areas, very damp	"	tundra	400-630 700-760	CX

272	Soil, podsol	Ploughed, moist	Normal	n.f.b.	400-650 770-850	CXI
273	The same	The same	A = 0°; < = 15°	"	400-650	CXI
274	" "	" "	A = 0°; < = 30°	"	400-650	CXI
275	" "	" "	A = 0°; < = 60°	"	400-650	CXI
276	" "	" "	A = 90°; <= 15°	"	400-650 770-850	CXII
277	" "	" "	A = 90°; <= 30°	"	400-650 770-850	CXII
278	" "	" "	A = 90°; <= 45°	"	400-650 770-850	CXII
279	" "	" "	A = 90°; <= 60°	"	400-650 770-850	CXII
280	" "	" "	A = 90°; < = 75°	"	400-650 810-850	CXII
281	" "	" "	A = 270°; <= 15°	"	400-650	CXII
282	" "	" "	A = 270°; <= 30°	"	400-610	CXII
283	" "	" "	A = 270°; <= 45°	"	400-640	CXII
284	" "	" "	A = 270°; <= 60°	"	400-640	CXII
285	" "	" "	A = 270°; <= 75°	"	400-570	CXII
286	" "	Ploughed, wet	<= 45°	"	400-650	CXIII

287	Soil, podsol	Ploughed, dry	A = 0°; ∢ = 45°	n.f.b.	400-650	CXIII
288	The same	" "	A = 90°; ∢ = 45°	"	400-650	CXIII
289	" "	" "	A = 180°; ∢ = 45°	"	400-650	CXIII
290	Soil, sandy loam	Ploughed, moist	Cloudy sky; Normal	forest steppe	400-650 730-850	CXIV
291	The same	The same	The same; ∢ = 15°	forest steppe	400-650 740-850	CXIV
292	" "	" "	" " ; ∢ = 30°	" "	400-650 730-850	CXIV
293	" "	" "	" " ; ∢ = 45°	" "	400-650 740-850	CXIV
294	" "	" "	" " ; ∢ = 60°	" "	400-650 710-850	CXIV
295	" "	" "	A = 0°; ∢ = 45°	" "	400-650 720-850	CXV
296	" "	" "	A = 90°; ∢ = 45°	" "	400-650 720-850	CXV
297	" "	" "	A = 180°; ∢ = 45°	" "	400-650 720-850	CXV
298	" "	" "	A = 270°; ∢ = 45°	" "	400-650 720-800	CXV
299	" "	Ploughed, dry	Normal	" "	400-650	CXVI
300	" "	The same	A = 0°; ∢ = 45°	" "	400-650	CXVI
301	" "	" "	A = 90°; ∢ = 45°	" "	400-650	CXVI

302	Soil, grey podsol	Ploughed, dry	Normal	steppe	400-850	CXVII
303	Soil, black earth leached	Ploughed, slightly moist	"	"	400-650 770-830	CXVIII
304	Soil, black earth, rich	Ploughed, wet	"	black earth	400-650	CXIX
305	The same	The same	$A = 0^\circ; \angle = 45^\circ$	" "	400-650	CXIX
306	" "	" "	$A = 180^\circ; \angle = 45^\circ$	" "	400-650	CXIX
307	" "	Ploughed, dry	Normal	" "	400-650 770-840	CXIX
308	" "	" "	$A = 0^\circ; \angle = 45^\circ$	" "	400-650 770-840	CXIX
309	" "	" "	$A = 90^\circ; \angle = 45^\circ$	" "	400-650 770-840	CXIX
310	" "	" "	$A = 180^\circ; \angle = 45^\circ$	" "	400-650 770-840	CXIX
311	Soil, clay loam	Ploughed, moist	From the air; alt. = 300 m.	n.f.b.	400-490 710-810	CXX
312	Cliffs	Bare, dry	$A = 110^\circ$	mountainous	400-650	CXXI
313	The same	The same, on mountain tops	Normal	"	400-650 700-850	CXXI
314	" "	The same, bare dry	"	tundra	400-650	CXXI
315	Hill slope	Bare dry	"	steppe	400-650 700-800	CXXII

316	Shale	Individual samples, dry	$A = 90^\circ$; $\angle = 45^\circ$	desert	400-650	CXXIII
317	Salt marshes	" " "	$A = 90^\circ$; $\angle = 45^\circ$	"	400-650 740-850	CXXIV
318	Turf	Bare dry	Normal	tundra	400-650 700-900	CXXV

6. Roads

319	Earth road	Heavily trampled, black earth, dry	Normal	black earth	400-650	CXXVI
320	The same	Trampled, sand loam	"	forest steppe	400-650 790-830	CXXVI
321	" "	The same	Cloudy sky; $\angle = 30^\circ$	forest steppe	400-650 800-830	CXXVI
322	" "	Grey podsol	Normal	steppe	400-850	CXXVI
323	" "	Black earth, leached	"	"	400-650 700-840	CXXVI
324	" "	Little used, chestnut-brown earth	"	mountainous	400-650	CXXVI
325	" "	Trampled, podsol, dry	"	n.f.b.	400-650 700-850	CXXVI
326	" "	Muddy and wet	$A = 90^\circ$; $\angle = 45^\circ$	"	400-650	CXXVI
327	" "	Covered with a layer of loess, dry	Normal	desert	400-650 770-850	CXXVI
328	Road	End of winter, yellowish after rain, wet	"	n.f.b.	400-650	CXXVII

329	Road, paved cobblestone	Dry	Normal	tundra	400-650 710-900	CXXVIII
330	The same	The same	"	n.f.b.	400-650 710-850	CXXVIII
331	" "	" "	$A = 90^{\circ}$; $\angle = 45^{\circ}$	"	400-650	CXXVIII
332	" "	Wet	$A = 90^{\circ}$; $\angle = 45^{\circ}$	"	400-650	CXXVIII

7. Water Surfaces and Snow

333	Water in river	Kuban, muddy	Almost plumb	steppe	400-650 700-840	CXXIX
334	The same	In the mountain river Dzhemagat, clear	Normal	mountainous	400-650	CXXIX
335	Water in reservoir	Very muddy, chocolate color	"	desert	400-650 720-860	CXXIX
336	Pond	Clear with reflection of blue sky	$A = 90^{\circ}$; $\angle = 45^{\circ}$	n.f.b.	400-540	CXXX
337	Snow	Fresh	Normal	"	400-900	CXXXI
338	The same	Dry, with crust	$A = 0^{\circ}$; $\angle = 20^{\circ}$	"	400-650	CXXXII
339	" "	The same	$A = 0^{\circ}$; $\angle = 40^{\circ}$	"	400-650	CXXXII
340	" "	" "	$A = 0^{\circ}$; $\angle = 60^{\circ}$	"	400-650	CXXXII

341	Snow	Dry, with crust	A = 0°; < = 80°	n.f.b.	400-650	CXXXII
342	The same	The same	A = 90°; < = 20°	"	700-900	CXXXIII
343	" "	" "	A = 90°; < = 40°	"	400-620 700-900	CXXXIII
344	" "	" "	A = 90°; < = 60°	"	400-620 700-900	CXXXIII
345	" "	" "	A = 90°; < = 80°	"	400-620 700-900	CXXXIII
346	" "	" "	A = 180°; < = 20°	"	700-900	CXXXIV
347	" "	" "	A = 180°; < = 40°	"	400-650 700-900	CXXXIV
348	" "	" "	A = 180°; < = 60°	"	400-650 700-900	CXXXIV
349	" "	" "	A = 180°; < = 80°	"	400-650 700-900	CXXXIV
350	" "	" "	A = 270°; < = 20°	"	700-900	CXXXV
351	" "	" "	A = 270°; < = 40°	"	700-900	CXXXV
352	" "	" "	A = 270°; < = 60°	"	700-900	CXXXV
353	" "	" "	A = 270°; < = 80°	"	700-900	CXXXV
354	" "	Covered with film of ice	Cloudy sky; < = 45°	"	400-900	CXXXVI

8. Buildings and Building Materials

355	Stones	Gathered in a pile, dry	$A = 90^\circ; < = 45^\circ$	n.f.b.	400-650	CXXXVII
356	Brick	Calcined, red	$A = 90^\circ; < = 45^\circ$	"	400-650	CXXXVIII
357	Roof, shingled	Old, dry	Normal	"	400-650 720-850	CXXXIX
358	Roof, iron	Painted red, old	$A = 90^\circ; < = 45^\circ$	"	400-650	CXL
359	Roof, straw	Fresh	$A = 180^\circ; < = 45^\circ$	forest steppe	400-650	CXLI
360	Roof, straw	Old	$A = 180^\circ; < = 60^\circ$	forest steppe	400-650 720-840	CXLI
361	Bridge, wooden	Old, grown dark	Normal	n.f.b.	400-650 710-850	CXLII
362	Street, cobble-stone	In city, wet	$A = 90^\circ; < = 45^\circ$	"	400-650	CXLIII
363	The same	In city, dry	$A = 90^\circ; < = 45^\circ$	"	400-650 740-840	CXLIII
364	Street, wood block	In city, dry	$A = 90^\circ; < = 45^\circ$	"	400-650 760-850	CXLIV
365	Quay, granite	The same	$A = 90^\circ; < = 45^\circ$	"	400-650 730-850	CXLV
366	Square, asphalt	" "	$A = 90^\circ; < = 45^\circ$	"	400-650	CXLVI
367	Wall of log house	Grown dark	$A = 110^\circ$	"	400-650	CXLVII

368	Sidewalk, asphalt	In city, dry	$A = 90^{\circ}; < = 45^{\circ}$	n.f.b.	400-650 750-840	CXLVIII
369	Sidewalk, flagstone	In city, dry	$A = 90^{\circ}; < = 45^{\circ}$	"	400-650	CXLIX
370	Roof tile	New, red	Normal	tundra	400-650 720-880	CL

λ	1	2	3	4	5	6	7	8	9	10
S	G	G	G	G	G/G	G/G	G	G	G/G	P/P
N	3	1	3	1	1/1	1/1	3	1	1/1	2/4
Sp	7	3	7	3	1/1	3/3	8	3	3/3	4/5
400	0.051	0.058	0.047	0.026	0.059	0.072	0.044	0.033	0.084	0.020
410	0.052	0.057	0.048	0.027	0.060	0.073	0.045	0.034	0.086	0.020
420	0.054	0.056	0.049	0.030	0.061	0.074	0.047	0.037	0.086	0.020
430	0.061	0.054	0.050	0.031	0.062	0.074	0.049	0.039	0.091	0.021
440	0.062	0.052	0.052	0.034	0.061	0.074	0.050	0.044	0.097	0.022
450	0.065	0.050	0.056	0.036	0.065	0.073	0.052	0.046	0.101	0.024
460	0.063	0.049	0.059	0.036	0.073	0.072	0.054	0.044	0.109	0.025
470	0.062	0.047	0.060	0.037	0.076	0.071	0.055	0.042	0.115	0.026
480	0.065	0.045	0.060	0.037	0.075	0.070	0.056	0.044	0.123	0.027
490	0.066	0.045	0.061	0.039	0.087	0.070	0.058	0.048	0.131	0.027
500	0.066	0.044	0.063	0.040	0.095	0.071	0.060	0.045	0.144	0.029
510	0.080	0.044	0.071	0.042	0.106	0.073	0.070	0.048	0.161	0.034
520	0.096	0.044	0.090	0.052	0.120	0.077	0.085	0.065	0.185	0.040
530	0.114	0.045	0.119	0.070	0.149	0.080	0.106	0.087	0.213	0.053
540	0.138	0.047	0.138	0.085	0.169	0.082	0.121	0.106	0.233	0.066
550	0.148	0.050	0.147	0.091	0.176	0.087	0.128	0.113	0.245	0.070
560	0.136	0.052	0.142	0.088	0.178	0.090	0.123	0.110	0.249	0.067
570	0.128	0.051	0.130	0.081	0.173	0.091	0.119	0.099	0.247	0.053
580	0.121	0.050	0.117	0.071	0.168	0.095	0.109	0.088	0.241	0.048
590	0.114	0.050	0.111	0.071	0.168	0.098	0.098	0.090	0.234	0.050
600	0.113	0.050	0.103	0.068	0.160	0.100	0.090	0.083	0.229	0.050
610	0.109	0.049	0.103	0.064	0.152	0.101	0.086	0.073	0.224	0.049
620	0.106	0.049	0.095	0.060	0.153	0.101	0.082	0.068	0.220	0.053
630	0.105	0.050	0.092	0.059	0.151	0.102	0.079	0.065	0.211	0.051
640	0.104	0.051	0.090	0.059	0.143	0.102	0.078	0.069	0.205	0.042
650	0.094	0.052	0.086	0.059	0.141	0.101	0.076	0.070	0.202	0.036
660	- -	- -	- -	- -	- -	0.100	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	0.100	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	0.100	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	0.100	- -	- -	- -	- -
700	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.120
710	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.141
720	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.164
730	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.187
740	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.218
750	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.270
760	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.320
770	- -	- -	- -	- -	- -	0.100	- -	- -	- -	0.342
780	- -	- -	- -	- -	0.517	0.101	- -	- -	- -	0.360
790	- -	- -	- -	- -	0.528	0.102	- -	- -	0.398	0.375
800	- -	- -	- -	- -	0.529	0.103	- -	- -	0.405	0.385
810	- -	- -	- -	- -	0.524	0.104	- -	- -	0.411	0.391
820	- -	- -	- -	- -	0.517	0.105	- -	- -	0.418	0.396
830	- -	- -	- -	- -	0.509	0.106	- -	- -	0.420	0.396
840	- -	- -	- -	- -	0.500	0.107	- -	- -	0.421	0.392
850	- -	- -	- -	- -	0.542	0.108	- -	- -	0.422	0.388
860	- -	- -	- -	- -	0.535	0.109	- -	- -	0.422	0.380
870	- -	- -	- -	- -	0.530	0.110	- -	- -	0.422	0.373
880	- -	- -	- -	- -	- -	0.110	- -	- -	- - -	0.365
890	- -	- -	- -	- -	- -	0.110	- -	- -	- -	0.363
900	- -	- -	- -	- -	- -	0.110	- -	- -	- -	0.363

λλ	11	12	13	14	15	16	17	18
S	B/B	G	G	G	G	G	G	G/G
N	1/1	1	1	1	1	1	1	3/1
Sp	2/2	2	3	1	3	2	2	7/2
400	0.202	0.026	0.033	0.050	0.044	0.071	0.010	0.031
410	0.203	0.027	0.033	0.050	0.043	0.080	0.010	0.035
420	0.204	0.027	0.033	0.050	0.043	0.089	0.010	0.033
430	0.205	0.027	0.035	0.050	0.043	0.097	0.010	0.035
440	0.209	0.030	0.037	0.050	0.041	0.102	0.010	0.035
450	0.210	0.031	0.039	0.050	0.040	0.106	0.011	0.037
460	0.211	0.032	0.040	0.050	0.040	0.107	0.011	0.037
470	0.211	0.034	0.040	0.050	0.040	0.106	0.012	0.039
480	0.212	0.036	0.039	0.050	0.040	0.106	0.011	0.041
490	0.214	0.038	0.037	0.050	0.040	0.111	0.010	0.043
500	0.215	0.043	0.039	0.050	0.045	0.122	0.010	0.048
510	0.215	0.054	0.046	0.051	0.057	0.145	0.010	0.055
520	0.215	0.072	0.058	0.053	0.084	0.190	0.018	0.065
530	0.214	0.092	0.078	0.056	0.115	0.220	0.020	0.079
540	0.213	0.109	0.096	0.059	0.129	0.240	0.022	0.090
550	0.213	0.118	0.108	0.060	0.150	0.255	0.024	0.098
560	0.213	0.117	0.105	0.061	0.140	0.267	0.024	0.100
570	0.216	0.104	0.095	0.063	0.108	0.275	0.023	0.094
580	0.220	0.092	0.084	0.064	0.089	0.281	0.021	0.088
590	0.224	0.083	0.074	0.065	0.073	0.282	0.018	0.086
600	0.231	0.073	0.066	0.066	0.085	0.282	0.020	0.085
610	0.239	0.064	0.058	0.067	0.066	0.284	0.018	0.085
620	0.247	0.060	0.052	0.068	0.060	0.289	0.018	0.080
630	0.254	0.061	0.050	0.067	0.063	0.299	0.018	0.079
640	0.261	0.061	0.050	0.066	0.053	0.315	0.017	0.078
650	0.269	0.060	0.049	0.065	0.049	0.330	0.015	0.076
660	- -	- -	- -	- -	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	- -	- -	- -
700	- -	- -	- -	- -	- -	- -	- -	- -
710	- -	- -	- -	- -	- -	- -	- -	0.126
720	- -	- -	- -	- -	- -	- -	- -	0.178
730	0.301	- -	- -	- -	- -	- -	- -	0.194
740	0.301	- -	- -	- -	- -	- -	- -	0.229
750	0.300	- -	- -	- -	- -	- -	- -	0.240
760	0.300	- -	- -	- -	- -	- -	- -	- -
770	0.299	- -	- -	- -	- -	- -	- -	- -
780	0.296	- -	- -	- -	- -	- -	- -	- -
790	0.293	- -	- -	- -	- -	- -	- -	- -
800	0.291	- -	- -	- -	- -	- -	- -	- -
810	0.290	- -	- -	- -	- -	- -	- -	---
820	0.289	- -	- -	- -	- -	- -	- -	- -
830	0.287	- -	- -	- -	- -	- -	- -	- -
840	0.285	- -	- -	- -	- -	- -	- -	- -
850	0.284	- -	- -	- -	- -	- -	- -	- -
860	- -	- -	- -	- -	- -	- -	- -	- -
870	- -	- -	- -	- -	- -	- -	- -	- -
880	- -	- -	- -	- -	- -	- -	- -	- -
890	- -	- -	- -	- -	- -	- -	- -	- -
900	- -	- -	- -	- -	- -	- -	- -	- -

λλ	19	20	21	22	23	24	25	26	27
S	G/G	G	G/G	G/G	G	G	G	P/P	/G
N	2/1	1	4/	1/	1	1	1		/1
Sp	6/3	1	8/	3/	3	2	2		/2
400	0.020	- -	0.023	0.034	0.027	0.049	0.030	0.105	- -
410	0.020	- -	0.024	0.037	0.025	0.050	0.026	0.100	- -
420	0.022	- -	0.025	0.038	0.022	0.051	0.026	0.099	- -
430	0.029	- -	0.027	0.044	0.020	0.054	0.026	0.096	- -
440	0.028	- -	0.028	0.044	0.022	0.055	0.025	0.094	- -
450	0.030	- -	0.026	0.047	0.023	0.057	0.024	0.092	- -
460	0.030	- -	0.027	0.048	0.026	0.058	0.024	0.090	- -
470	0.032	- -	0.026	0.050	0.028	0.060	0.025	0.090	- -
480	0.032	- -	0.026	0.051	0.030	0.061	0.025	0.090	- -
490	0.033	- -	0.026	0.051	0.031	0.063	0.025	0.091	- -
500	0.040	- -	0.022	0.054	0.033	0.069	0.025	0.095	- -
510	0.048	- -	0.031	0.070	0.038	0.076	0.027	0.100	- -
520	0.064	0.037	0.036	0.094	0.045	0.085	0.030	0.105	- -
530	0.082	0.044	0.041	0.129	0.057	0.098	0.034	0.111	- -
540	0.097	0.049	0.051	0.147	0.063	0.105	0.036	0.114	- -
550	0.107	0.051	0.049	0.157	0.066	0.111	0.038	0.114	- -
560	0.104	0.049	0.048	0.154	0.062	0.111	0.036	0.112	- -
570	0.094	0.048	0.050	0.136	0.057	0.108	0.035	0.108	- -
580	0.082	0.037	0.044	0.121	0.051	0.100	0.031	0.103	- -
590	0.076	0.037	0.043	0.110	0.049	0.099	0.030	0.100	- -
600	0.074	0.034	0.044	0.114	0.050	0.093	0.028	0.097	- -
610	0.071	0.037	0.042	0.112	0.050	0.095	0.030	0.094	- -
620	0.066	0.033	0.040	0.111	0.050	0.096	0.028	0.090	- -
630	0.065	0.029	0.043	0.101	0.050	0.097	0.027	0.087	- -
640	0.065	0.030	0.043	0.100	0.048	0.090	0.026	0.083	- -
650	0.066	0.032	0.035	0.099	0.042	0.090	0.028	0.080	- -
660	- -	- -	- -	- -	- -	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	- -	- -	- -	- -
700	- -	- -	- -	- -	- -	- -	- -	- -	- -
710	- -	- -	0.050	- -	- -	- -	- -	- -	- -
720	- -	- -	0.062	0.088	- -	- -	- -	0.278	- -
730	0.185	- -	0.070	0.141	- -	- -	- -	0.328	- -
740	0.250	- -	0.075	0.165	- -	- -	- -	0.369	- -
750	0.277	- -	0.079	0.174	- -	- -	- -	0.397	0.522
760	0.293	- -	0.081	0.178	- -	- -	- -	0.418	0.543
770	0.313	- -	0.082	0.177	- -	- -	- -	0.437	0.555
780	0.334	- -	0.083	0.176	- -	- -	- -	0.452	0.567
790	0.360	- -	0.084	0.174	- -	- -	- -	0.470	0.573
800	0.377	- -	0.085	0.173	- -	- -	- -	0.483	0.578
810	0.394	- -	0.085	0.172	- -	- -	- -	0.497	0.582
820	0.406	- -	0.085	0.173	- -	- -	- -	0.510	0.587
830	0.413	- -	0.085	0.177	- -	- -	- -	0.519	0.593
840	- -	- -	0.086	0.180	- -	- -	- -	0.530	0.601
850	- -	- -	0.086	0.182	- -	- -	- -	0.538	0.611
860	- -	- -	0.087	- -	- -	- -	- -	- -	0.622
870	- -	- -	0.087	- -	- -	- -	- -	- -	0.633
880	- -	- -	0.087	- -	- -	- -	- -	- -	- -
890	- -	- -	- -	- -	- -	- -	- -	- -	- -
900	- -	- -	- -	- -	- -	- -	- -	- -	- -

λλ	28	29	30	31	32	33	34	35	36
S	G	G	G	G	G	G	P/P	G/G	G
N	2	1	1	2	1	1	2/1	1/1	1
Sp	4	2	3	5	3	3	4/1	2/2	1
400	0.068	0.034	0.034	0.034	0.024	0.041	0.028	0.030	0.056
410	0.066	0.032	0.032	0.036	0.024	0.041	0.026	0.028	0.057
420	0.062	0.032	0.032	0.038	0.024	0.041	0.024	0.030	0.059
430	0.060	0.038	0.033	0.039	0.024	0.044	0.030	0.030	0.061
440	0.064	0.042	0.030	0.040	0.031	0.044	0.033	0.031	0.062
450	0.066	0.045	0.030	0.041	0.034	0.047	0.038	0.033	0.063
460	0.064	0.046	0.030	0.042	0.035	0.048	0.039	0.033	0.065
470	0.063	0.047	0.039	0.043	0.035	0.047	0.038	0.035	0.068
480	0.066	0.047	0.055	0.045	0.036	0.042	0.035	0.035	0.070
490	0.070	0.043	0.052	0.045	0.039	0.035	0.036	0.034	0.071
500	0.072	0.047	0.045	0.045	0.044	0.039	0.043	0.037	0.072
510	0.074	0.059	0.038	0.045	0.057	0.049	0.053	0.041	0.074
520	0.077	0.081	0.034	0.047	0.072	0.064	0.067	0.058	0.076
530	0.078	0.099	0.039	0.050	0.085	0.079	0.084	0.077	0.079
540	0.080	0.111	0.051	0.051	0.095	0.089	0.096	0.089	0.081
550	0.081	0.116	0.071	0.052	0.099	0.092	0.105	0.096	0.082
560	0.081	0.105	0.080	0.053	0.096	0.088	0.100	0.087	0.084
570	0.082	0.092	0.098	0.054	0.084	0.078	0.089	0.082	0.085
580	0.082	0.082	0.088	0.054	0.075	0.068	0.079	0.071	0.087
590	0.084	0.068	0.087	0.054	0.068	0.061	0.072	0.068	0.089
600	0.086	0.078	0.082	0.054	0.064	0.056	0.070	0.067	0.090
610	0.087	0.066	0.076	0.054	0.061	0.052	0.069	0.062	0.090
620	0.088	0.064	0.081	0.054	0.060	0.050	0.069	0.058	0.090
630	0.089	0.060	0.081	0.054	0.060	0.050	0.069	0.054	0.090
640	0.089	0.055	0.064	0.054	0.059	0.049	0.069	0.051	0.091
650	0.089	0.052	0.062	0.054	0.059	0.049	0.069	0.051	0.091
660	- -	- -	- -	- -	- -	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	- -	- -	- -	- -
700	- -	- -	- -	- -	- -	- -	- -	- -	- -
710	- -	- -	- -	- -	- -	- -	---	0.180	- -
720	- -	- -	- -	- -	- -	- -	0.160	0.262	- -
730	- -	- -	- -	- -	- -	- -	0.200	0.374	- -
740	- -	- -	- -	- -	- -	- -	0.240	0.446	- -
750	- -	- -	- -	- -	- -	- -	0.274	0.469	- -
760	- -	- -	- -	- -	- -	- -	0.294	0.476	- -
770	- -	- -	- -	- -	- -	- -	0.302	0.476	- -
780	- -	- -	- -	- -	- -	- -	0.309	0.472	- -
790	- -	- -	- -	- -	- -	- -	0.314	0.466	- -
800	- -	- -	- -	- -	- -	- -	0.319	0.461	- -
810	- -	- -	- -	- -	- -	- -	0.322	0.454	- -
820	- -	- -	- -	- -	- -	- -	0.328	0.447	- -
830	- -	- -	- -	- -	- -	- -	0.331	0.439	- -
840	- -	- -	- -	- -	- -	- -	0.335	0.481	- -
850	- -	- -	- -	- -	- -	- -	0.340	0.472	- -
860	- -	- -	- -	- -	- -	- -	0.345	0.414	- -
870	- -	- -	- -	- -	- -	- -	0.349	0.405	- -
880	- -	- -	- -	- -	- -	- -	0.351	- -	- -
890	- -	- -	- -	- -	- -	- -	0.352	- -	- -
900	- -	- -	- -	- -	- -	- -	0.352	- -	- -

λλ	37	38	39	40	41	42	43	44	45
S	G/G	G/G	G/G	G/G	G/G	G	G/G	G/G	G/G
N	2/2	1/1	2/1	1/1	1/1	1	3/2	3/2	4/1
Sp	6/5	2/2	5/3	3/3	2/3	1	6/2	7/2	10/2
400	0.034	0.040	0.041	0.020	0.030	0.047	0.096	0.138	0.051
410	0.035	0.041	0.040	0.020	0.030	0.046	0.095	0.135	0.059
420	0.038	0.042	0.041	0.020	0.030	0.048	0.094	0.132	0.059
430	0.040	0.045	0.042	0.021	0.030	0.049	0.094	0.130	0.064
440	0.043	0.048	0.043	0.022	0.031	0.050	0.095	0.128	0.066
450	0.046	0.050	0.043	0.024	0.032	0.051	0.097	0.126	0.066
460	0.046	0.051	0.042	0.027	0.034	0.054	0.100	0.125	0.070
470	0.048	0.051	0.041	0.030	0.035	0.061	0.103	0.124	0.072
480	0.048	0.051	0.042	0.031	0.037	0.068	0.103	0.123	0.074
490	0.049	0.054	0.047	0.030	0.040	0.074	0.101	0.123	0.075
500	0.054	0.061	0.052	0.030	0.044	0.081	0.102	0.123	0.084
510	0.064	0.074	0.063	0.034	0.053	0.091	0.109	0.124	0.091
520	0.082	0.102	0.080	0.042	0.065	0.112	0.117	0.127	0.096
530	0.106	0.118	0.107	1.055	0.081	0.142	0.114	0.131	0.106
540	0.109	0.123	0.117	0.065	0.088	0.161	0.130	0.136	0.121
550	0.124	0.129	0.125	0.072	0.092	0.177	0.131	0.141	0.126
560	0.122	0.128	0.128	0.073	0.098	0.188	0.130	0.145	0.130
570	0.108	0.116	0.125	0.071	0.090	0.200	0.127	0.148	0.129
580	0.095	0.103	0.117	0.065	0.080	0.210	0.123	0.150	0.129
590	0.090	0.094	0.104	0.058	0.072	0.220	0.123	0.151	0.130
600	0.084	0.090	0.095	0.058	0.068	0.220	0.123	0.153	0.128
610	0.081	0.087	0.087	0.060	0.066	0.214	0.124	0.155	0.136
620	0.077	0.082	0.080	0.059	0.065	0.208	0.125	0.157	0.130
630	0.074	0.079	0.071	0.051	0.064	0.199	0.126	0.159	0.130
640	0.073	0.079	0.060	0.058	0.063	0.191	0.126	0.159	0.131
650	0.072	0.079	0.055	0.058	0.062	0.186	0.127	0.159	0.129
660	- -	- -	- -	- -	- -	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	- -	- -	- -	- -
700	0.142	- -	- -	- -	- -	- -	- -	- -	0.142
710	0.236	- -	0.184	0.237	- -	- -	- -	- -	0.182
720	0.402	0.440	0.268	0.327	- -	- -	- -	- -	0.215
730	0.452	0.518	0.335	0.387	- -	- -	- -	- -	0.226
740	0.484	0.562	0.364	0.415	- -	- -	- -	- -	0.276
750	0.512	0.589	0.380	0.432	- -	- -	- -	- -	0.302
760	0.531	0.604	- -	0.445	0.542	- -	- -	- -	- -
770	0.550	0.618	- -	0.457	0.562	- -	0.260	0.188	- -
780	0.560	0.674	- -	0.465	0.578	- -	0.272	0.190	- -
790	0.569	0.679	- -	0.471	0.589	- -	0.282	0.197	- -
800	0.575	0.680	- -	0.480	0.596	- -	0.295	0.202	- -
810	0.580	- -	- -	0.485	0.601	- -	0.325	0.209	- -
820	0.583	- -	- -	0.491	0.606	- -	0.366	0.214	- -
830	0.586	- -	- -	0.498	0.609	- -	0.385	0.221	- -
840	0.588	- -	- -	0.501	0.610	- -	- -	- -	- -
850	0.589	- -	- -	0.505	0.611	- -	- -	- -	- -
860	0.590	- -	- -	0.509	0.612	- -	- -	- -	- -
870	0.590	- -	- -	0.511	0.613	- -	- -	- -	- -
880	0.590	- -	- -	0.512	0.614	- -	- -	- -	- -
890	- -	- -	- -	- -	- -	- -	- -	- -	- -
900	- -	- -	- -	- -	- -	- -	- -	- -	- -

λλ	46	47	48	49	50	51	52	53	54
S	G/G	G	G/G	G	G	G	G/G	P/P	P/P
N	2/1	3	1/1	1	1	1		2/2	
Sp	6/3	5	3/4	4	1	2		4/2	
400	0.052	0.018	0.021	0.032	0.024	0.050	0.031	0.018	0.130
410	0.052	0.017	0.021	0.031	0.021	0.050	0.031	0.019	0.122
420	0.052	0.017	0.021	0.030	0.019	0.050	0.031	0.020	0.115
430	0.050	0.017	0.022	0.033	0.019	0.051	0.032	0.024	0.109
440	0.048	0.017	0.023	0.033	0.020	0.054	0.033	0.026	0.106
450	0.051	0.016	0.025	0.032	0.020	0.056	0.033	0.024	0.103
460	0.052	0.015	0.025	0.034	0.021	0.060	0.033	0.027	0.102
470	0.052	0.015	0.026	0.037	0.023	0.064	0.033	0.029	0.104
480	0.053	0.015	0.0[illegible]	0.035	0.025	0.068	0.033	0.028	0.108
490	0.053	0.015	0.027	0.033	0.027	0.071	0.035	0.027	0.110
500	0.060	0.016	0.026	0.032	0.029	0.076	0.037	0.027	0.120
510	0.062	0.017	0.030	0.036	0.032	0.079	0.039	0.027	0.124
520	0.075	0.017	0.034	0.041	0.033	0.083	0.040	0.029	0.132
530	0.09[illegible]	0.019	0.040	0.048	0.037	0.087	0.041	0.033	0.141
540	0.099	0.021	0.046	0.051	0.038	0.090	0.046	0.041	0.146
550	0.104	0.021	0.050	0.054	0.039	0.093	0.047	0.045	0.144
560	0.107	0.021	0.048	0.053	0.039	0.097	0.046	0.044	0.141
570	0.102	0.020	0.045	0.049	0.040	0.099	0.044	0.042	0.137
580	0.096	0.020	0.040	0.046	0.041	0.101	0.047	0.040	0.131
590	0.094	0.019	0.040	0.044	0.041	0.104	0.051	0.039	0.127
600	0.092	0.019	0.041	0.045	0.043	0.108	0.056	0.040	0.122
610	0.094	0.019	0.043	0.048	0.044	0.110	0.061	0.050	0.116
620	0.092	0.019	0.042	0.053	0.044	0.112	0.063	0.054	0.126
630	0.090	0.019	0.040	0.052	0.045	0.114	0.067	0.052	0.133
640	0.089	0.018	0.038	0.049	0.046	0.116	0.071	0.050	0.127
650	0.090	0.017	0.039	0.048	0.046	0.117	0.075	0.048	0.120
660	- -	- -	- -	- -	- -	- -	- -	- -	- -
670	- -	- -	- -	- -	- -	- -	- -	- -	- -
680	- -	- -	- -	- -	- -	- -	- -	- -	- -
690	- -	- -	- -	- -	- -	- -	- -	- -	- -
700	- -	- -	- -	- -	- -	- -	- -	- -	- -
710	- -	- -	0.114	- -	- -	- -	- -	- -	- -
720	- -	- -	0.150	- -	- -	- -	- -	- -	- -
730	0.190	- -	0.210	- -	- -	- -	0.178	- -	0.203
740	0.210	- -	0.250	- -	- -	- -	0.188	- -	0.224
750	0.224	- -	0.269	- -	- -	- -	0.198	0.200	0.249
760	0.238	- -	0.281	- -	- -	- -	0.206	0.202	0.273
770	0.252	- -	0.290	- -	- -	- -	0.212	0.201	0.298
780	0.270	- -	0.299	- -	- -	- -	0.218	0.193	0.310
790	0.285	- -	0.304	- -	- -	- -	0.222	0.189	0.318
800	0.303	- -	0.309	- -	- -	- -	0.226	0.180	0.320
810	0.322	- -	0.310	- -	- -	- -	0.229	0.177	0.323
820	0.340	- -	0.310	- -	- -	- -	0.231	0.178	0.325
830	0.359	- -	0.310	- -	- -	- -	0.233	0.186	0.324
840	0.376	- -	0.310	- -	- -	- -		0.193	0.323
850	- -	- -	0.310	- -	- -	- -	- -	0.200	0.321
860	-	- -	0.310	- -	- -	- -	- -	0.202	- -
870	- -	- -	0.310	- -	- -	- -	- -	0.203	- -
880	- -	- -	- -	- -	- -	- -	- -	0.202	- -
8[illegible]	- -	- -	- -	- -	- -	- -	- -	0.201	- -
[illegible]	- -	- -	- -	- -	- -	- -	- -	0.200	- -

λμ	55	56	57	58	59	60	61	62	63
S	P/P	G/G	G/G	G/G	G/G	G	G	G	G
N	3/2	2/1	1/1	1/1	1/1	1	1	1	1
Sp	6/3	4/1	1/1	1/1	1/1	1	1	1	2
400	0.074	0.112	0.128	0.150	0.161	0.090	0.102	0.119	0.130
410	0.085	0.116	0.141	0.163	0.176	0.092	0.104	0.121	0.143
420	0.090	0.120	0.153	0.180	0.191	0.094	0.108	0.125	0.157
430	0.109	0.126	0.169	0.195	0.209	0.098	0.110	0.131	0.171
440	0.105	0.132	0.183	0.209	0.222	0.102	0.115	0.136	0.180
450	0.104	0.139	0.199	0.222	0.237	0.109	0.121	0.143	0.188
460	0.102	0.148	0.210	0.231	0.250	0.118	0.128	0.150	0.196
470	0.106	0.156	0.220	0.243	0.262	0.127	0.139	0.159	0.201
480	0.101	0.164	0.229	0.252	0.273	0.135	0.148	0.169	0.208
490	0.100	0.172	0.235	0.261	0.283	0.143	0.157	0.176	0.216
500	0.098	0.181	0.244	0.270	0.291	0.150	0.163	0.182	0.225
510	0.099	0.189	0.254	0.280	0.300	0.155	0.171	0.188	0.240
520	0.110	0.195	0.268	0.292	0.310	0.160	0.173	0.192	0.253
530	0.116	0.205	0.285	0.309	0.328	0.164	0.177	0.197	0.171
540	0.126	0.218	0.301	0.322	0.338	0.168	0.179	0.199	0.185
550	0.122	0.229	0.317	0.335	0.349	0.170	0.180	0.200	0.300
560	0.119	0.239	0.324	0.346	0.361	0.170	0.181	0.201	0.318
570	0.117	0.249	0.335	0.360	0.372	0.170	0.181	0.202	0.341
580	0.114	0.255	0.349	0.372	0.381	0.169	0.180	0.203	0.362
590	0.111	0.261	0.360	0.382	0.390	0.164	0.179	0.204	0.373
600	0.127	0.261	0.369	0.388	0.397	0.160	0.179	0.205	0.371
610	0.148	0.260	0.373	0.392	0.401	0.159	0.179	0.205	0.356
620	0.146	0.259	0.379	0.395	0.405	0.160	0.179	0.205	0.347
630	0.146	0.260	0.382	0.399	0.411	0.160	0.180	0.205	0.347
640	0.157	0.261	0.388	0.404	0.420	0.161	0.181	0.205	0.355
650	0.166	0.266	0.395	0.415	0.430	0.160	0.182	0.205	0.366
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	-	-	-	-	-	-	-	-
730	-	-	-	-	-	-	-	-	-
740	-	-	0.410	0.453	0.463	-	-	-	-
750	-	-	0.398	0.433	0.454	-	-	-	-
760	-	0.300	0.380	0.427	0.437	-	-	-	-
770	0.778	0.300	0.360	0.400	0.415	-	-	-	-
780	0.780	0.300	0.335	0.360	0.382	-	-	-	-
790	0.780	0.299	0.316	0.331	0.349	-	-	-	-
800	0.778	0.294	0.301	0.312	0.323	-	-	-	-
810	0.775	0.291	0.292	0.300	0.309	-	-	-	-
820	0.772	0.290	0.295	0.300	0.310	-	-	-	-
830	0.770	0.291	0.298	0.307	0.313	-	-	-	-
840	0.765	0.294	0.302	0.313	0.319	-	-	-	-
850	0.761	0.300	0.309	0.318	0.323	-	-	-	-
860	0.757	0.308	0.317	0.323	0.329	-	-	-	-
870	0.751	-	-	-	-	-	-	-	-
880	0.750	-	-	-	-	-	-	-	-
890	0.750	-	-	-	-	-	-	-	-
900	0.750	-	-	-	-	-	-	-	-

λλ	64	65	66	67	68	69	70	71	72
S	G	G	G/G	G/G	G/G	G/G	P/P	P	P/P
N	1	1	1/1	1/1	1/1	1/1	2/1		
Sp	1	1	2/1	1/1	1/1	3/1	6/1		
400	0.163	0.201	0.149	0.152	0.149	0.054	0.011	0.035	0.101
410	0.186	0.220	0.149	0.153	0.149	0.050	0.012	0.040	0.106
420	0.205	0.238	0.149	0.154	0.149	0.049	0.012	0.048	0.109
430	0.222	0.252	0.150	0.159	0.150	0.056	0.013	0.054	0.110
440	0.236	0.262	0.157	0.162	0.157	0.060	0.013	0.061	0.110
450	0.246	0.271	0.163	0.171	0.163	0.061	0.013	0.069	0.112
460	0.253	0.277	0.174	0.182	0.176	0.060	0.013	0.070	0.117
470	0.260	0.281	0.196	0.200	0.190	0.059	0.013	0.071	0.121
480	0.264	0.288	0.210	0.215	0.200	0.060	0.013	0.071	0.127
490	0.271	0.293	0.228	0.222	0.209	0.056	0.014	0.071	0.130
500	0.280	0.300	0.239	0.227	0.218	0.070	0.015	0.071	0.133
510	0.292	0.307	0.247	0.230	0.222	0.077	0.018	0.074	0.136
520	0.300	0.315	0.251	0.231	0.223	0.096	0.028	0.080	0.139
530	0.311	0.324	0.259	0.232	0.226	0.110	0.037	0.090	0.140
540	0.323	0.333	0.261	0.234	0.227	0.119	0.043	0.096	0.141
550	0.387	0.346	0.2[illegible]	0.235	0.228	0.120	0.046	0.100	0.141
560	0.350	0.360	0.269	0.239	0.230	0.112	0.044	0.103	0.142
570	0.365	0.377	0.270	0.243	0.232	0.111	0.040	0.108	0.143
580	0.380	0.390	0.270	0.246	0.235	0.112	0.035	0.110	0.147
590	0.394	0.401	0.270	0.248	0.238	0.105	0.035	0.111	0.151
600	0.400	0.408	0.270	0.248	0.239	0.088	0.035	0.113	0.159
610	0.398	0.406	0.279	0.246	0.239	0.078	0.033	0.114	0.168
620	0.395	0.402	0.269	0.243	0.237	0.078	0.030	0.113	0.171
630	0.397	0.404	0.266	0.239	0.231	0.078	0.030	0.111	0.176
640	0.402	0.410	0.262	0.233	0.228	0.074	0.031	0.109	0.179
650	0.409	0.416	0.261	0.229	0.222	0.082	0.027	0.102	0.180
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	-	-	0.329	-	0.259	-	-	0.172
730	-	-	-	0.343	0.303	0.342	-	-	0.183
740	-	-	0.358	0.350	0.308	0.467	-	-	0.186
750	-	-	0.358	0.350	0.306	0.542	-	-	0.187
760	-	-	0.356	0.348	0.303	0.571	-	-	0.181
770	-	-	0.349	0.339	0.300	0.591	-	-	0.183
780	-	-	0.336	0.327	0.293	0.605	-	-	0.195
790	-	-	0.322	0.311	0.283	0.615	0.242	-	0.228
800	-	-	0.309	0.301	0.273	0.622	0.249	-	0.245
810	-	-	0.306	0.300	0.265	0.628	0.251	-	0.257
820	-	-	0.312	0.307	0.266	0.629	0.255	-	0.263
830	-	-	0.321	0.316	0.272	0.626	0.259	-	0.284
840	-	-	0.333	0.327	0.281	0.625	0.261	-	0.310
850	-	-	0.345	0.338	0.293	-	0.265	-	-
860	-	-	0.355	0.348	0.301	-	0.270	-	-
870	-	-	-	-	-	-	0.278	-	-
880	-	-	-	-	-	-	0.2[illegible]8	-	-
890	-	-	-	-	-	-	0.300	-	-
900	-	-	-	-	-	-	0.301	-	-

λλ	73	74	75	76	77	78	79	80	81
S	P/P	P/P	G/G	G	G	G/G	G/G	G/G	P
N			1/1	1	1	1/1	1/1	1/1	
Sp			1/3	1	1	2/1	2/1	1/1	
400	0.029	0.044	0.030	0.030	0.031	0.026	0.053	0.128	0.034
410	0.030	0.036	0.033	0.033	0.038	0.029	0.061	0.130	0.039
420	0.032	0.049	0.039	0.039	0.042	0.030	0.067	0.131	0.040
430	0.036	0.051	0.040	0.040	0.048	0.034	0.071	0.133	0.041
440	0.039	0.055	0.041	0.041	0.050	0.039	0.075	0.139	0.042
450	0.041	0.059	0.042	0.043	0.051	0.042	0.079	0.145	0.044
460	0.043	0.063	0.043	0.046	0.052	0.043	0.081	0.150	0.046
470	0.047	0.068	0.044	0.049	0.054	0.041	0.086	0.154	0.047
480	0.050	0.071	0.045	0.050	0.056	0.045	0.090	0.161	0.049
490	0.051	0.075	0.045	0.051	0.057	0.050	0.095	0.171	0.050
500	0.055	0.081	0.049	0.053	0.060	0.058	0.102	0.179	0.056
510	0.060	0.089	0.059	0.068	0.077	0.069	0.114	0.189	0.063
520	0.068	0.096	0.075	0.082	0.091	0.075	0.131	0.210	0.075
530	0.075	0.103	0.087	0.095	0.103	0.109	0.158	0.319	0.090
540	0.081	0.109	0.094	0.102	0.111	0.135	0.194	0.369	0.101
550	0.086	0.112	0.098	0.105	0.115	0.151	0.213	0.375	0.108
560	0.087	0.116	0.096	0.101	0.112	0.145	0.204	0.338	0.107
570	0.086	0.118	0.088	0.094	0.105	0.130	0.182	0.349	0.099
580	0.084	0.117	0.081	0.088	0.097	0.121	0.163	0.293	0.092
590	0.083	0.115	0.081	0.086	0.091	0.114	0.155	0.281	0.090
600	0.085	0.113	0.085	0.089	0.095	0.110	0.151	0.270	0.088
610	0.089	0.118	0.085	0.089	0.095	0.103	0.150	0.257	0.088
620	0.093	0.125	0.079	0.083	0.091	0.100	0.150	0.247	0.089
630	0.099	0.132	0.073	0.079	0.088	0.099	0.150	0.239	0.090
640	0.105	0.140	0.069	0.072	0.085	0.098	0.150	0.226	0.089
650	0.112	0.142	0.075	0.080	0.089	0.098	0.151	0.206	0.086
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	0.170	0.210	0.291	-	-	0.283	0.350	-	-
730	0.215	0.232	0.301	-	-	0.328	0.400	0.492	-
740	0.258	0.250	0.306	-	-	0.385	0.453	0.512	-
750	0.277	0.252	0.305	-	-	0.424	0.492	0.540	-
760	0.290	0.272	0.303	-	-	0.444	0.518	0.561	-
770	0.299	0.281	0.309	-	-	0.456	0.538	0.563	-
780	0.305	0.289	0.311	-	-	0.461	0.550	0.572	-
790	0.310	0.293	0.313	-	-	-	-	0.603	-
800	0.311	0.297	0.314	-	-	-	-	0.643	-
810	0.315	0.300	0.315	-	-	-	-	0.681	-
820	0.321	0.303	0.318	-	-	-	-	0.712	-
830	0.331	0.311	0.322	-	-	-	-	0.733	-
840	0.339	0.323	0.329	-	-	-	-	-	-
850	0.370	0.340	0.339	-	-	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	82	83	84	85	86	87	88	89	90
S	G	G	G	G/G	G	G	G	G/G	G/G
N	1	1	1	1/1	2	2	2	1/1	1/1
Sp	2	2	2	/2	4	4	4	1/1	1/1
400	0.064	0.051	0.050	0.030	0.037	0.041	0.050	0.026	0.017
410	0.068	0.058	0.053	0.038	0.037	0.040	0.060	0.029	0.018
420	0.071	0.063	0.057	0.042	0.037	0.042	0.065	0.030	0.019
430	0.073	0.068	0.060	0.048	0.038	0.045	0.071	0.031	0.020
440	0.076	0.070	0.061	0.050	0.039	0.050	0.080	0.033	0.021
450	0.078	0.075	0.066	0.051	0.040	0.052	0.082	0.037	0.025
460	0.080	0.079	0.069	0.052	0.041	0.055	0.082	0.040	0.030
470	0.081	0.082	0.075	0.053	0.042	0.057	0.082	0.043	0.036
480	0.082	0.087	0.079	0.052	0.041	0.058	0.088	0.045	0.039
490	0.084	0.091	0.083	0.052	0.045	0.060	0.097	0.047	0.040
500	0.087	0.095	0.090	0.055	0.050	0.067	0.110	0.049	0.041
510	0.090	0.105	0.097	0.062	0.060	0.080	0.135	0.050	0.044
520	0.100	0.117	0.108	0.075	0.078	0.105	0.173	0.054	0.050
530	0.121	0.144	0.131	0.093	0.100	0.131	0.211	0.081	0.060
540	0.144	0.177	0.157	0.107	0.122	0.159	0.261	0.100	0.071
550	0.167	0.194	0.178	0.112	0.132	0.170	0.280	0.125	0.095
560	0.173	0.196	0.180	0.113	0.130	0.171	0.279	0.142	0.129
570	0.161	0.186	0.171	0.111	0.116	0.160	0.262	0.132	0.154
580	0.149	0.170	0.158	0.110	0.107	0.142	0.243	0.123	0.151
590	0.137	0.151	0.142	0.109	0.101	0.139	0.239	0.126	0.143
600	0.128	0.141	0.135	0.105	0.102	0.140	0.239	0.132	0.132
610	0.124	0.138	0.130	0.101	0.095	0.139	0.241	0.132	0.128
620	0.122	0.134	0.130	0.096	0.089	0.134	0.242	0.127	0.130
630	0.121	0.133	0.130	0.091	0.085	0.130	0.232	0.117	0.131
640	0.122	0.137	0.130	0.087	0.080	0.125	0.220	0.110	0.129
650	0.125	0.143	0.133	0.085	0.075	0.120	0.210	0.105	0.121
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	-	-	-	-	-	-	0.259	-
730	-	-	-	-	-	-	-	0.284	-
740	-	-	-	-	-	-	-	0.351	-
750	-	-	-	0.269	-	-	-	0.412	0.470
760	-	-	-	0.299	-	-	-	0.427	0.481
770	-	-	-	0.322	-	-	-	0.440	0.491
780	-	-	-	0.342	-	-	-	0.450	0.501
790	-	-	-	0.359	-	-	-	0.470	0.520
800	-	-	-	0.377	-	-	-	0.515	0.564
810	-	-	-	0.399	-	-	-	0.610	0.619
820	-	-	-	0.426	-	-	-	0.700	0.660
830	-	-	-	0.481	-	-	-	0.759	0.689
840	-	-	-	0.528	-	-	-	0.788	0.710
850	-	-	-	0.543	-	-	-	0.805	0.725
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	91	92	93	94	95	96	97	98	99
S	G/G	G/G	G G	P/P	G/G	G/G	G/G	G/G	G/G
N	1/1	2/2	1/1		8/3	2/1	2/1	2/1	2/1
Sp	1/1	4/5	2/2		8/3	2/1	2/1	2/1	2/1
400	0.020	0.030	0.050	0.015	0.022	0.020	0.022	0.022	0.022
410	0.022	0. 33	0.058	0.015	0.022	0.020	0.022	0. 22	0.022
420	0.028	0.035	0.074	0.018	0.023	0.020	0.023	0 023	0.023
430	0.031	0. 39	0.081	0.020	0.024	0.020	0.024	0.024	0.024
440	0.038	0.043	0.081	0.022	0. 26	0.022	0.026	0.028	0.028
450	0.043	.047	0.080	0.025	0.027	0.023	0.027	0.030	0.030
460	0.048	.049	0.080	0.027	0.029	0.025	0.029	0.032	0.032
470	0.050	0.050	0.080	0.029	0.028	0.026	0.028	0.034	0.034
480	0.050	0.047	0.083	0.027	0.032	0.028	0.032	0.038	0.038
490	0.050	0.048	0.087	0.026	0.035	0.030	0.035	0.040	0.040
500	0.054	0.054	0.094	0.029	0.040	0.032	0.04	.045	0.045
510	0.063	0.069	0.104	0.035	0.049	0.041	0.0 2	0.060	0.062
520	0.075	0.090	0.120	0.050	0.066	0.059	0.074	0.082	0.092
530	0.094	0.130	0.134	0.072	0.086	0.079	0.101	0.115	0.123
540	0.121	0.160	0.146	0.093	0.102	0.098	0.119	0.128	0.143
550	0.1	0.181	0.139	0.104	0.115	0.111	0.121	0.129	0.151
560	0.1 9	0.181	0.142	0.097	0.110	0.105	0.11	0.123	0.147
570	0.175	0.166	0.138	0.084	0.096	0.092	0.1 5	0.111	0.127
580	0. 65	0.149	0.132	0.073	0.087	0.080	0.092	0.100	0.110
590	0.151	0.132	0.129	0.067	0.078	0.072	.083	0.090	0.095
600	0.143	0.133	0.131	0.061	0.070	0.065	0.077	0.082	0.088
610	0.141	0.133	0.132	0.060	0.065	0.061	0.074	0.077	0.081
620	.146	0.126	0.136	0.159	0.161	0.057	0.069	0.073	0.079
630	0.145	0.123	0.134	0.052	0.056	0.050	0.065	0.070	0.077
640	.137	0.121	0.130	0.047	0.054	0.045	0.064	0.070	0.077
650	0.130	0.121	0.129	0.040	0.057	0.042	0.065	0.070	0.078
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	0.256	-	-	-	-	-	-	-
720	-	0.334	-	-	-	-	-	-	-
730	-	0.459	-	0.172	0.530	0.511	0.522	0.507	0.575
740	-	0.597	0.460	0.205	0.540	0.524	0.535	0.517	0.591
750	0.625	0.648	0.472	0.249	0.551	0.534	0.546	0.525	0.608
760	0.645	0.700	0.480	0.292	0.565	0.545	0.557	0.537	0.622
770	0.662	0.750	0.489	0.322	0.578	0.558	0.568	0.549	0.639
'80	0.677	0.778	0.499	0.342	0.593	0.569	0.580	0.560	0.651
790	0.693	0.787	0.526	.355	0.608	0.580	0.593	0.571	0.669
800	0.716	0.791	0.548	0.368	0.622	0.596	0.610	0.583	0.683
810	0.740	0.802	0.567	0.378	0.638	0.610	0.623	0.599	0.700
82	0.765	0.835	0.610	0.389	0.654	0.625	0.640	0.613	0.715
830	0.789	0.865	0.713	0.399	0.672	0.641	0.658	0.630	0.731
840	0.805	0.888	0.790	0.411	0.690	0.660	0.687	0.648	0.750
85	0.816	0.893	0.833	0.423	0.710	0.677	0.690	0.661	0.764
860	-	-	-	0.437	-	-	-	-	-
870	-	-	-	0.450	-	-	-	-	-
880	-	-	-	0.463	-	-	-	-	-
890	-	-	-	0.477	-	-	-	-	-
900	-	-	-	0.489	-	-	-	-	-

λλ	100	101	102	103	104	105	106	107	108
S	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G
N	2/1	4/1	4/1	5/1	5/1	5/1	3/1	3/1	3/1
Sp	2/1	4/1	4/1	5/1	5/1	5/1	3/1	3/1	3/1
400	0.022	0.020	0.023	0.023	0.029	0.030	0.021	0.028	0.037
410	0.022	0.020	0.023	0.023	0.030	0.031	0.021	0.028	0.037
420	0.023	0.021	0.026	0.026	0.031	0.037	0.022	0.029	0.037
430	0.028	0.023	0.028	0.028	0.033	0.045	0.023	0.030	0.038
440	0.032	0.026	0.031	0.031	0.037	0.043	0.024	0.031	0.039
450	0.035	0.029	0.033	0.033	0.039	0.047	0.025	0.032	0.040
460	0.039	0.030	0.035	0.035	0.040	0.053	0.026	0.034	0.041
470	0.040	0.030	0.035	0.035	0.040	0.058	0.029	0.036	0.042
480	0.039	0.031	0.035	0.035	0.040	0.056	0.030	0.038	0.043
490	0.040	0.033	0.038	0.038	0.042	0.058	0.031	0.039	0.047
500	0.049	0.038	0.042	0.043	0.051	0.068	0.035	0.045	0.052
510	0.070	0.050	0.056	0.065	0.075	0.086	0.041	0.053	0.064
520	0.105	0.078	0.090	0.102	0.120	0.124	0.055	0.070	0.080
530	0.149	0.112	0.119	0.138	0.155	0.172	0.076	0.089	0.101
540	0.182	0.129	0.134	0.154	0.179	0.206	0.090	0.108	0.121
550	0.198	0.133	0.145	0.160	0.190	0.225	0.095	0.118	0.134
560	0.182	0.131	0.142	0.155	0.184	0.224	0.090	0.112	0.131
570	0.161	0.120	0.131	0.142	0.170	0.221	0.081	0.103	0.122
580	0.141	0.107	0.114	0.128	0.150	0.204	0.073	0.096	0.111
590	0.134	0.098	0.103	0.116	0.183	0.185	0.069	0.090	0.103
600	0.133	0.094	0.100	0.109	0.171	0.186	0.063	0.082	0.097
610	0.110	0.091	0.097	0.103	0.111	0.176	0.060	0.079	0.090
620	0.095	0.084	0.094	0.100	0.109	0.161	0.059	0.073	0.087
630	0.100	0.079	0.089	0.096	0.104	0.157	0.057	0.070	0.082
640	0.092	0.073	0.082	0.092	0.095	0.152	0.055	0.068	0.080
650	0.096	0.071	0.077	0.084	0.088	0.150	0.054	0.066	0.079
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	0.728	0.740	0.842	0.851	0.754	0.501	0.519	0.532
730	0.618	0.763	0.780	0.871	0.891	0.797	0.520	0.535	0.550
740	0.720	0.790	0.815	0.902	0.927	0.850	0.530	0.550	0.563
750	0.757	0.795	0.822	0.914	0.933	0.859	0.540	0.561	0.575
760	0.785	0.796	0.824	0.920	0.939	0.865	0.545	0.572	0.583
770	0.809	0.796	0.825	0.924	0.939	0.869	0.548	0.582	0.599
780	0.830	0.800	0.830	0.928	0.943	0.876	0.550	0.591	0.611
790	0.847	0.811	0.839	0.934	-	0.883	0.553	0.603	0.625
800	0.861	0.828	0.852	0.941	-	0.892	0.565	0.619	0.644
810	0.876	0.850	0.867	0.945	-	0.902	0.590	0.641	0.672
820	0.889	0.872	0.887	-	-	0.910	0.620	0.674	0.710
830	0.899	0.890	0.905	-	-	0.921	0.639	0.700	0.739
840	0.926	0.902	0.910	-	-	0.923	0.650	0.723	0.761
850	0.911	0.928	0.939	-	-	0.940	0.658	0.742	0.776
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λ	109	110	111	112	113	114	115	116	117
S	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G
N	3/1	3/1	1/1	1/1	1/1	7/3	3/1	4/1	4/1
Sp	3/1	3/1	1/1	1/1	1/1	7/3	3/1	4/1	4/1
400	0.040	0.050	0.043	0.050	0.050	0.027	0.024	0.024	0.024
410	0.042	0.057	0.044	0.050	0.050	0.032	0.029	0.029	0.029
420	0.045	0.062	0.045	0.050	0.050	0.035	0.030	0.030	0.030
430	0.049	0.069	0.047	0.051	0.051	0.035	0.031	0.031	0.031
440	0.050	0.073	0.049	0.053	0.053	0.045	0.031	0.031	0.031
450	0.053	0.079	0.051	0.057	0.057	0.037	0.032	0.032	0.032
460	0.056	0.081	0.053	0.060	0.060	0.038	0.033	0.033	0.033
470	0.058	0.084	0.057	0.061	0.061	0.041	0.038	0.038	0.038
480	0.060	0.085	0.059	0.062	0.062	0.040	0.036	0.036	0.036
490	0.063	0.089	0.061	0.068	0.068	0.039	0.036	0.036	0.036
500	0.070	0.095	0.069	0.072	0.072	0.041	0.040	0.040	0.040
510	0.088	0.115	0.077	0.074	0.074	0.054	0.051	0.051	0.051
520	0.120	0.152	0.100	0.129	0.115	0.089	0.075	0.075	0.075
530	0.159	0.202	0.150	0.178	0.167	0.116	0.110	0.110	0.110
540	0.180	0.245	0.180	0.203	0.192	0.126	0.123	0.123	0.123
550	0.184	0.251	0.192	0.218	0.210	0.131	0.128	0.128	0.128
560	0.173	0.227	0.181	0.209	0.199	0.121	0.119	0.127	0.119
570	0.159	0.214	0.163	0.181	0.173	0.114	0.106	0.120	0.106
580	0.147	0.211	0.149	0.160	0.155	0.093	0.091	0.104	0.091
590	0.134	0.201	0.127	0.141	0.152	0.084	0.077	0.091	0.089
600	0.126	0.191	0.125	0.146	0.161	0.073	0.071	0.086	0.089
610	0.119	0.184	0.116	0.133	0.146	0.079	0.069	0.080	0.090
620	0.112	0.178	0.104	0.121	0.131	0.077	0.060	0.070	0.090
630	0.107	0.169	0.096	0.110	0.117	0.068	0.056	0.063	0.084
640	0.101	0.161	0.087	0.095	0.105	0.070	0.052	0.059	0.083
650	0.100	0.164	0.072	0.082	0.094	0.067	0.058	0.061	0.075
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	0.580	0.600	0.510	0.539	0.589	-	-	-	-
730	0.620	0.738	0.570	0.630	0.673	0.404	0.440	0.392	0.480
740	0.680	0.870	0.620	0.700	0.742	0.495	0.520	0.485	0.570
750	0.750	0.965	0.660	0.760	0.794	0.558	0.586	0.560	0.628
760	0.791	-	0.690	0.800	0.832	0.592	0.635	0.610	0.705
770	0.820	-	0.715	0.834	0.865	0.616	-	-	-
780	0.842	-	0.735	0.861	0.889	0.635	-	-	-
790	0.868	-	0.752	0.884	0.910	0.651	-	-	-
800	0.880	-	0.771	0.905	0.927	0.664	-	-	-
810	0.900	-	0.789	0.921	0.941	0.676	-	-	-
820	0.919	-	0.805	0.938	0.953	0.686	-	-	-
830	0.935	-	0.820	0.952	0.969	0.694	-	-	-
840	0.949	-	0.833	0.968	0.981	0.700	-	-	-
850	0.951	-	0.846	0.980	0.991	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	118	119	120	121	122	123	124	125	126
S	G/G	G/G	G	G	G	G	G	G	G
N	4/2	4/2	3	3	4	4	4	1	1
Sp	4/2	4/2	3	3	4	4	4	1	1
400	0.027	0.024	0.029	0.030	0.030	0.030	0.033	0.036	0.038
410	0.032	0.029	0.027	0.030	0.030	0.030	0.034	0.038	0.040
420	0.035	0.030	0.026	0.030	0.030	0.030	0.035	0.044	0.044
430	0.035	0.031	0.026	0.031	0.031	0.031	0.038	0.047	0.050
440	0.035	0.031	0.027	0.033	0.033	0.033	0.040	0.045	0.052
450	0.037	0.032	0.030	0.037	0.037	0.037	0.043	0.048	0.058
460	0.038	0.033	0.031	0.037	0.037	0.038	0.047	0.049	0.057
470	0.041	0.038	0.030	0.036	0.036	0.040	0.049	0.050	0.057
480	0.040	0.040	0.029	0.035	0.039	0.042	0.051	0.053	0.057
490	0.039	0.042	0.030	0.036	0.040	0.047	0.057	0.050	0.056
500	0.041	0.050	0.031	0.039	0.044	0.054	0.066	0.054	0.062
510	0.054	0.069	0.037	0.048	0.058	0.068	0.088	0.067	0.076
520	0.089	0.115	0.052	0.064	0.080	0.095	0.115	0.091	0.103
530	0.128	0.161	0.075	0.088	0.109	0.122	0.140	0.125	0.141
540	0.147	0.184	0.095	0.107	0.127	0.140	0.154	0.152	0.165
550	0.150	0.184	0.110	0.118	0.134	0.149	0.163	0.164	0.175
560	0.141	0.164	0.104	0.114	0.131	0.141	0.161	0.157	0.173
570	0.126	0.150	0.098	0.107	0.120	0.131	0.152	0.134	0.157
580	0.112	0.127	0.089	0.100	0.110	0.120	0.142	0.114	0.134
590	0.099	0.112	0.080	0.092	0.100	0.110	0.132	0.100	0.117
600	0.092	0.108	0.071	0.088	0.094	0.101	0.123	0.104	0.118
610	0.089	0.101	0.064	0.083	0.087	0.092	0.114	0.105	0.128
620	0.080	0.095	0.059	0.080	0.080	0.087	0.107	0.094	0.109
630	0.075	0.091	0.058	0.079	0.075	0.083	0.099	0.082	0.098
640	0.072	0.093	0.059	0.078	0.070	0.081	0.094	0.080	0.092
650	0.070	0.080	0.060	0.078	0.067	0.081	0.093	0.080	0.091
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	0.460	0.510	-	-	-	-	-	-	-
730	0.570	0.608	-	-	-	-	-	-	-
740	0.665	0.704	-	-	-	-	-	-	-
750	0.750	0.790	-	-	-	-	-	-	-
760	0.830	0.890	-	-	-	-	-	-	-
770	-	-	-	-	-	-	-	-	-
780	-	-	-	-	-	-	-	-	-
790	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-
810	-	-	-	-	-	-	-	-	-
820	-	-	-	-	-	-	-	-	-
830	-	-	-	-	-	-	-	-	-
840	-	-	-	-	-	-	-	-	-
850	-	-	-	-	-	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	127	128	129	130	131	132	133	134	135
S	G	G	G	G	G	G	G	G	G
N	1	1	1	2	2	2	2	2	1
Sp	1	1	1	2	2	2	2	2	2
400	0.038	0.038	0.038	0.022	0.024	0.028	0.028	0.028	0.024
410	0.040	0.040	0.040	0.022	0.026	0.030	0.030	0.030	0.038
420	0.044	0.044	0.044	0.030	0.032	0.034	0.031	0.034	0.040
430	0.050	0.050	0.050	0.034	0.034	0.042	0.042	0.042	0.044
440	0.052	0.052	0.052	0.040	0.043	0.049	0.049	0.049	0.050
450	0.058	0.058	0.058	0.040	0.042	0.050	0.050	0.050	0.052
460	0.057	0.057	0.057	0.040	0.046	0.050	0.050	0.050	0.056
470	0.057	0.057	0.057	0.044	0.046	0.051	0.051	0.051	0.056
480	0.057	0.057	0.057	0.045	0.048	0.051	0.051	0.051	0.054
490	0.062	0.062	0.062	0.042	0.045	0.051	0.051	0.051	0.058
500	0.068	0.068	0.068	0.046	0.049	0.055	0.055	0.055	0.060
510	0.084	0.084	0.084	0.058	0.066	0.074	0.073	0.073	0.063
520	0.119	0.120	0.120	0.091	0.094	0.111	0.106	0.110	0.067
530	0.155	0.164	0.179	0.121	0.130	0.160	0.156	0.145	0.076
540	0.176	0.197	0.212	0.139	0.156	0.187	0.184	0.170	0.082
550	0.182	0.214	0.229	0.146	0.164	0.196	0.190	0.180	0.084
560	0.178	0.211	0.245	0.140	0.157	0.192	0.185	0.172	0.085
570	0.163	0.175	0.210	0.128	0.141	0.162	0.160	0.152	0.094
580	0.141	0.150	0.170	0.114	0.134	0.133	0.139	0.137	0.096
590	0.126	0.133	0.153	0.100	0.114	0.112	0.122	0.123	0.086
600	0.145	0.131	0.151	0.094	0.114	0.106	0.130	0.129	0.098
610	0.159	0.144	0.150	0.077	0.108	0.092	0.116	0.116	0.102
620	0.142	0.133	0.143	0.090	0.102	0.092	0.104	0.110	0.108
630	0.121	0.126	0.139	0.085	0.088	0.078	0.102	0.101	0.099
640	0.108	0.121	0.138	0.070	0.088	0.062	0.090	0.091	0.093
650	0.108	0.123	0.135	0.060	0.067	0.060	0.076	0.077	0.090
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	-	-	-	-	-	-	-	-
730	-	-	-	-	-	-	-	-	-
740	-	-	-	-	-	-	-	-	-
750	-	-	-	-	-	-	-	-	-
760	-	-	-	-	-	-	-	-	-
770	-	-	-	-	-	-	-	-	-
780	-	-	-	-	-	-	-	-	-
790	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-
810	-	-	-	-	-	-	-	-	-
820	-	-	-	-	-	-	-	-	-
830	-	-	-	-	-	-	-	-	-
840	-	-	-	-	-	-	-	-	-
850	-	-	-	-	-	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	136	137	138	139	140	141	142	143	144
S	G	G	G	G	G	P/P	G	G/G	G/G
N	1	1	1	1	1		1	2/2	1/1
Sp	1	1	2	2	2		3	3/3	3/1
400	0.020	0.026	0.019	0.022	0.037	0.034	0.054	0.019	0.065
410	0.022	0.043	0.023	0.026	0.042	0.033	0.050	0.024	0.083
420	0.029	0.051	0.027	0.030	0.050	0.040	0.050	0.027	0.092
430	0.034	0.063	0.034	0.041	0.062	0.036	0.048	0.029	0.098
440	0.039	0.071	0.034	0.040	0.064	0.042	0.050	0.029	0.104
450	0.042	0.081	0.034	0.044	0.070	0.042	0.047	0.030	0.108
460	0.044	0.091	0.040	0.049	0.073	0.044	0.047	0.028	0.110
470	0.046	0.092	0.040	0.050	0.076	0.048	0.047	0.033	0.113
480	0.045	0.091	0.036	0.047	0.072	0.052	0.046	0.028	0.118
490	0.046	0.081	0.040	0.050	0.076	0.049	0.050	0.030	0.120
500	0.051	0.084	0.044	0.056	0.084	0.056	0.051	-	0.121
510	0.056	0.087	0.050	0.063	0.096	0.059	0.057	-	0.120
520	0.069	0.091	0.062	0.076	0.114	0.067	0.067	-	0.115
530	0.076	0.104	0.076	0.099	0.143	0.076	0.077	-	0.119
540	0.085	0.117	0.089	0.124	0.162	0.078	0.085	-	0.140
550	0.087	0.125	0.094	0.131	0.171	0.082	0.091	-	0.161
560	0.089	0.120	0.095	0.134	0.170	0.082	0.094	-	0.170
570	0.102	0.137	0.092	0.125	0.166	0.083	0.089	-	0.182
580	0.102	0.124	0.087	0.118	0.160	0.082	0.083	-	0.181
590	0.098	0.117	0.082	0.112	0.153	0.085	0.085	-	0.172
600	0.105	0.142	0.080	0.110	0.137	0.084	0.087	-	0.165
610	0.110	0.151	0.078	0.112	0.130	0.092	0.083	-	0.164
620	0.111	0.158	0.084	0.126	0.150	0.093	0.080	-	0.154
630	0.108	0.158	0.081	0.116	0.157	0.098	0.079	-	0.163
640	0.101	0.142	0.079	0.113	0.134	0.099	0.075	-	0.174
650	0.097	0.132	0.074	0.106	0.127	0.105	0.075	-	0.182
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	0.112	-
720	-	-	-	-	-	-	-	0.123	-
730	-	-	-	-	-	0.166	-	0.135	0.312
740	-	-	-	-	-	0.201	-	0.148	0.406
750	-	-	-	-	-	0.236	-	0.161	0.467
760	-	-	-	-	-	0.264	-	0.180	0.494
770	-	-	-	-	-	0.280	-	0.200	0.516
780	-	-	-	-	-	0.288	-	0.220	0.536
790	-	-	-	-	-	0.292	-	0.238	0.561
800	-	-	-	-	-	0.299	-	0.255	0.581
810	-	-	-	-	-	0.307	-	0.267	0.612
820	-	-	-	-	-	0.315	-	0.262	0.615
830	-	-	-	-	-	0.331	-	0.252	0.623
840	-	-	-	-	-	0.350	-	0.249	0.629
850	-	-	-	-	-	0.368	-	0.250	-
860	-	-	-	-	-	0.377	-	-	-
870	-	-	-	-	-	0.387	-	-	-
880	-	-	-	-	-	0.392	-	-	-
890	-	-	-	-	-	0.400	-	-	-
900	-	-	-	-	-	0.402	-	-	-

λλ	145	146	147	148	149	150	151	152	153
S	G/G	P/P	B/B	G/G	G/G	G/G	G	G/G	G/G
N	1/1		1/1	1/1	1/1	1/1	1	1/1	2/2
Sp	3/1		1/1	2/2	2/2	2/2	3	2/2	3/2
400	0.045	0.055	0.060	0.058	0.109	0.210	0.028	0.046	0.053
410	0.046	0.060	0.060	0.056	0.116	0.210	0.022	0.045	0.061
420	0.049	0.062	0.060	0.054	0.119	0.210	0.021	0.044	0.070
430	0.050	0.067	0.060	0.054	0.120	0.212	0.026	0.043	0.079
440	0.052	0.069	0.060	0.054	0.121	0.216	0.026	0.042	0.086
450	0.054	0.070	0.058	0.054	0.122	0.220	0.022	0.042	0.091
460	0.056	0.071	0.057	0.056	0.123	0.223	0.021	0.045	0.098
470	0.057	0.073	0.056	0.058	0.127	0.230	0.026	0.046	0.103
480	0.059	0.077	0.054	0.060	0.129	0.234	0.035	0.046	0.108
490	0.061	0.079	0.053	0.063	0.134	0.240	0.048	0.044	0.112
500	0.065	0.080	0.054	0.067	0.143	0.245	0.051	0.048	0.120
510	0.078	0.082	0.060	0.069	0.151	0.251	0.050	0.052	0.128
520	0.099	0.094	0.096	0.070	0.153	0.259	0.048	0.060	0.135
530	0.134	0.113	0.122	0.071	0.156	0.264	0.047	0.067	0.141
540	0.154	0.122	0.136	0.072	0.157	0.271	0.047	0.070	0.150
550	0.164	0.129	0.142	0.077	0.159	0.279	0.050	0.071	0.158
560	0.157	0.129	0.140	0.079	0.161	0.284	0.053	0.070	0.165
570	0.141	0.117	0.126	0.081	0.166	0.291	0.053	0.070	0.172
580	0.126	0.113	0.105	0.081	0.169	0.299	0.050	0.069	0.180
590	0.114	0.112	0.093	0.081	0.170	0.303	0.047	0.065	0.187
600	0.166	0.113	0.087	0.081	0.172	0.310	0.046	0.064	0.189
610	0.100	0.116	0.082	0.081	0.174	0.317	0.046	0.065	0.189
620	0.090	0.116	0.076	0.081	0.176	0.320	0.046	0.064	0.186
630	0.092	0.112	0.070	0.081	0.179	0.325	0.046	0.063	0.181
640	0.085	0.103	0.064	0.085	0.180	0.328	0.046	0.064	0.175
650	0.100	0.084	0.056	0.091	0.183	0.329	0.046	0.068	0.166
660	-	-	0.052	-	-	-	-	-	-
670	-	-	0.052	-	-	-	-	-	-
680	-	-	0.056	-	-	-	-	-	-
690	-	-	0.070	-	-	-	-	-	-
700	-	-	0.132	-	-	-	-	0.165	-
710	-	-	0.300	-	-	-	-	0.190	-
720	0.385	0.100	0.344	0.188	0.212	0.270	-	0.206	-
730	0.465	0.170	0.400	0.191	0.215	0.258	-	0.217	-
740	0.620	0.250	0.424	0.195	0.218	0.247	-	0.221	-
750	0.740	0.322	0.452	0.198	0.220	0.243	-	0.227	-
760	0.770	0.418	0.464	0.200	0.222	0.248	-	0.229	-
770	0.790	0.520	0.472	0.200	0.227	0.260	-	0.226	0.329
780	0.808	0.590	0.478	0.201	0.234	0.279	-	0.221	0.346
790	0.823	0.649	0.482	0.207	0.249	0.300	-	0.216	0.360
800	0.832	0.670	0.485	0.215	0.270	0.318	-	0.214	0.372
810	0.840	0.681	-	0.224	0.290	0.330	-	0.219	0.410
820	0.845	0.688	-	0.227	0.300	0.340	-	0.221	0.452
830	-	0.689	-	0.227	0.303	0.342	-	0.229	0.481
840	-	0.689	-	-	-	-	-	0.235	-
850	-	0.689	-	-	-	-	-	0.243	-
860	-	-	-	-	-	-	-	0.251	-
870	-	-	-	-	-	-	-	0.258	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	154	155	156	157	158	159	160	161	162
S	P	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G
N		1/1	1/1	1/1	1/1	1/1	1/1	3/4	2 2
Sp		3/2	3/1	3/2	2/2	2/2	2/2	6/5	4/3
400	0.060	0.025	0.022	0.054	0.018	0.024	0.042	0.031	0.046
410	0.064	0.030	0.024	0.062	0.019	0.027	0.046	0.035	0.056
420	0.068	0.034	0.027	0.067	0.022	0.030	0.045	0.036	0.058
430	0.068	0.035	0.028	0.067	0.023	0.031	0.042	0.045	0.059
440	0.078	0.036	0.030	0.064	0.024	0.031	0.045	0.045	0.067
450	0.082	0.040	0.032	0.067	0.024	0.031	0.049	0.044	0.070
460	0.081	0.048	0.037	0.072	0.025	0.032	0.050	0.043	0.067
470	0.086	0.054	0.039	0.067	0.026	0.034	0.052	0.044	0.058
480	0.088	0.057	0.037	0.060	0.028	0.036	0.053	0.043	0.052
490	0.094	0.057	0.037	0.064	0.029	0.036	0.051	0.045	0.050
500	0.098	0.057	0.040	0.071	0.030	0.040	0.050	0.049	0.068
510	0.096	0.062	0.046	0.081	0.032	0.041	0.051	0.054	0.060
520	0.104	0.071	0.058	0.091	0.038	0.047	0.059	0.058	0.077
530	0.119	0.079	0.066	0.091	0.040	0.050	0.065	0.075	0.129
540	0.130	0.084	0.073	0.101	0.041	0.052	0.070	0.083	0.170
550	0.141	0.088	0.075	0.105	0.041	0.055	0.072	0.081	0.221
560	0.150	0.089	0.076	0.108	0.041	0.055	0.073	0.081	0.200
570	0.149	0.089	0.075	0.112	0.042	0.056	0.072	0.083	0.180
580	0.137	0.088	0.074	0.113	0.042	0.055	0.071	0.082	0.179
590	0.131	0.087	0.071	0.111	0.042	0.053	0.070	0.074	0.167
600	0.140	0.086	0.067	0.106	0.042	0.052	0.070	0.071	0.156
610	0.152	0.085	0.065	0.100	0.042	0.052	0.070	0.072	0.146
620	0.160	0.083	0.065	0.096	0.042	0.053	0.070	0.074	0.135
630	0.165	0.085	0.065	0.098	-	-	-	0.070	0.095
640	0.159	0.092	0.068	0.104	-	-	-	0.069	0.078
650	0.131	0.100	0.070	0.108	-	-	-	0.068	0.072
660	-	-	-	-	-	-	-	0.070	-
670	-	-	-	-	-	-	-	0.076	-
680	-	-	-	-	-	-	-	0.090	-
690	-	-	-	-	-	-	-	0.118	-
700	-	-	-	-	-	-	-	0.150	-
710	-	-	-	-	-	-	-	0.218	0.130
720	-	0.168	0.116	0.141	-	-	-	0.320	0.280
730	-	0.182	0.127	0.149	0.240	0.400	0.328	0.360	0.398
740	-	0.211	0.138	0.173	0.270	0.433	0.356	0.371	0.454
750	-	0.238	0.149	0.198	0.291	0.460	0.376	0.380	0.478
760	-	0.252	0.155	0.221	0.311	0.478	0.398	0.385	0.495
770	-	0.262	0.160	0.238	0.331	0.498	0.422	0.390	0.500
780	-	0.261	0.163	0.249	0.344	0.518	0.446	0.391	0.510
790	-	0.262	0.165	0.252	0.362	0.542	0.472	0.392	0.518
800	-	0.264	-	0.254	0.384	0.565	0.502	0.392	0.527
810	-	0.270	-	0.262	0.428	0.597	0.538	0.391	0.530
820	-	0.280	-	0.273	0.462	0.632	0.579	0.391	0.559
830	-	0.290	-	0.285	0.488	-	0.627	0.390	0.566
840	-	-	-	-	0.506	-	0.680	0.390	0.623
850	-	-	-	-	0.522	-	0.722	0.384	-
860	-	-	-	-	-	-	-	0.376	-
870	-	-	-	-	-	-	-	0.364	-
880	-	-	-	-	-	-	-	0.355	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	163	164	165	166	167	168	169	170	171
S	G/G	M	G/G	G/G	P/P	P/P	G/P	G/P	G/P
N	4/1	1	1/1	1/1			3/1	3/1	1/1
Sp	7/2	2	2/1	2/1			5/1	5/2	2/2
400	0.053	0.010	0.048	0.021	0.044	0.050	0.027	0.028	0.011
410	0.057	0.013	0.046	0.014	0.048	0.052	0.027	0.025	0.012
420	0.059	0.014	0.038	0.019	0.058	0.053	0.027	0.021	0.015
430	0.062	0.014	0.046	0.021	0.058	0.057	0.027	0.020	0.019
440	0.063	0.018	0.044	0.025	0.065	0.063	0.027	0.021	0.021
450	0.065	0.020	0.038	0.027	0.071	0.061	0.027	0.022	0.024
460	0.069	0.022	0.038	0.028	0.070	0.063	0.028	0.023	0.027
470	0.073	0.024	0.040	0.032	0.077	0.072	0.030	0.025	0.030
480	0.075	0.026	0.039	0.031	0.085	0.081	0.033	0.028	0.031
490	0.083	0.037	0.040	0.033	0.077	0.080	0.037	0.029	0.037
500	0.083	0.053	0.035	0.036	0.083	0.088	0.040	0.032	0.044
510	0.093	0.078	0.037	0.047	0.085	0.094	0.041	0.036	0.059
520	0.097	0.097	0.042	0.050	0.103	0.100	0.043	0.038	0.080
530	0.101	0.107	0.046	0.063	0.116	0.116	0.048	0.040	0.102
540	0.110	0.114	0.052	0.070	0.120	0.115	0.050	0.043	0.117
550	0.119	0.115	0.052	0.072	0.127	0.119	0.052	0.048	0.115
560	0.120	0.110	0.054	0.070	0.134	0.113	0.055	0.050	0.127
570	0.123	0.096	0.051	0.068	0.125	0.127	0.058	0.049	0.129
580	0.123	0.073	0.046	0.066	0.118	0.136	0.060	0.049	0.120
590	0.127	0.053	0.048	0.062	0.115	0.137	0.061	0.051	0.108
600	0.128	0.045	0.047	0.062	0.122	0.134	0.063	0.056	0.092
610	0.132	0.047	0.054	0.060	0.124	0.129	0.067	0.061	0.080
620	0.132	0.048	0.056	0.061	0.120	0.133	0.069	0.066	0.096
630	0.134	0.040	0.058	0.058	0.118	0.143	0.070	0.067	0.081
640	0.135	0.025	0.058	0.060	0.121	0.147	0.071	0.066	0.057
650	0.136	0.007	0.056	0.060	0.112	0.156	0.074	0.063	0.031
660	-	0.000	-	0.072	-	-	-	-	-
670	-	0.013	-	0.095	-	-	-	-	-
680	-	0.028	-	0.123	-	-	-	-	-
690	-	0.052	-	0.148	-	-	-	-	-
700	0.245	0.088	-	0.152	-	-	-	-	-
710	0.263	0.150	-	0.154	0.168	-	-	-	0.475
720	0.278	0.245	-	0.157	0.245	-	-	-	0.540
730	0.289	0.347	-	0.156	0.278	-	-	-	0.599
740	0.299	0.420	-	0.156	0.291	-	-	-	0.617
750	0.309	0.495	-	0.156	0.300	-	-	-	0.636
760	0.315	0.630	-	0.156	0.307	-	-	-	0.651
770	0.322	0.740	0.691	-	0.310	-	-	0.121	0.664
780	0.330	0.798	0.691	-	0.311	0.244	-	0.129	0.678
790	0.337	-	0.691	-	0.312	0.264	-	0.135	0.686
800	0.342	-	0.691	-	0.313	0.281	-	0.141	0.693
810	0.350	-	0.691	-	0.314	0.300	-	0.150	0.701
820	0.356	-	0.691	-	0.313	0.314	-	0.155	0.709
830	0.362	-	0.691	-	0.313	0.335	-	0.161	0.716
840	0.368	-	0.691	-	-	0.370	0.138	0.167	0.721
850	0.372	-	0.691	-	-	0.397	0.143	0.171	0.729
860	0.376	-	0.691	-	-	0.421	0.150	0.175	0.733
870	0.380	-	0.691	-	-	0.449	0.159	0.179	0.741
880	-	-	-	-	-	0.471	0.169	0.181	0.747
890	-	-	-	-	-	0.487	0.180	0.183	0.750
900	-	-	-	-	-	0.494	0.190	0.189	0.752

λλ	172	173	174	175	176	177	178	179	180
S	G/P	G	G/P	G/P	P	P	P	G/G	G/G
N	1/1	3	3/1	2/1	1	1	1	1/1	1/1
Sp	2/1	6	5/1	4/2	1	1	1	3/2	3/2
400	0.032	0.016	0.020	0.018	0.060	0.115	0.045	0.046	0.047
410	0.039	0.015	0.018	0.020	0.058	0.117	0.057	0.056	0.047
420	0.042	0.016	0.016	0.030	0.059	0.128	0.064	0.072	0.051
430	0.050	0.017	0.014	0.041	0.064	0.137	0.067	0.082	0.050
440	0.055	0.018	0.013	0.055	0.067	0.136	0.069	0.095	0.050
450	0.062	0.019	0.013	0.070	0.066	0.121	0.070	0.096	0.055
460	0.070	0.020	0.014	0.080	0.072	0.118	0.068	0.096	0.053
470	0.079	0.021	0.016	0.086	0.079	0.125	0.065	0.098	0.053
480	0.089	0.022	0.018	0.085	0.076	0.142	0.070	0.101	0.055
490	0.101	0.025	0.019	0.082	0.076	0.157	0.072	0.100	0.057
500	0.116	0.027	0.020	0.078	0.082	0.170	0.078	0.104	0.060
510	0.132	0.032	0.025	0.076	0.092	0.192	0.089	0.110	0.062
520	0.151	0.039	0.029	0.082	0.104	0.230	0.112	0.129	0.068
530	0.176	0.042	0.031	0.090	0.116	0.278	0.135	0.154	0.096
540	0.195	0.048	0.033	0.092	0.120	0.296	0.151	0.163	0.099
550	0.214	0.051	0.035	0.093	0.120	0.308	0.156	0.170	0.108
560	0.224	0.054	0.037	0.092	0.119	0.311	0.127	0.144	0.109
570	0.230	0.055	0.039	0.090	0.117	0.313	0.116	0.136	0.101
580	0.230	0.051	0.040	0.087	0.115	0.315	0.120	0.118	0.090
590	0.222	0.050	0.041	0.085	0.113	0.330	0.132	0.114	0.082
600	0.200	0.050	0.043	0.085	0.110	0.351	0.139	0.109	0.070
610	0.182	0.050	0.046	0.087	0.114	0.386	0.140	0.109	0.079
620	0.198	0.050	0.049	0.090	0.118	0.412	0.142	0.105	0.072
630	0.201	0.049	0.052	0.090	0.113	0.350	0.140	0.102	0.075
640	0.182	0.045	0.054	0.090	0.106	0.304	0.137	0.104	0.060
650	0.163	0.040	0.056	0.091	0.100	0.292	0.136	0.105	0.045
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	0.204	-	-	-	-	-	-	-	-
700	0.330	-	-	-	-	-	-	0.077	0.093
710	0.425	-	-	-	-	-	-	0.164	0.132
720	0.495	-	-	-	-	-	-	0.258	0.175
730	0.537	-	-	-	-	-	-	0.438	0.246
740	0.560	-	-	-	-	-	-	0.562	0.336
750	0.574	-	-	-	-	-	-	0.629	0.382
760	0.585	-	-	-	-	-	-	0.657	0.404
770	0.592	-	-	-	-	-	-	0.666	0.412
780	0.596	-	-	-	-	-	-	0.669	0.417
790	-	-	-	-	-	-	-	0.669	0.422
800	-	-	-	-	-	-	-	0.666	0.428
810	-	-	-	-	-	-	-	0.659	0.434
820	-	-	0.211	0.323	-	-	-	0.650	0.440
830	-	-	0.233	0.325	-	-	-	0.638	0.442
840	-	-	0.251	0.323	-	-	-	0.623	0.434
850	-	-	0.271	0.322	-	-	-	0.611	0.400
860	-	-	0.288	0.320	-	-	-	-	-
870	-	-	0.300	0.315	-	-	-	-	-
880	-	-	0.310	0.310	-	-	-	-	-
890	-	-	0.320	0.305	-	-	-	-	-
900	-	-	0.329	0.300	-	-	-	-	-

λ	181	182	183	184	185	186	187	188	189
S	P	P	G	G	G/P	G/G	G/G	G/G	G/G
N	1	1	1		3/2	1/1	1/1	1/1	1/1
Sp	1	1	3		6/3	2/2	2/2	2/2	2/2
400	0.050	0.078	0.059	0.032	0.044	0.026	0.051	0.067	0.021
410	0.060	0.078	0.056	0.032	0.042	0.031	0.050	0.072	0.022
420	0.068	0.079	0.055	0.034	0.040	0.035	0.055	0.082	0.026
430	0.088	0.084	0.062	0.034	0.039	0.040	0.064	0.093	0.030
440	0.091	0.089	0.069	0.034	0.041	0.046	0.071	0.100	0.032
450	0.088	0.084	0.069	0.042	0.044	0.051	0.074	0.106	0.034
460	0.078	0.079	0.068	0.044	0.045	0.050	0.075	0.109	0.034
470	0.065	0.070	0.066	0.038	0.042	0.048	0.074	0.108	0.032
480	0.054	0.059	0.062	0.037	0.036	0.047	0.073	0.105	0.029
490	0.050	0.056	0.062	0.036	0.035	0.049	0.071	0.100	0.027
500	0.048	0.054	0.066	0.042	0.041	0.056	0.074	0.101	0.030
510	0.060	0.065	0.090	0.051	0.058	0.070	0.100	0.121	0.040
520	0.074	0.078	0.131	0.068	0.077	0.083	0.120	0.145	0.051
530	0.105	0.105	0.141	0.080	0.097	0.094	0.141	0.171	0.064
540	0.148	0.132	0.151	0.085	0.111	0.099	0.152	0.192	0.076
550	0.170	0.135	0.152	0.089	0.113	0.104	0.160	0.207	0.086
560	0.180	0.139	0.142	0.086	0.102	0.108	0.156	0.206	0.085
570	0.175	0.146	0.127	0.078	0.088	0.096	0.147	0.190	0.073
580	0.162	0.159	0.109	0.078	0.073	0.081	0.135	0.172	0.064
590	0.150	0.157	0.103	0.077	0.062	0.081	0.123	0.161	0.061
600	0.137	0.155	0.099	0.080	0.061	0.086	0.119	0.158	0.067
610	0.130	0.160	0.083	0.082	0.059	0.081	0.118	0.153	0.067
620	0.144	0.167	0.082	0.078	0.051	0.073	0.118	0.152	0.060
630	0.130	0.162	0.084	0.074	0.046	0.074	0.113	0.150	0.054
640	0.118	0.156	0.069	0.075	0.040	0.070	0.106	0.141	0.051
650	0.110	0.152	0.063	0.076	0.032	0.063	0.095	0.121	0.049
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	0.152	-	-	-	-
710	-	-	-	-	0.455	0.112	0.195	0.254	0.100
720	-	-	-	-	0.620	0.215	0.300	0.470	0.151
730	-	-	-	-	0.690	0.318	0.425	0.614	0.194
740	-	-	-	-	0.738	0.410	0.560	0.700	0.220
750	-	-	-	-	0.770	0.467	0.646	0.777	0.240
760	-	-	-	-	0.794	0.487	0.688	0.807	0.252
770	-	-	-	-	0.812	0.500	0.720	0.821	0.262
780	-	-	-	-	0.824	0.510	0.748	0.830	0.269
790	-	-	-	-	0.831	0.521	0.765	0.837	0.272
800	-	-	-	-	0.835	0.530	0.780	0.840	0.274
810	-	-	-	-	0.839	0.540	0.790	0.841	0.276
820	-	-	-	-	0.842	0.549	0.795	0.843	-
830	-	-	-	-	0.847	0.558	0.800	0.845	-
840	-	-	-	-	0.851	0.565	0.803	0.848	-
850	-	-	-	-	0.857	0.573	0.809	0.850	-
860	-	-	-	-	0.862	0.581	0.811	0.851	-
870	-	-	-	-	0.869	0.589	0.815	0.853	-
880	-	-	-	-	0.872	0.597	0.819	0.855	-
890	-	-	-	-	0.877	-	-	-	-
900	-	-	-	-	0.880	-	-	-	-

	190	191	192	193	194	195	196	197	198
S	G/G	G	G/G	G/G	G/G	G	G/G	G/G	G/G
N	1/1	1	1/1	1/1	1/1	1	1/1	1/1	1/1
Sp	2/1	2	3/2	3/2	3/1	3	3/1	1/1	1/1
400	0.025	0.039	0.056	0.043	0.035	0.050	0.022	0.020	0.025
410	0.031	0.041	0.054	0.043	0.037	0.056	0.028	0.020	0.026
420	0.034	0.049	0.052	0.046	0.039	0.061	0.030	0.020	0.029
430	0.039	0.056	0.051	0.051	0.040	0.068	0.030	0.020	0.031
440	0.041	0.059	0.052	0.052	0.040	0.072	0.030	0.020	0.036
450	0.045	0.062	0.053	0.053	0.041	0.076	0.030	0.020	0.040
460	0.045	0.064	0.053	0.054	0.044	0.079	0.030	0.022	0.042
470	0.045	0.064	0.056	0.057	0.046	0.081	0.030	0.025	0.043
480	0.041	0.061	0.059	0.059	0.048	0.082	0.030	0.024	0.041
490	0.040	0.059	0.061	0.061	0.050	0.094	0.031	0.023	0.044
500	0.044	0.054	0.063	0.068	0.052	0.100	0.037	0.026	0.046
510	0.051	0.064	0.067	0.078	0.055	0.103	0.044	0.029	0.049
520	0.065	0.082	0.078	0.088	0.058	0.109	0.051	0.050	0.060
530	0.090	0.101	0.094	0.097	0.059	0.119	0.060	0.075	0.082
540	0.114	0.118	0.102	0.100	0.061	0.133	0.063	0.083	0.078
550	0.141	0.134	0.110	0.101	0.063	0.147	0.062	0.087	0.094
560	0.152	0.141	0.099	0.103	0.066	0.151	0.059	0.078	0.097
570	0.132	0.128	0.088	0.103	0.069	0.157	0.052	0.060	0.087
580	0.107	0.112	0.081	0.103	0.070	0.158	0.048	0.049	0.072
590	0.090	0.103	0.078	0.104	0.071	0.159	0.043	0.038	0.056
600	0.093	0.108	0.076	0.105	0.071	0.161	0.040	0.030	0.055
610	0.092	0.107	0.076	0.106	0.072	0.167	0.039	0.042	0.061
620	0.082	0.094	0.076	0.106	0.073	0.173	0.038	0.058	0.067
630	0.081	0.090	0.076	0.107	0.075	0.183	0.036	0.054	0.065
640	0.080	0.089	0.076	0.109	0.076	0.195	0.036	0.041	0.052
650	0.072	0.081	0.076	0.111	0.077	0.210	0.036	0.034	0.042
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.180	-	0.102	-	-	-	-	-	-
710	0.207	-	0.138	-	-	-	-	-	-
720	0.241	-	0.215	0.239	-	-	0.339	0.213	0.227
730	0.271	-	0.328	0.258	-	-	0.344	0.259	0.244
740	0.295	-	0.415	0.272	-	-	0.343	0.291	0.267
750	0.313	-	0.450	0.286	-	-	0.344	0.322	0.291
760	0.329	-	0.493	0.301	0.183	-	0.355	0.360	0.314
770	0.340	-	0.512	0.316	0.189	-	0.377	0.400	0.341
780	-	-	0.528	0.330	0.191	-	0.387	0.432	0.365
790	-	-	0.538	0.345	0.192	-	0.384	0.458	0.392
800	-	-	0.533	0.361	0.192	-	0.386	0.480	0.417
810	-	-	0.511	0.379	0.192	-	0.361	0.500	0.441
820	-	-	0.487	0.400	0.192	-	0.345	0.513	0.469
830	-	-	0.468	0.426	0.191	-	0.332	0.520	0.492
840	-	-	0.453	0.448	0.190	-	0.328	0.521	0.504
850	-	-	0.445	0.460	0.190	-	0.323	0.522	0.510
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λ	199	200	201	202	203	204	205	206	207
S	G/G	G/G	G	G	G	G	G	G	G/G
N	1/2	1/1	1	1	1	1	1	1	2/2
Sp	1/5	1/1	2	2	2	2	2	1	4/4
400	0.025	0.025	0.031	0.070	0.090	0.030	0.060	0.101	0.019
410	0.026	0.026	0.040	0.088	0.111	0.033	0.081	0.125	0.020
420	0.029	0.029	0.041	0.101	0.127	0.039	0.100	0.143	0.023
430	0.031	0.031	0.044	0.108	0.137	0.048	0.119	0.159	0.027
440	0.036	0.036	0.049	0.105	0.132	0.057	0.130	0.170	0.030
450	0.040	0.040	0.051	1.103	0.128	0.061	0.132	0.174	0.032
460	0.042	0.042	0.052	0.108	0.136	0.061	0.132	0.175	0.033
470	0.043	0.043	0.052	0.111	0.149	0.062	0.134	0.175	0.033
480	0.041	0.041	0.051	0.121	0.162	0.064	0.139	0.178	0.033
490	0.044	0.044	0.049	0.131	0.182	0.069	0.142	0.181	0.034
500	0.046	0.046	0.046	0.150	0.203	0.074	0.149	0.190	0.038
510	0.049	0.050	0.046	0.188	0.238	0.083	0.164	0.216	0.040
520	0.060	0.071	0.060	0.232	0.279	0.092	0.200	0.257	0.050
530	0.072	0.112	0.081	0.267	0.337	0.104	0.262	0.335	0.069
540	0.078	0.158	0.100	0.300	0.386	0.114	0.313	0.420	0.086
550	0.074	0.165	0.119	0.331	0.450	0.123	0.352	0.474	0.099
560	0.067	0.150	0.120	0.345	0.508	0.127	0.374	0.493	0.103
570	0.057	0.179	0.111	0.337	0.509	0.126	0.372	0.489	0.091
580	0.051	0.114	0.097	0.282	0.375	0.123	0.335	0.460	0.072
590	0.045	0.104	0.096	0.293	0.380	0.120	0.310	0.410	0.062
600	0.044	0.091	0.091	0.295	0.417	0.117	0.289	0.384	0.059
610	0.054	0.078	0.080	0.278	0.390	0.112	0.286	0.363	0.056
620	0.061	0.078	0.071	0.225	0.302	0.110	0.275	0.348	0.052
630	0.060	0.076	0.066	0.201	0.236	0.109	0.264	0.339	0.050
640	0.055	0.070	0.064	0.186	0.199	0.110	0.259	0.330	0.042
650	0.051	0.067	0.070	0.218	0.235	0.111	0.256	0.320	0.033
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	0.290	0.413	-	-	-	-	-	-	-
730	0.325	0.454	-	-	-	-	-	-	0.187
740	0.361	0.488	-	-	-	-	-	-	0.232
750	0.393	0.515	-	-	-	-	-	-	0.265
760	0.425	0.545	-	-	-	-	-	-	0.290
770	0.452	0.570	-	-	-	-	-	-	0.315
780	0.479	0.591	-	-	-	-	-	-	0.324
790	0.500	0.617	-	-	-	-	-	-	0.351
800	0.520	0.638	-	-	-	-	-	-	0.363
810	0.535	0.657	-	-	-	-	-	-	0.380
820	0.545	0.675	-	-	-	-	-	-	0.410
830	0.575	0.690	-	-	-	-	-	-	0.448
840	0.564	0.700	-	-	-	-	-	-	0.478
850	0.569	0.705	-	-	-	-	-	-	0.498
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λ	208	209	210	211	212	213	214	215	216
S	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G	G
N	2/2	1/2	3/2	3/2	1/2	1/1	2/2	1	1
Sp	4/3	1/3	6/4	6/4	2/4	2/2	5/5	3	2
400	0.025	0.092	0.021	0.025	0.028	0.041	0.072	0.027	0.032
410	0.031	0.104	0.025	0.036	0.040	0.051	0.083	0.029	0.034
420	0.036	0.113	0.029	0.043	0.049	0.061	0.091	0.030	0.040
430	0.041	0.122	0.033	0.050	0.053	0.069	0.099	0.036	0.047
440	0.045	0.128	0.039	0.051	0.058	0.072	0.108	0.039	0.052
450	0.049	0.133	0.041	0.052	0.059	0.077	0.113	0.040	0.061
460	0.050	0.141	0.042	0.052	0.059	0.079	0.120	0.040	0.069
470	0.051	0.145	0.043	0.051	0.060	0.080	0.121	0.040	0.071
480	0.051	0.140	0.044	0.050	0.061	0.081	0.120	0.041	0.072
490	0.053	0.138	0.043	0.050	0.063	0.083	0.121	0.044	0.075
500	0.058	0.139	0.043	0.050	0.069	0.089	0.131	0.050	0.079
510	0.069	0.149	0.050	0.055	0.084	0.105	0.143	0.060	0.085
520	0.094	0.181	0.060	0.068	0.110	0.131	0.151	0.074	0.093
530	0.126	0.222	0.079	0.085	0.146	0.162	0.177	0.090	0.110
540	0.159	0.271	0.093	0.104	0.164	0.179	0.191	0.101	0.129
550	0.174	0.325	0.112	0.124	0.161	0.183	0.214	0.108	0.157
560	0.167	0.378	0.121	0.132	0.150	0.174	0.216	0.107	0.169
570	0.147	0.385	0.118	0.137	0.141	0.161	0.198	0.094	0.158
580	0.124	0.311	0.100	0.118	0.138	0.155	0.180	0.082	0.140
590	0.111	0.291	0.083	0.101	0.133	0.154	0.160	0.078	0.120
600	0.102	0.258	0.080	0.091	0.132	0.154	0.164	0.077	0.105
610	0.099	0.244	0.071	0.083	0.131	0.152	0.170	0.076	0.108
620	0.092	0.218	0.067	0.078	0.130	0.150	0.169	0.075	0.107
630	0.088	0.182	0.063	0.072	0.129	0.144	0.165	0.073	0.100
640	0.080	0.169	0.060	0.069	0.127	0.140	0.160	0.071	0.092
650	0.071	0.154	0.059	0.063	0.123	0.132	0.153	0.070	0.085
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	0.140	-	-	-	-
710	-	-	-	-	0.220	-	-	-	-
720	-	-	0.239	-	0.385	0.415	0.400	-	-
730	0.425	0.490	0.383	-	0.455	0.530	0.493	-	-
740	0.472	0.530	0.433	0.490	0.530	0.591	0.555	-	-
750	0.512	0.580	0.460	0.510	0.580	0.636	0.600	-	-
760	0.550	0.614	0.480	0.530	0.614	0.664	0.630	-	-
770	0.582	0.651	0.501	0.550	0.670	0.698	0.658	-	-
780	0.610	0.681	0.529	0.571	0.695	0.719	0.678	-	-
790	0.631	0.713	0.565	0.601	0.719	0.740	0.697	-	-
800	0.650	0.748	0.604	0.631	0.738	0.759	0.713	-	-
810	0.675	0.771	0.634	0.656	0.760	0.775	0.732	-	-
820	0.695	0.796	0.660	0.680	0.773	0.790	0.753	-	-
830	0.711	0.818	0.680	0.698	0.790	-	0.771	-	-
840	0.730	0.832	0.698	0.714	0.802	-	0.780	-	-
850	0.745	0.847	0.715	0.731	0.815	-	0.791	-	-
860	-	-	0.730	0.743	0.827	-	-	-	-
870	-	-	0.741	0.753	0.832	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	217	218	219	220	221	222	223	224	225
S	G/G	G/G	G/G	G/G	G/G	G	G	G/G	G/G
N	1/1	1/1	1/1	1/1	1/3	1	1	1/1	1/1
Sp	1/2	1/2	1/2	1/1	3/5	3	3	2/2	2/2
400	0.052	0.044	0.041	0.037	0.058	0.039	0.027	0.028	0.040
410	0.063	0.063	0.048	0.044	0.064	0.041	0.027	0.038	0.044
420	0.075	0.076	0.062	0.050	0.069	0.047	0.028	0.038	0.049
430	0.084	0.082	0.074	0.049	0.070	0.051	0.030	0.038	0.050
440	0.094	0.095	0.084	0.048	0.071	0.054	0.029	0.038	0.052
450	0.107	0.112	0.101	0.050	0.072	0.058	0.032	0.038	0.054
460	0.121	0.125	0.123	0.052	0.073	0.059	0.034	0.042	0.058
470	0.134	0.138	0.130	0.055	0.074	0.060	0.034	0.047	0.060
480	0.149	0.150	0.140	0.066	0.077	0.061	0.035	0.046	0.062
490	0.161	0.163	0.154	0.071	0.079	0.065	0.035	0.044	0.071
500	0.173	0.173	0.167	0.072	0.081	0.070	0.037	0.047	0.084
510	0.183	0.180	0.180	0.073	0.087	0.081	0.046	0.067	0.113
520	0.195	0.187	0.193	0.075	0.094	0.103	0.072	0.094	0.150
530	0.206	0.193	0.207	0.079	0.112	0.118	0.099	0.117	0.175
540	0.215	0.200	0.219	0.080	0.133	0.108	0.110	0.131	0.187
550	0.220	0.208	0.227	0.080	0.141	0.098	0.113	0.132	0.187
560	0.223	0.217	0.233	0.085	0.137	0.095	0.103	0.137	0.182
570	0.222	0.225	0.242	0.089	0.126	0.091	0.094	0.130	0.171
580	0.220	0.234	0.248	0.085	0.115	0.083	0.081	0.120	0.159
590	0.218	0.243	0.253	0.083	0.103	0.070	0.067	0.110	0.152
600	0.217	0.251	0.258	0.082	0.106	0.052	0.065	0.118	0.150
610	0.216	0.258	0.261	0.081	0.102	0.051	0.057	0.122	0.148
620	0.215	0.265	0.266	0.085	0.090	0.045	0.052	0.117	0.141
630	0.215	0.272	0.272	0.090	0.084	0.035	0.043	0.110	0.132
640	0.215	0.277	0.269	0.094	0.076	0.032	0.042	0.100	0.121
650	0.215	0.282	0.272	0.096	0.078	0.031	0.040	0.095	0.111
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	0.339	-	-	-	-
710	-	-	-	-	0.392	-	-	0.281	-
720	0.312	0.286	0.250	0.311	0.450	-	-	0.394	0.330
730	0.338	0.312	0.267	0.312	0.493	-	-	0.456	0.458
740	0.373	0.344	0.291	0.312	0.534	-	-	0.495	0.590
750	0.394	0.360	0.324	0.314	0.550	-	-	0.525	0.675
760	0.410	0.378	0.345	0.315	0.570	-	-	0.552	0.720
770	0.422	0.398	0.347	0.310	0.584	-	-	0.571	0.742
780	0.441	0.418	0.358	0.301	0.596	-	-	0.586	0.752
790	0.463	0.440	0.360	0.296	0.610	-	-	0.598	0.750
800	0.495	0.475	0.397	0.300	0.621	-	-	0.607	0.738
810	0.525	0.506	0.423	0.307	0.635	-	-	0.615	0.713
820	0.550	0.535	0.459	0.319	0.646	-	-	0.623	0.692
830	0.574	0.556	0.527	0.331	0.652	-	-	0.631	0.684
840	-	-	-	0.337	0.659	-	-	0.638	0.680
850	-	-	-	0.330	0.663	-	-	0.642	0.679
860	-	-	-	-	0.666	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	226	227	228	229	230	231	232	233	234
S	G/G	G	G/G	G/G	P	P/P	P	P	G
N	1/1	1	1/1	1/1					3
Sp	2/2	1	1/1	1/1					4
400	0.044	0.071	-	0.055	0.190	0.148	0.164	0.059	0.355
410	0.050	0.081	-	0.061	0.218	0.151	0.171	0.059	0.378
420	0.052	0.091	0.017	0.064	0.239	0.155	0.180	0.059	0.418
430	0.056	0.108	0.029	0.064	0.251	0.160	0.188	0.060	0.464
440	0.059	0.122	0.031	0.069	0.262	0.164	0.195	0.060	0.499
450	0.061	0.140	0.033	0.073	0.271	0.169	0.201	0.061	0.528
460	0.063	0.155	0.032	0.070	0.280	0.171	0.208	0.062	0.549
470	0.065	0.170	0.031	0.067	0.288	0.177	0.212	0.064	0.567
480	0.062	0.185	0.030	0.064	0.293	0.181	0.217	0.068	0.582
490	0.065	0.200	-	0.060	0.301	0.186	0.219	0.071	0.599
500	0.075	0.212	-	-	0.309	0.190	0.220	0.072	0.610
510	0.091	0.228	-	-	0.318	0.194	0.220	0.078	0.623
520	0.117	0.238	-	-	0.325	0.200	0.220	0.081	0.633
530	0.144	0.249	-	-	0.334	0.207	0.220	0.085	0.642
540	0.163	0.257	-	-	0.342	0.215	0.220	0.088	0.651
550	0.171	0.265	-	-	0.352	0.223	0.219	0.090	0.661
560	0.169	0.272	-	-	0.361	0.231	0.219	0.091	0.669
570	0.161	0.280	-	-	0.371	0.238	0.219	0.092	0.675
580	0.153	0.284	-	-	0.379	0.241	0.219	0.092	0.681
590	0.151	0.289	-	-	0.389	0.244	0.220	0.091	0.690
600	0.153	0.290	-	-	0.398	0.246	0.227	0.090	0.700
610	0.151	0.290	-	-	0.407	0.248	0.234	0.090	0.710
620	0.149	0.290	-	-	0.416	0.249	0.235	0.089	0.721
630	0.142	0.290	-	-	0.422	0.249	0.235	0.084	0.732
640	0.135	0.290	-	-	0.428	0.250	0.235	0.080	0.743
650	0.131	0.290	-	-	0.430	0.250	0.234	0.074	0.757
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	0.291	-	-	-
710	-	-	0.159	0.110	-	0.311	-	-	-
720	0.450	-	0.161	0.124	-	0.322	-	-	-
730	0.575	-	0.167	0.145	-	0.334	-	-	-
740	0.685	-	0.171	0.169	-	0.343	-	-	-
750	0.729	-	0.181	0.195	-	0.351	-	-	-
760	0.751	-	0.187	0.231	-	0.359	-	-	-
770	0.766	-	0.199	0.272	-	0.366	-	-	-
780	0.771	-	0.210	0.319	-	0.373	-	-	-
790	0.769	-	0.224	0.368	-	0.382	-	-	-
800	0.758	-	0.235	0.442	-	0.392	-	-	-
810	0.736	-	0.244	0.535	-	0.405	-	-	-
820	0.710	-	0.251	0.591	-	0.418	-	-	-
830	0.698	-	0.257	0.613	-	0.430	-	-	-
840	0.691	-	0.260	0.626	-	0.440	-	-	-
850	0.690	-	0.261	0.633	-	0.449	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

	235	236	237	238	239	240	241	242	243
S	G/G	G	M/B	G	G/P	P/P	G/G	M/P	P
N	1/3	3	1/2	2	2/1		3/1	1/2	
Sp	2/4	4	1/3	2	6/2		10/1	1/3	
400	0.080	0.223	0.200	0.124	0.045	0.103	0.102	0.119	0.079
410	0.088	0.249	0.200	0.129	0.046	0.105	0.122	0.121	0.080
420	0.095	0.269	0.193	0.136	0.047	0.107	0.135	0.125	0.081
430	0.102	0.290	0.190	0.141	0.048	0.110	0.144	0.137	0.082
440	0.108	0.308	0.193	0.147	0.049	0.111	0.148	0.154	0.083
450	0.113	0.325	0.200	0.152	0.050	0.114	0.149	0.170	0.087
460	0.118	0.342	0.210	0.159	0.051	0.118	0.156	0.180	0.088
470	0.122	0.360	0.220	0.163	0.054	0.122	0.165	0.184	0.090
480	0.130	0.375	0.224	0.170	0.057	0.127	0.169	0.187	0.091
490	0.137	0.391	0.220	0.175	0.060	0.130	0.169	0.191	0.094
500	0.145	0.410	0.210	0.180	0.063	0.132	0.172	0.196	0.098
510	0.153	0.433	0.185	0.188	0.067	0.137	0.181	0.208	0.102
520	0.162	0.457	0.174	0.193	0.070	0.140	0.194	0.220	0.109
530	0.171	0.480	0.170	0.200	0.073	0.141	0.209	0.233	0.118
540	0.179	0.500	0.174	0.210	0.077	0.143	0.218	0.246	0.130
550	0.187	0.525	0.180	0.221	0.079	0.145	0.230	0.260	0.139
560	0.191	0.541	0.188	0.234	0.079	0.147	0.241	0.275	0.142
570	0.197	0.559	0.190	0.254	0.074	0.149	0.255	0.290	0.145
580	0.202	0.571	0.188	0.270	0.073	0.151	0.267	0.299	0.146
590	0.210	0.585	0.190	0.288	0.074	0.155	0.277	0.304	0.148
600	0.220	0.597	0.193	0.301	0.077	0.160	0.287	0.309	0.150
610	0.230	0.607	0.198	0.312	0.079	0.164	0.302	0.312	0.151
620	0.240	0.615	0.198	0.320	0.082	0.170	0.314	0.313	0.160
630	0.252	0.624	0.210	0.327	0.085	0.176	0.322	0.312	0.166
640	0.260	0.631	0.225	0.331	0.086	0.179	0.330	0.311	0.160
650	0.280	0.639	0.250	0.332	0.086	0.181	0.337	0.305	0.150
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.360	-	-	-	-	-	-	-	-
710	0.371	-	-	-	-	-	-	-	-
720	0.380	-	-	-	-	0.270	-	-	-
730	0.388	-	-	-	-	0.283	-	-	-
740	0.394	-	-	-	-	0.285	-	-	-
750	0.400	-	0.510	-	-	0.286	0.333	0.299	-
760	0.406	-	0.528	-	-	0.281	0.335	0.300	-
770	0.411	-	0.534	-	-	0.284	0.337	0.301	-
780	0.418	-	0.538	-	-	0.308	0.335	0.303	-
790	0.424	-	0.539	-	-	0.330	0.331	0.308	-
800	0.434	-	0.539	-	-	0.348	0.326	0.310	-
810	0.450	-	0.538	-	-	0.359	0.319	0.314	-
820	0.471	-	0.538	-	-	0.362	0.311	0.320	-
830	0.503	-	0.539	-	-	0.390	0.310	0.320	-
840	0.535	-	0.540	-	0.173	0.410	0.312	0.319	-
850	0.563	-	0.544	-	0.182	-	0.316	0.308	-
860	0.590	-	-	-	0.184	-	0.320	-	-
870	0.608	-	-	-	0.180	-	-	-	-
880	-	-	-	-	0.171	-	-	-	-
890	-	-	-	-	0.164	-	-	-	-
900	-	-	-	-	0.175	-	-	-	-

	244	245	246	247	248	249	250	251	252
S	G	G	P/P	M	G/G	G/G	G/G	G/G	G/G
N				1	2/2	1/1	2/1	2/1	1/1
Sp				1	4/3	1/1	2/1	2/1	1/2
400	0.152	0.051	0.078	0.179	0.156	0.168	0.161	0.155	0.110
410	0.154	0.057	0.079	0.184	0.156	0.182	0.174	0.169	0.113
420	0.156	0.060	0.080	0.189	0.156	0.197	0.189	0.181	0.119
430	0.159	0.061	0.080	0.195	0.157	0.211	0.202	0.195	0.122
440	0.161	0.063	0.081	0.202	0.159	0.225	0.215	0.208	0.129
450	0.166	0.064	0.084	0.208	0.162	0.237	0.229	0.220	0.133
460	0.170	0.066	0.088	0.214	0.167	0.247	0.239	0.230	0.141
470	0.170	0.068	0.089	0.219	0.175	0.251	0.244	0.237	0.149
480	0.170	0.068	0.090	0.224	0.184	0.256	0.250	0.241	0.155
490	0.171	0.066	0.091	0.231	0.196	0.264	0.257	0.250	0.163
500	0.178	0.065	0.093	0.238	0.211	0.279	0.270	0.260	0.172
510	0.188	0.065	0.097	0.247	0.228	0.300	0.287	0.276	0.183
520	0.197	0.068	0.101	0.256	0.240	0.321	0.308	0.293	0.193
530	0.203	0.070	0.104	0.265	0.250	0.339	0.324	0.312	0.203
540	0.205	0.071	0.110	0.273	0.256	0.354	0.340	0.328	0.211
550	0.207	0.073	0.113	0.282	0.260	0.369	0.353	0.341	0.220
560	0.209	0.076	0.117	0.289	0.261	0.379	0.365	0.352	0.225
570	0.213	0.078	0.120	0.295	0.260	0.389	0.375	0.363	0.232
580	0.218	0.080	0.121	0.301	0.259	0.400	0.384	0.373	0.238
590	0.222	0.081	0.120	0.307	0.258	0.407	0.393	0.381	0.241
600	0.223	0.082	0.117	0.314	0.256	0.417	0.401	0.390	0.248
610	0.224	0.082	0.111	0.320	0.256	0.422	0.410	0.400	0.252
620	0.221	0.081	0.109	0.327	0.257	0.429	0.616	0.409	0.260
630	0.217	0.078	0.114	0.334	0.259	0.433	0.622	0.415	0.266
640	0.210	0.072	0.121	0.341	0.264	0.439	0.628	0.420	0.275
650	0.200	0.065	0.128	0.349	0.269	0.044	0.631	0.426	0.285
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	0.364	-	-	-	0.412
710	-	-	0.098	-	0.385	-	-	-	0.450
720	-	-	0.112	-	0.406	-	-	-	0.482
730	-	-	0.134	-	0.427	-	-	-	0.513
740	-	-	0.157	-	0.448	-	-	-	0.541
750	-	-	0.180	-	0.470	-	-	-	0.563
760	-	-	0.191	-	0.488	-	-	-	0.583
770	-	-	0.208	-	0.508	0.480	0.450	0.440	0.599
780	-	-	0.220	-	0.527	0.483	0.451	0.440	0.609
790	-	-	0.232	-	0.544	0.485	0.451	0.440	0.615
800	-	-	0.235	-	0.559	0.488	0.452	0.440	0.618
810	-	-	0.242	-	0.578	0.489	0.453	0.440	0.618
820	-	-	0.244	-	0.591	0.490	0.453	0.440	0.623
830	-	-	0.250	-	0.605	0.490	0.452	0.440	0.639
840	-	-	0.256	-	0.620	0.490	0.451	0.440	0.654
850	-	-	0.258	-	0.634	0.490	0.451	0.439	0.665
860	-	-	-	-	0.648	0.490	0.451	0.438	0.675
870	-	-	-	-	0.661	0.490	0.450	0.437	0.689
880	-	-	-	-	-	0.489	0.450	0.435	0.699
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

	253	254	255	256	257	258	259	260	261
S	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G
N	1/1	1/1	2/2	1/1	1/1	1/1	1/1	1/1	1/1
Sp	1/1	1/2	4/3	1/1	1/1	1/1	1/1	1/1	1/1
400	0.140	0.122	0.125	0.104	0.143	0.150	0.120	0.162	0.154
410	0.141	0.126	0.133	0.111	0.150	0.159	0.127	0.170	0.162
420	0.145	0.130	0.142	0.117	0.160	0.168	0.135	0.180	0.173
430	0.148	0.135	0.150	0.121	0.168	0.177	0.142	0.190	0.184
440	0.151	0.140	0.160	0.122	0.178	0.187	0.150	0.201	0.192
450	0.156	0.145	0.170	0.124	0.186	0.199	0.159	0.212	0.204
460	0.160	0.150	0.180	0.127	0.200	0.210	0.170	0.224	0.215
470	0.167	0.158	0.191	0.129	0.212	0.221	0.179	0.237	0.225
480	0.175	0.165	0.203	0.130	0.224	0.235	0.191	0.251	0.238
490	0.187	0.174	0.219	0.133	0.241	0.253	0.206	0.264	0.250
500	0.198	0.183	0.234	0.138	0.254	0.268	0.221	0.278	0.259
510	0.208	0.193	0.253	0.142	0.270	0.284	0.237	0.288	0.270
520	0.218	0.204	0.265	0.150	0.287	0.300	0.251	0.300	0.280
530	0.225	0.214	0.278	0.160	0.303	0.323	0.267	0.311	0.290
540	0.233	0.222	0.285	0.169	0.321	0.340	0.272	0.321	0.298
550	0.241	0.230	0.293	0.180	0.341	0.359	0.287	0.330	0.306
560	0.248	0.237	0.300	0.189	0.352	0.370	0.294	0.339	0.312
570	0.251	0.241	0.305	0.198	0.364	0.380	0.302	0.345	0.319
580	0.257	0.247	0.308	0.205	0.371	0.388	0.308	0.351	0.322
590	0.260	0.251	0.310	0.210	0.376	0.391	0.314	0.354	0.328
600	0.264	0.257	0.311	0.211	0.378	0.395	0.318	0.357	0.331
610	0.271	0.263	0.310	0.211	0.378	0.398	0.318	0.358	0.334
620	0.280	0.270	0.309	0.210	0.377	0.397	0.317	0.357	0.337
630	0.290	0.279	0.305	0.210	0.376	0.396	0.316	0.356	0.338
640	0.301	0.290	0.302	0.211	0.375	0.394	0.315	0.354	0.339
650	0.319	0.301	0.299	0.213	0.374	0.390	0.314	0.350	0.339
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.411	0.430	0.283	-	0.357	0.369	0.304	0.322	0.340
710	0.433	0.472	0.282	-	0.350	0.362	0.303	0.321	0.339
720	0.454	0.503	0.281	0.258	0.341	0.357	0.302	0.320	0.338
730	0.476	0.533	0.280	0.259	0.335	0.351	0.302	0.322	0.338
740	0.484	0.559	0.280	0.260	0.330	0.343	0.303	0.324	0.338
750	0.523	0.581	0.280	0.260	0.323	0.338	0.306	0.325	0.339
760	0.543	0.600	0.280	0.259	0.319	0.333	0.309	0.326	0.340
770	0.562	0.618	0.280	0.258	0.313	0.328	0.312	0.327	0.341
780	0.578	0.629	0.280	0.257	0.310	-	0.317	0.329	0.342
790	0.591	0.635	0.280	-	0.308	-	0.320	0.332	0.345
800	0.594	0.637	0.280	-	0.305	-	0.325	0.335	0.350
810	0.600	0.639	0.280	-	0.303	-	0.331	0.342	0.356
820	0.609	0.646	0.280	-	0.302	-	0.339	0.350	0.362
830	0.621	0.660	0.280	-	0.301	-	0.346	0.358	0.369
840	0.636	0.671	0.280	-	0.300	-	0.353	0.365	0.377
850	0.651	0.688	-	-	0.300	-	0.361	0.371	0.383
860	0.664	0.700	-	-	0.300	-	0.369	0.379	0.390
870	0.675	0.712	-	-	0.300	-	0.373	0.385	0.400
880	0.684	0.721	-	-	0.300	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	262	263	264	265	266	267	268	269	270
S	G/G	G/G	G/G	G/G	G/G	G/G	G	G	G/G
N	1/1	1/1	1/1	1/1	1/1	1/1	3	2	3/1
Sp	1/1	1/1	1/1	1/1	1/1	1/1	5	3	11/1
400	0.088	0.131	0.136	0.111	0.182	0.136	0.117	0.400	0.181
410	0.095	0.139	0.144	0.117	0.200	0.144	0.124	0.413	0.193
420	0.103	0.148	0.153	0.123	0.218	0.153	0.125	0.430	0.205
430	0.112	0.157	0.163	0.129	0.237	0.163	0.127	0.450	0.217
440	0.120	0.168	0.173	0.138	0.253	0.173	0.130	0.470	0.224
450	0.131	0.178	0.183	0.147	0.272	0.183	0.136	0.493	0.232
460	0.140	0.189	0.194	0.153	0.289	0.194	0.146	0.515	0.241
470	0.151	0.200	0.206	0.162	0.308	0.206	0.146	0.538	0.249
480	0.161	0.210	0.218	0.172	0.323	0.218	0.156	0.557	0.257
490	0.172	0.222	0.233	0.184	0.341	0.229	0.166	0.570	0.269
500	0.183	0.230	0.244	0.198	0.359	0.236	0.178	0.578	0.280
510	0.196	0.241	0.252	0.212	0.370	0.244	0.178	0.583	0.295
520	0.207	0.248	0.262	0.227	0.382	0.250	0.185	0.588	0.309
530	0.218	0.253	0.269	0.243	0.394	0.258	0.195	0.593	0.322
540	0.230	0.259	0.277	0.260	0.403	0.268	0.211	0.598	0.335
550	0.243	0.261	0.279	0.277	0.412	0.277	0.238	0.605	0.349
560	0.254	0.263	0.283	0.287	0.420	0.284	0.250	0.610	0.361
570	0.264	0.266	0.286	0.303	0.427	0.294	0.262	0.615	0.374
580	0.272	0.268	0.287	0.313	0.431	0.300	0.284	0.625	0.385
590	0.279	0.269	0.288	0.320	0.435	0.305	0.282	0.633	0.398
600	0.281	0.270	0.289	0.322	0.438	0.310	0.280	0.640	0.405
610	0.284	0.272	0.290	0.324	0.438	0.315	0.296	0.648	0.410
620	0.285	0.274	0.291	0.325	0.438	0.319	0.329	0.652	0.413
630	0.286	0.277	0.293	0.327	0.435	0.320	0.351	0.654	0.414
640	0.287	0.279	0.294	0.328	0.431	0.321	0.371	0.655	0.413
650	0.287	0.230	0.295	0.329	0.429	0.322	0.368	0.655	0.411
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	0.347	0.410	0.322	-	-	-
710	-	0.295	-	0.351	0.409	0.321	-	-	-
720	0.315	0.296	0.325	0.357	0.409	0.321	-	-	-
730	0.319	0.296	0.328	0.360	0.409	0.322	-	-	-
740	0.325	0.298	0.333	0.363	0.409	0.323	-	-	-
750	0.330	0.299	0.337	0.365	0.409	0.324	-	-	-
760	0.335	0.300	0.342	0.369	0.409	0.325	-	-	-
770	0.340	0.302	0.549	0.374	0.409	0.326	-	-	-
780	0.348	0.305	0.353	0.380	0.410	0.330	-	-	-
790	0.355	0.308	0.360	0.385	0.411	0.335	-	-	-
800	0.360	0.310	0.368	0.390	0.413	0.340	-	-	0.251
810	0.368	0.313	0.373	0.398	0.418	0.342	-	-	0.246
820	0.375	0.318	0.381	0.403	0.420	0.345	-	-	0.243
830	0.383	0.320	0.388	0.410	0.425	0.347	-	-	0.242
840	0.390	0.323	0.397	0.416	0.429	0.350	-	-	0.243
850	0.398	0.329	0.402	0.422	0.432	0.352	-	-	0.244
860	0.403	0.333	-	0.428	0.438	0.356	-	-	0.245
870	0.410	-	-	0.433	0.441	0.359	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λ λ	271	272	273	274	275	276	277	278	279
S	G/P	G/G	G	G	G	G/G	G/G	G/G	G/G
N	2/1	4/2	2	2	2	2/2	2/2	2/2	2/2
Sp	4/2	4/2	2	2	2	2/2	2/2	2/2	2/2
400	0.032	0.038	0.045	0.041	0.034	0.041	0.054	0.046	0.038
410	0.034	0.040	0.047	0.043	0.036	0.041	0.056	0.047	0.039
420	0.037	0.042	0.049	0.047	0.039	0.042	0.059	0.048	0.040
430	0.039	0.044	0.051	0.049	0.041	0.043	0.061	0.049	0.040
440	0.040	0.047	0.053	0.050	0.043	0.045	0.065	0.050	0.041
450	0.041	0.049	0.055	0.053	0.046	0.047	0.069	0.051	0.042
460	0.042	0.050	0.057	0.054	0.047	0.048	0.070	0.053	0.042
470	0.042	0.051	0.059	0.056	0.048	0.048	0.071	0.054	0.043
480	0.042	0.051	0.060	0.057	0.049	0.049	0.070	0.055	0.045
490	0.042	0.051	0.061	0.058	0.049	0.049	0.070	0.056	0.047
500	0.044	0.051	0.061	0.058	0.049	0.050	0.071	0.059	0.048
510	0.047	0.051	0.061	0.058	0.049	0.054	0.075	0.060	0.04[illegible]
520	0.050	0.051	0.061	0.058	0.049	0.056	0.079	0.061	0.051
530	0.055	0.053	0.061	0.058	0.048	0.058	0.081	0.063	0.054
540	0.059	0.054	0.062	0.059	0.050	0.060	0.085	0.065	0.056
550	0.061	0.057	0.065	0.060	0.051	0.062	0.089	0.067	0.059
560	0.063	0.059	0.067	0.063	0.053	0.066	0.092	0.070	0.060
570	0.065	0.061	0.069	0.066	0.058	0.069	0.100	0.073	0.063
580	0.064	0.065	0.071	0.068	0.060	0.072	0.105	0.078	0.067
590	0.063	0.067	0.073	0.070	0.061	0.076	0.111	0.080	0.071
600	0.061	0.069	0.075	0.072	0.063	0.078	0.115	0.082	0.073
610	0.060	0.070	0.077	0.074	0.064	0.080	0.119	0.085	0.074
620	0.064	0.071	0.079	0.076	0.066	0.081	0.120	0.088	0.075
630	0.071	0.074	0.082	0.079	0.068	0.082	0.120	0.090	0.075
640	-	0.077	0.085	0.080	0.070	0.081	0.119	0.090	0.074
650	-	0.079	0.087	0.032	0.071	0.080	0.117	0.090	0.073
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.095	-	-	-	-	-	-	-	-
710	0.090	-	-	-	-	-	-	-	-
720	0.085	-	-	-	-	-	-	-	-
730	0.087	-	-	-	-	-	-	-	-
740	0.095	-	-	-	-	-	-	-	-
750	0.111	-	-	-	-	-	-	-	-
760	0.121	-	-	-	-	-	-	-	-
770	-	0.134	-	-	-	0.153	0.172	0.148	0.188
780	-	0.141	-	-	-	0.155	0.173	0.149	0.190
790	-	0.149	-	-	-	0.159	0.179	0.151	0.195
800	-	0.157	-	-	-	0.163	0.183	0.158	0.200
810	-	0.168	-	-	-	0.171	0.191	0.164	0.207
820	-	0.182	-	-	-	0.180	0.200	0.170	0.216
830	-	0.202	-	-	-	0.191	0.211	0.179	0.224
840	-	0.224	-	-	-	0.204	0.221	0.189	0.232
850	-	0.250	-	-	-	0.215	0.231	0.199	0.241
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

	280	281	282	283	284	285	286	287	288
S	G/G	G	G	G	G	G	G	G	G
N	1/1	1	1	1	1	1	2	3	4
Sp	1/1	1	1	1	1	1	4	5	7
400	0.050	0.104	0.106	0.097	0.097	0.111	0.050	0.062	0.111
410	0.050	0.105	0.108	0.100	0.100	0.111	0.050	0.064	0.119
420	0.050	0.106	0.112	0.103	0.103	0.117	0.051	0.068	0.128
430	0.051	0.107	0.115	0.107	0.107	0.122	0.053	0.072	0.136
440	0.053	0.110	0.119	0.111	0.111	0.128	0.056	0.077	0.141
450	0.055	0.111	0.123	0.114	0.114	0.133	0.058	0.079	0.147
460	0.057	0.112	0.127	0.117	0.117	0.139	0.059	0.080	0.151
470	0.059	0.111	0.131	0.119	0.119	0.145	0.060	0.080	0.152
480	0.059	0.110	0.134	0.121	0.121	0.150	0.060	0.080	0.153
490	0.059	0.111	0.139	0.125	0.125	0.156	0.060	0.081	0.155
500	0.060	0.115	0.144	0.129	0.129	0.162	0.060	0.083	0.158
510	0.062	0.120	0.150	0.134	0.134	0.168	0.058	0.086	0.160
520	0.065	0.125	0.155	0.139	0.139	0.174	0.054	0.090	0.163
530	0.068	0.131	0.162	0.145	0.145	0.182	0.054	0.095	0.168
540	0.070	0.137	0.168	0.152	0.152	0.189	0.061	0.100	0.175
550	0.071	0.142	0.176	0.160	0.160	0.197	0.071	0.105	0.183
560	0.074	0.147	0.183	0.167	0.167	0.207	0.076	0.107	0.190
570	0.077	0.154	0.191	0.175	0.175	0.215	0.076	0.109	0.197
580	0.081	0.161	0.199	0.183	0.183	-	0.077	0.112	0.201
590	0.086	0.166	0.208	0.191	0.191	-	0.080	0.117	0.206
600	0.089	0.173	0.215	0.199	0.199	-	0.083	0.119	0.211
610	0.092	0.179	0.222	0.206	0.206	-	0.087	0.121	0.216
620	0.094	0.186	-	0.213	0.213	-	0.085	0.122	0.221
630	0.096	0.192	-	0.218	0.218	-	0.081	0.123	0.229
640	0.098	0.198	-	0.225	0.225	-	0.078	0.123	0.235
650	0.099	0.204	-	-	-	-	0.076	0.123	0.240
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	-	-	-	-
720	-	-	-	-	-	-	-	-	-
730	-	-	-	-	-	-	-	-	-
740	-	-	-	-	-	-	-	-	-
750	-	-	-	-	-	-	-	-	-
760	-	-	-	-	-	-	-	-	-
770	-	-	-	-	-	-	-	-	-
780	-	-	-	-	-	-	-	-	-
790	-	-	-	-	-	-	-	-	-
800	-	-	-	-	-	-	-	-	-
810	0.218	-	-	-	-	-	-	-	-
820	0.228	-	-	-	-	-	-	-	-
830	0.240	-	-	-	-	-	-	-	-
840	0.253	-	-	-	-	-	-	-	-
850	0.272	-	-	-	-	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

	289	290	291	292	293	294	295	296	297
S	G	G/G	G/G	G/G	G/G	G/G	G/G	G/G	G/G
N	2	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Sp	3	2/1	2/1	2/1	2/1	1/1	2/2	2/2	2/2
400	0.103	0.029	0.029	0.034	0.043	0.081	0.150	0.084	0.108
410	0.111	0.029	0.029	0.031	0.043	0.080	0.150	0.084	0.113
420	0.119	0.030	0.030	0.032	0.044	0.080	0.150	0.084	0.118
430	0.126	0.031	0.031	0.034	0.049	0.080	0.150	0.086	0.123
440	0.132	0.036	0.036	0.040	0.054	0.081	0.150	0.090	0.129
450	0.139	0.040	0.040	0.046	0.060	0.083	0.152	0.094	0.133
460	0.141	0.041	0.041	0.049	0.062	0.086	0.154	0.095	0.137
470	0.145	0.042	0.042	0.050	0.064	0.089	0.157	0.090	0.142
480	0.146	0.043	0.043	0.050	0.065	0.093	0.161	0.090	0.147
490	0.147	0.043	0.043	0.050	0.067	0.097	0.166	0.092	0.153
500	0.149	0.044	0.044	0.050	0.070	0.101	0.172	0.094	0.159
510	0.152	0.046	0.046	0.050	0.073	0.106	0.178	0.093	0.166
520	0.158	0.047	0.047	0.051	0.079	0.109	0.184	0.098	0.174
530	0.161	0.049	0.049	0.053	0.083	0.111	0.191	0.103	0.184
540	0.165	0.050	0.050	0.057	0.086	0.113	0.197	0.104	0.198
550	0.171	0.054	0.054	0.060	0.087	0.115	0.202	0.106	0.215
560	0.179	0.058	0.058	0.062	0.088	0.116	0.206	0.110	0.222
570	0.186	0.059	0.059	0.064	0.090	0.117	0.208	0.116	0.226
580	0.191	0.060	0.060	0.067	0.096	0.119	0.212	0.122	0.228
590	0.197	0.062	0.062	0.071	0.102	0.120	0.216	0.128	0.231
600	0.201	0.065	0.065	0.074	0.110	0.122	0.220	0.130	0.236
610	0.206	0.067	0.067	0.077	0.112	0.127	0.224	0.131	0.242
620	0.211	0.069	0.069	0.080	0.122	0.131	0.228	0.126	0.250
630	0.217	0.070	0.070	0.082	0.130	0.137	0.232	0.130	0.258
640	0.221	0.071	0.071	0.086	0.136	0.141	0.235	0.133	0.266
650	0.227	0.072	0.072	0.087	0.140	0.146	0.239	0.138	0.269
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-
710	-	-	-	-	-	0.130	-	-	-
720	-	-	-	-	-	0.129	0.168	0.148	0.204
730	-	0.059	-	0.075	-	0.129	0.164	0.140	0.196
740	-	0.058	0.062	0.073	0.090	0.130	0.159	0.133	0.192
750	-	0.058	0.062	0.073	0.087	0.131	0.158	0.131	0.192
760	-	0.058	0.063	0.074	0.086	0.134	0.160	0.132	0.194
770	-	0.059	0.065	0.078	0.087	0.139	0.165	0.134	0.200
780	-	0.060	0.067	0.080	0.090	0.145	0.172	0.138	0.210
790	-	0.063	0.069	0.085	0.098	0.157	0.182	0.146	0.224
800	-	0.067	0.072	0.091	0.107	0.164	0.196	0.159	0.244
810	-	0.070	0.076	0.102	0.120	0.176	0.212	0.174	-
820	-	0.073	0.081	0.113	0.135	0.189	0.235	0.193	-
830	-	0.077	0.085	0.122	0.152	0.200	0.257	0.215	-
840	-	0.078	0.085	0.129	0.162	0.204	0.279	0.242	-
850	-	0.077	0.083	0.131	0.167	0.206	0.300	0.271	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	298	299	300	301	302	303	304	305	306
S	G/G	G	G	G	G/G	P	G	G	G
N	1/1	1	1	1	3/2		1	1	1
Sp	1/2	2	2	2	5/4		2	1	1
400	0.098	0.094	0.102	0.102	0.037	0.054	0.016	0.048	0.048
410	0.102	0.100	0.110	0.110	0.040	0.055	0.016	0.049	0.049
420	0.106	0.109	0.118	0.118	0.041	0.058	0.016	0.050	0.050
430	0.110	0.110	0.126	0.126	0.043	0.061	0.016	0.051	0.051
440	0.116	0.118	0.132	0.132	0.041	0.067	0.017	0.052	0.052
450	0.120	0.125	0.139	0.139	0.037	0.070	0.018	0.053	0.053
460	0.125	0.132	0.144	0.144	0.035	0.073	0.019	0.055	0.055
470	0.130	0.138	0.148	0.148	0.035	0.075	0.020	0.057	0.057
480	0.135	0.141	0.149	0.149	0.038	0.073	0.020	0.058	0.058
490	0.139	0.143	0.150	0.150	0.040	0.075	0.020	0.059	0.059
500	0.145	0.143	0.147	0.147	0.043	0.079	0.020	0.060	0.060
510	0.151	0.143	0.144	0.144	0.047	0.081	0.020	0.060	0.060
520	0.159	0.143	0.142	0.142	0.049	0.083	0.020	0.060	0.060
530	0.167	0.144	0.140	0.140	0.050	0.085	0.020	0.060	0.060
540	0.175	0.145	0.142	0.142	0.049	0.086	0.020	0.059	0.060
550	0.185	0.147	0.146	0.146	0.049	0.086	0.020	0.058	0.060
560	0.192	0.150	0.150	0.150	0.050	0.087	0.020	0.057	0.061
570	0.198	0.152	0.156	0.156	0.055	0.089	0.020	0.055	0.062
580	0.203	0.156	0.164	0.164	0.059	0.090	0.020	0.055	0.062
590	0.206	0.159	0.173	0.173	0.060	0.091	0.021	0.055	0.063
600	-	0.163	0.182	0.182	0.060	0.091	0.021	0.056	0.063
610	-	0.168	0.188	0.188	0.060	0.092	0.021	0.057	0.064
620	-	0.173	0.196	0.196	0.060	0.095	0.022	0.058	0.065
630	-	0.178	0.202	0.202	0.060	0.099	0.023	0.059	0.066
640	-	0.184	0.206	0.206	0.060	0.101	0.024	0.058	0.066
650	-	0.189	0.208	0.208	0.060	0.103	0.025	0.055	0.065
660	-	-	-	-	0.061	-	-	-	-
670	-	-	-	-	0.065	-	-	-	-
680	-	-	-	-	0.069	-	-	-	-
690	-	-	-	-	0.074	-	-	-	-
700	-	-	-	-	0.079	-	-	-	-
710	-	-	-	-	0.083	-	-	-	-
720	0.141	-	-	-	0.089	-	-	-	-
730	0.132	-	-	-	0.094	-	-	-	-
740	0.125	-	-	-	0.103	-	-	-	-
750	0.122	-	-	-	0.122	-	-	-	-
760	0.123	-	-	-	0.155	-	-	-	-
770	0.124	-	-	-	0.192	0.148	-	-	-
780	0.129	-	-	-	0.212	0.152	-	-	-
790	0.137	-	-	-	0.222	0.158	-	-	-
800	0.147	-	-	-	0.228	0.162	-	-	-
810	-	-	-	-	0.230	0.169	-	-	-
820	-	-	-	-	0.230	0.178	-	-	-
830	-	-	-	-	0.229	0.188	-	-	-
840	-	-	-	-	0.225	-	-	-	-
850	-	-	-	-	0.220	-	-	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	307	308	309	310	311	312	313	314	315
S	G/G	G/G	G/G	G/G	G/G	P	P/P	G	P/P
N	3/1	3/1	3/1	1/1	1/1			3	
Sp	5/1	5/1	5/1	2/1	1/1			9	
400	0.024	0.033	0.037	0.042	0.025	0.087	0.068	0.075	0.083
410	0.023	0.033	0.037	0.042	0.029	0.088	0.077	0.081	0.084
420	0.022	0.033	0.037	0.042	0.032	0.089	0.089	0.089	0.085
430	0.023	0.032	0.037	0.042	0.036	0.090	0.122	0.097	0.087
440	0.023	0.031	0.037	0.042	0.038	0.090	0.158	0.100	0.088
450	0.023	0.030	0.036	0.043	0.039	0.092	0.188	0.101	0.089
460	0.023	0.030	0.036	0.045	0.039	0.096	0.212	0.100	0.090
470	0.024	0.030	0.037	0.046	0.039	0.100	0.231	0.096	0.092
480	0.025	0.031	0.038	0.048	0.039	0.101	0.245	0.094	0.096
490	0.026	0.032	0.039	0.049	0.039	0.101	0.256	0.094	0.100
500	0.026	0.033	0.040	0.049	-	0.101	0.265	0.096	0.105
510	0.026	0.034	0.040	0.049	-	0.103	0.271	0.099	0.112
520	0.026	0.034	0.040	0.049	-	0.112	0.278	0.101	0.119
530	0.027	0.034	0.040	0.047	-	0.129	0.281	0.105	0.124
540	0.028	0.034	0.040	0.045	-	0.140	0.285	0.108	0.130
550	0.029	0.032	0.040	0.044	-	0.147	0.289	0.109	0.135
560	0.030	0.031	0.040	0.044	-	0.141	0.290	0.110	0.140
570	0.030	0.031	0.040	0.044	-	0.135	0.291	0.110	0.146
580	0.030	0.033	0.040	0.045	-	0.135	0.292	0.110	0.150
590	0.030	0.035	0.040	0.047	-	0.141	0.294	0.111	0.152
600	0.030	0.037	0.041	0.049	-	0.150	0.295	0.111	0.154
610	0.031	0.038	0.042	0.050	-	0.160	0.296	0.111	0.156
620	0.033	0.039	0.043	0.051	-	0.170	0.297	0.110	0.159
630	0.034	0.040	0.044	0.050	-	0.182	0.298	0.103	0.161
640	0.036	0.039	0.043	0.050	-	0.193	0.298	0.098	0.167
650	0.035	0.039	0.042	0.049	-	0.201	0.298	0.088	0.173
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	0.281	-	0.242
710	-	-	-	-	0.045	-	0.279	-	0.287
720	-	-	-	-	0.046	-	0.281	-	0.322
730	-	-	-	-	0.047	-	0.288	-	0.344
740	-	-	-	-	0.048	-	0.294	-	0.353
750	-	-	-	-	0.048	-	0.302	-	0.361
760	-	-	-	-	0.049	-	0.312	-	0.376
770	0.048	0.052	0.058	0.068	0.049	-	0.329	-	0.442
780	0.050	0.055	0.060	0.071	0.050	-	0.334	-	0.515
790	0.053	0.059	0.063	0.078	0.050	-	0.325	-	0.544
800	0.059	0.062	0.067	0.081	0.050	-	0.307	-	0.560
810	0.061	0.066	0.071	0.084	0.050	-	0.282	-	-
820	0.065	0.069	0.076	0.089	-	-	0.253	-	-
830	0.069	0.073	0.080	0.092	-	-	0.227	-	-
840	0.071	0.079	0.083	0.098	-	-	0.208	-	-
850	-	-	-	-	-	-	0.200	-	-
860	-	-	-	-	-	-	-	-	-
870	-	-	-	-	-	-	-	-	-
880	-	-	-	-	-	-	-	-	-
890	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

	316	317	318	319	320	321	322	323	324
S	G	M/P	G/P	G	G/G	G/G	G/G	P/P	P
N	3	2/1	2/3	1	1/1	1/1	3/2		
Sp	4	3/1	4/5	3	2/1	2/1	5/4		
400	0.451	0.139	0.021	0.061	0.056	0.091	0.081	0.072	0.154
410	0.472	0.142	0.022	0.062	0.057	0.092	0.079	0.074	0.162
420	0.493	0.150	0.023	0.064	0.058	0.094	0.078	0.079	0.170
430	0.519	0.157	0.025	0.066	0.060	0.098	0.077	0.089	0.178
440	0.535	0.163	0.028	0.068	0.061	0.100	0.076	0.092	0.183
450	0.554	0.172	0.029	0.067	0.063	0.104	0.076	0.094	0.188
460	0.571	0.179	0.030	0.066	0.065	0.108	0.076	0.093	0.188
470	0.590	0.181	0.031	0.064	0.058	0.112	0.077	0.091	0.185
480	0.607	0.185	0.032	0.063	0.071	0.117	0.080	0.093	0.182
490	0.621	0.192	0.033	0.067	0.073	0.121	0.083	0.099	0.183
500	0.637	0.202	0.033	0.070	0.075	0.123	0.087	0.105	0.187
510	0.650	0.211	0.032	0.077	0.074	0.127	0.090	0.113	0.190
520	0.663	0.218	0.033	0.082	0.076	0.129	0.093	0.119	0.191
530	0.677	0.223	0.037	0.084	0.079	0.133	0.098	0.124	0.191
540	0.688	0.230	0.038	0.083	0.081	0.137	0.099	0.127	0.191
550	0.699	0.238	0.037	0.081	0.084	0.140	0.100	0.128	0.191
560	0.707	0.248	0.037	0.081	0.089	0.141	0.101	0.129	0.190
570	0.714	0.258	0.037	0.084	0.091	0.143	0.105	0.130	0.189
580	0.721	0.266	0.038	0.087	0.092	0.148	0.108	0.131	0.186
590	0.729	0.272	0.041	0.088	0.094	0.150	0.110	0.136	0.181
600	0.732	0.278	0.043	0.088	0.097	0.153	0.111	0.141	0.178
610	0.738	0.281	0.044	0.089	0.099	0.158	0.112	0.149	0.171
620	0.740	0.283	0.045	0.090	0.102	0.162	0.112	0.151	0.165
630	0.740	0.285	0.045	0.091	0.109	0.170	0.111	0.151	0.158
640	0.739	0.288	0.046	0.094	0.113	0.175	0.110	0.150	0.151
650	0.738	0.289	0.047	0.093	0.119	0.180	0.113	0.149	0.141
660	-	-	-	-	-	-	0.124	-	-
670	-	-	-	-	-	-	0.139	-	-
680	-	-	-	-	-	-	0.149	-	-
690	-	-	-	-	-	-	0.157	-	-
700	-	-	0.069	-	-	-	0.161	0.171	-
710	-	-	0.081	-	-	-	0.162	0.181	-
720	-	-	0.090	-	-	-	0.161	0.190	-
730	-	-	0.099	-	-	-	0.157	0.201	-
740	-	0.277	0.102	-	-	-	0.156	0.213	-
750	-	0.274	0.106	-	-	-	0.167	0.230	-
760	-	0.272	0.108	-	-	-	0.180	0.249	-
770	-	0.270	0.109	-	-	-	0.191	0.271	-
780	-	0.270	0.110	-	-	-	0.202	0.291	-
790	-	0.270	0.111	-	0.139	-	0.213	0.309	-
800	-	0.270	0.113	-	0.145	0.180	0.223	0.320	-
810	-	0.274	0.119	-	0.156	0.183	0.233	0.328	-
820	-	0.280	0.124	-	0.164	0.188	0.242	0.333	-
830	-	0.291	0.131	-	0.171	0.191	0.250	0.338	-
840	-	0.302	0.138	-	-	-	0.257	0.340	-
850	-	0.309	0.141	-	-	-	0.263	-	-
860	-	-	0.144	-	-	-	-	-	-
870	-	-	0.148	-	-	-	-	-	-
880	-	-	0.150	-	-	-	-	-	-
890	-	-	0.151	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-

λλ	325	326	327	328	329	330	331	332	333
S	G/G	G	G/G	G	P/P	G/G	G	G	P/P
N	2/2	1	1/1	1		4/3	1	2	
Sp	5/4	3	2/1	3		12/10	2	4	
400	0.121	0.027	0.136	0.626	0.106	0.172	0.109	0.052	0.153
410	0.127	0.026	0.140	0.640	0.108	0.190	0.106	0.055	0.159
420	0.131	0.025	0.141	0.651	0.110	0.215	0.104	0.055	0.162
430	0.137	0.027	0.142	0.661	0.113	0.232	0.108	0.057	0.168
440	0.140	0.028	0.142	0.669	0.116	0.241	0.113	0.061	0.171
450	0.146	0.031	0.141	0.675	0.120	0.247	0.122	0.063	0.177
460	0.150	0.033	0.142	0.679	0.125	0.257	0.130	0.064	0.180
470	0.152	0.035	0.143	0.681	0.132	0.266	0.137	0.062	0.183
480	0.156	0.036	0.147	0.684	0.140	0.270	0.140	0.065	0.188
490	0.159	0.037	0.150	0.689	0.150	0.273	0.141	0.068	0.191
500	0.161	0.038	0.153	0.697	0.160	0.272	0.142	0.064	0.193
510	0.165	0.039	0.158	0.707	0.169	0.276	0.146	0.054	0.198
520	0.170	0.040	0.160	0.718	0.177	0.288	0.148	0.043	0.200
530	0.179	0.042	0.161	0.732	0.184	0.299	0.149	0.040	0.202
540	0.188	0.047	0.161	0.749	0.191	0.310	0.150	0.044	0.204
550	0.199	0.050	0.163	0.765	0.198	0.316	0.151	0.056	0.206
560	0.206	0.055	0.168	0.773	0.206	0.321	0.150	0.064	0.208
570	0.211	0.060	0.171	0.779	0.214	0.321	0.150	0.069	0.206
580	0.217	0.066	0.177	0.781	0.220	0.326	0.151	0.069	0.204
590	0.219	0.071	0.181	0.782	0.224	0.333	0.157	0.068	0.202
600	0.220	0.073	0.185	0.781	0.227	0.341	0.161	0.066	0.200
610	0.219	0.072	0.188	0.778	0.228	0.349	0.166	0.066	0.198
620	0.218	0.070	0.187	0.774	0.229	0.356	0.169	0.068	0.194
630	0.213	0.063	0.184	0.772	0.229	0.366	0.171	0.067	0.191
640	0.210	0.057	0.182	0.774	0.230	0.376	0.174	0.067	0.186
650	0.209	0.049	0.185	0.790	0.232	0.386	0.176	0.069	0.180
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.279	-	-	-	-	-	-	-	0.153
710	0.282	-	-	-	0.322	0.395	-	-	0.147
720	0.283	-	-	-	0.325	0.391	-	-	0.141
730	0.287	-	-	-	0.330	0.387	-	-	0.135
740	0.289	-	-	-	0.330	0.381	-	-	0.130
750	0.291	-	-	-	0.330	0.381	-	-	0.122
760	0.295	-	-	-	0.330	0.386	-	-	0.117
770	0.299	-	0.626	-	0.337	0.395	-	-	0.110
780	0.302	-	0.628	-	0.340	0.410	-	-	0.103
790	0.308	-	0.628	-	0.342	0.422	-	-	0.098
800	0.312	-	0.627	-	0.346	0.435	-	-	0.091
810	0.321	-	0.625	-	0.351	0.450	-	-	0.084
820	0.330	-	0.621	-	0.355	0.463	-	-	0.079
830	0.341	-	0.619	-	0.352	0.478	-	-	0.074
840	0.351	-	0.616	-	0.352	0.490	-	-	0.066
850	0.361	-	0.616	-	0.348	0.501	-	-	-
860	-	-	-	-	0.342	-	-	-	-
870	-	-	-	-	0.350	-	-	-	-
880	-	-	-	-	0.360	-	-	-	-
900	-	-	-	-	0.364	-	-	-	-

λ	334	335	336	337	338	339	340	341	342
S	P	G/G	G	G/G	G	G	G	G	G/G
N		1/2	1	6/3	1	1	1	1	1/1
Sp		2/2	2	7/6	2	1	2	1	1/1
400	0.100	0.070	0.150	0.830	0.520	2.160	2.600	5.650	-
410	0.103	0.076	0.129	0.830	0.500	2.320	2.930	5.850	-
420	0.107	0.081	0.116	0.825	0.490	2.500	3.360	6.400	-
430	0.110	0.087	0.112	0.820	0.480	2.610	4.200	7.270	-
440	0.113	0.092	0.095	0.820	0.470	2.800	4.800	7.760	-
450	0.119	0.099	0.090	0.820	0.470	2.950	5.350	8.430	-
460	0.122	0.105	0.090	0.815	0.470	3.020	5.900	8.900	-
470	0.127	0.112	0.086	0.810	0.470	2.970	5.900	8.650	-
480	0.131	0.119	0.081	0.805	0.470	2.810	5.470	8.150	-
490	0.134	0.126	0.076	0.800	0.470	2.560	4.600	7.550	-
500	0.139	0.131	0.073	0.800	0.470	2.310	3.700	6.500	-
510	0.143	0.138	0.073	0.795	0.470	2.060	3.250	5.790	-
520	0.148	0.144	0.068	0.790	0.470	1.920	3.130	5.870	-
530	0.151	0.152	0.062	0.785	0.470	2.030	3.130	6.250	-
540	0.157	0.160	0.058	0.780	0.470	2.180	3.220	6.600	-
550	0.161	0.169	-	0.775	0.470	2.350	3.750	7.000	-
560	0.165	0.175	-	0.770	0.470	2.460	4.310	7.400	-
570	0.170	0.181	-	0.765	0.470	2.560	4.680	7.730	-
580	0.174	0.184	-	0.760	0.480	2.600	4.730	7.980	-
590	0.180	0.183	-	0.760	0.480	2.580	4.590	8.010	-
600	0.184	0.177	-	0.755	0.480	2.530	4.300	7.600	-
610	0.189	0.167	-	0.750	0.490	2.450	3.960	7.180	-
620	0.191	0.157	-	0.750	0.500	2.390	3.600	6.750	-
630	0.195	0.145	-	0.745	0.500	2.300	3.100	6.510	-
640	0.199	0.134	-	0.740	0.500	2.200	2.880	6.370	-
650	0.201	0.125	-	0.735	0.510	2.100	2.700	6.260	-
660	-	-	-	0.730	-	-	-	-	-
670	-	-	-	0.725	-	-	-	-	-
680	-	-	-	0.720	-	-	-	-	-
690	-	-	-	0.715	-	-	-	-	-
700	-	-	-	0.710	-	-	-	-	0.430
710	-	-	-	0.705	-	-	-	-	0.440
720	-	0.151	-	0.700	-	-	-	-	0.440
730	-	0.158	-	0.695	-	-	-	-	0.440
740	-	0.162	-	0.690	-	-	-	-	0.450
750	-	0.169	-	0.685	-	-	-	-	0.450
760	-	0.174	-	0.680	-	-	-	-	0.460
770	-	0.180	-	0.675	-	-	-	-	0.460
780	-	0.190	-	0.670	-	-	-	-	0.460
790	-	0.200	-	0.660	-	-	-	-	0.460
800	-	0.212	-	0.655	-	-	-	-	0.470
810	-	0.228	-	0.650	-	-	-	-	0.470
820	-	0.245	-	0.640	-	-	-	-	0.470
830	-	0.262	-	0.635	-	-	-	-	0.470
840	-	0.280	-	0.630	-	-	-	-	0.470
850	-	0.298	-	0.620	-	-	-	-	0.470
860	-	0.309	-	0.610	-	-	-	-	0.470
870	-	-	-	0.600	-	-	-	-	0.470
880	-	-	-	0.590	-	-	-	-	0.470
890	-	-	-	0.580	-	-	-	-	0.470
900	-	-	-	0.570	-	-	-	-	0.470

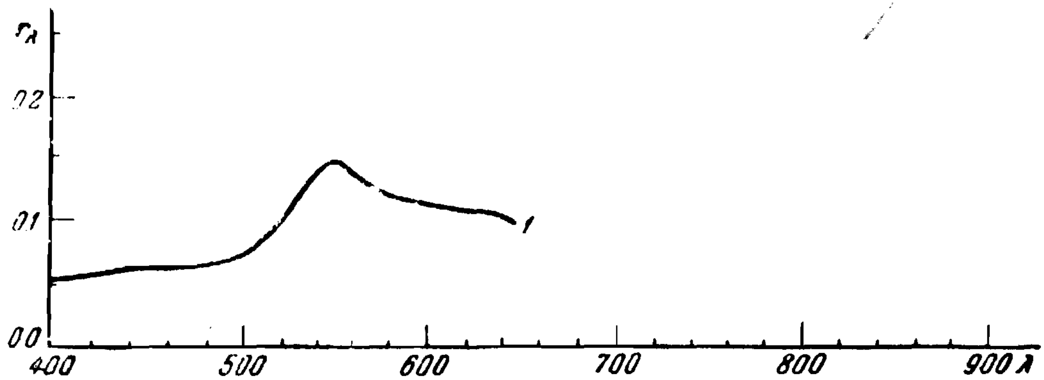
λ λ	343	344	345	346	347	348	349	350	351
S	G/G	G/G	G/G	G/G	G/G	G/G	G/G	/G	/G
N	1/1	1/1	1/1	/2	1/1	1/1	1/1	/1	/1
Sp	2/2	1/1	2/2	/2	2/2	2/2	1/2	/1	/1
400	0.820	0.870	0.970	-	0.500	0.550	0.650	-	-
410	0.760	0.810	0.940	-	0.510	0.560	0.660	-	-
420	0.710	0.760	0.890	-	0.520	0.560	0.660	-	-
430	0.670	0.700	0.840	-	0.520	0.570	0.660	-	-
440	0.640	0.660	0.780	-	0.530	0.590	0.660	-	-
450	0.620	0.650	0.740	-	0.530	0.600	0.660	-	-
460	0.630	0.670	0.750	-	0.540	0.610	0.660	-	-
470	0.650	0.720	0.790	-	0.550	0.620	0.660	-	-
480	0.670	0.770	0.820	-	0.550	0.640	0.660	-	-
490	0.690	0.840	0.850	-	0.560	0.650	0.660	-	-
500	0.700	0.890	0.870	-	0.560	0.660	0.660	-	-
510	0.690	0.920	0.880	-	0.570	0.670	0.660	-	-
520	0.650	0.920	0.870	-	0.570	0.680	0.660	-	-
530	0.620	0.880	0.840	-	0.570	0.690	0.650	-	-
540	0.580	0.820	0.800	-	0.580	0.700	0.650	-	-
550	0.550	0.740	0.760	-	0.580	0.710	0.650	-	-
560	0.510	0.660	0.730	-	0.580	0.720	0.650	-	-
570	0.480	0.620	0.700	-	0.590	0.730	0.650	-	-
580	0.480	0.640	0.670	-	0.590	0.730	0.650	-	-
590	0.500	0.680	0.670	-	0.590	0.740	0.650	-	-
600	0.550	0.740	0.680	-	0.600	0.740	0.650	-	-
610	0.620	0.790	0.700	-	0.600	0.740	0.640	-	-
620	0.660	0.840	0.720	-	0.600	0.740	0.640	-	-
630	-	-	-	-	0.600	0.730	0.640	-	-
640	-	-	-	-	0.600	0.720	0.640	-	-
650	-	-	-	-	0.610	0.710	0.640	-	-
660	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-
700	0.330	0.390	0.360	0.580	0.620	0.570	0.650	0.880	0.870
710	0.340	0.400	0.370	0.580	0.620	0.570	0.660	0.880	0.870
720	0.340	0.410	0.370	0.580	0.630	0.570	0.660	0.880	0.860
730	0.350	0.420	0.370	0.590	0.630	0.580	0.660	0.880	0.860
740	0.360	0.430	0.370	0.600	0.640	0.580	0.670	0.880	0.860
750	0.360	0.430	0.380	0.610	0.640	0.580	0.670	0.880	0.860
760	0.370	0.440	0.380	0.610	0.650	0.590	0.680	0.880	0.860
770	0.370	0.450	0.380	0.620	0.650	0.600	0.690	0.880	0.860
780	0.370	0.450	0.380	0.620	0.660	0.600	0.700	0.880	0.860
790	0.380	0.460	0.380	0.630	0.660	0.610	0.700	0.880	0.860
800	0.380	0.470	0.370	0.640	0.670	0.610	0.710	0.880	0.860
810	0.380	0.470	0.370	0.640	0.670	0.620	0.720	0.880	0.860
820	0.380	0.480	0.370	0.650	0.680	0.620	0.730	0.880	0.860
830	0.390	0.480	0.360	0.650	0.680	0.620	0.730	0.880	0.860
840	0.390	0.490	0.360	0.660	0.680	0.630	0.740	0.880	0.860
850	0.390	0.490	0.360	0.660	0.690	0.630	0.740	0.880	0.860
860	0.390	0.490	0.350	0.670	0.690	0.640	0.750	0.880	0.860
870	0.390	0.490	0.350	0.670	0.690	0.640	0.750	0.880	0.860
880	0.390	0.500	0.350	0.670	0.700	0.650	0.750	0.880	0.860
890	0.390	0.500	0.350	0.680	0.700	0.650	0.750	0.880	0.860
900	0.390	0.500	0.340	0.680	0.700	0.650	0.750	0.880	0.860

λ	352	353	354	355	356	357	358	359	360
S	/G	/G	G/G	G	G	G/G	G	G	G/G
N	/1	/1	1/1	1	3	6/4	2	1	1/1
Sp	/1	/1	3/1	2	9	20/11	4	3	3/2
400	-	-	0.720	0.100	0.100	0.095	0.093	0.158	0.133
410	-	-	0.720	0.112	0.102	0.098	0.097	0.164	0.136
420	-	-	0.725	0.123	0.105	0.099	0.099	0.175	0.135
430	-	-	0.730	0.137	0.108	0.102	0.100	0.193	0.139
440	-	-	0.730	0.145	0.110	0.101	0.100	0.212	0.139
450	-	-	0.730	0.154	0.111	0.105	0.100	0.226	0.143
460	-	-	0.735	0.161	0.113	0.108	0.100	0.234	0.149
470	-	-	0.740	0.168	0.115	0.108	0.100	0.236	0.147
480	-	-	0.740	0.172	0.118	0.114	0.101	0.233	0.147
490	-	-	0.740	0.178	0.120	0.113	0.103	0.225	0.150
500	-	-	0.740	0.182	0.121	0.118	0.108	0.213	0.151
510	-	-	0.740	0.197	0.127	0.125	0.113	0.209	0.159
520	-	-	0.745	0.209	0.134	0.132	0.119	0.213	0.166
530	-	-	0.750	0.211	0.149	0.136	0.120	0.220	0.172
540	-	-	0.750	0.202	0.167	0.143	0.121	0.229	0.177
550	-	-	0.750	0.182	0.191	0.146	0.124	0.242	0.182
560	-	-	0.750	0.174	0.214	0.152	0.131	0.251	0.187
570	-	-	0.750	0.179	0.240	0.150	0.143	0.256	0.192
580	-	-	0.750	0.182	0.267	0.152	0.151	0.257	0.196
590	-	-	0.750	0.197	0.291	0.158	0.159	0.252	0.196
600	-	-	0.755	0.200	0.310	0.159	0.167	0.240	0.193
610	-	-	0.760	0.202	0.329	0.161	0.177	0.235	0.183
620	-	-	0.760	0.204	0.342	0.166	0.184	0.234	0.180
630	-	-	0.760	0.209	0.354	0.169	0.189	0.234	0.183
640	-	-	0.760	0.217	0.352	0.171	0.191	0.236	0.186
650	-	-	0.760	0.222	0.370	0.172	0.192	0.234	0.190
660	-	-	0.760	-	-	-	-	-	-
670	-	-	0.760	-	-	-	-	-	-
680	-	-	0.760	-	-	-	-	-	-
690	-	-	0.760	-	-	-	-	-	-
700	0.930	0.790	0.760	-	-	-	-	-	-
710	0.930	0.790	0.760	-	-	-	-	-	-
720	0.930	0.790	0.760	-	-	0.237	-	-	0.332
730	0.930	0.790	0.760	-	-	0.246	-	-	0.332
740	0.930	0.790	0.760	-	-	0.251	-	-	0.332
750	0.930	0.790	0.760	-	-	0.256	-	-	0.333
760	0.930	0.790	0.760	-	-	0.259	-	-	0.336
770	0.930	0.790	0.760	-	-	0.261	-	-	0.340
780	0.930	0.790	0.760	-	-	0.266	-	-	0.345
790	0.930	0.790	0.760	-	-	0.270	-	-	0.353
800	0.930	0.790	0.760	-	-	0.278	-	-	0.368
810	0.930	0.790	0.760	-	-	0.294	-	-	0.397
820	0.930	0.790	0.760	-	-	0.311	-	-	0.446
830	0.930	0.790	0.760	-	-	0.332	-	-	0.460
840	0.930	0.800	0.760	-	-	0.349	-	-	0.489
850	0.930	0.800	0.760	-	-	0.371	-	-	-
860	0.930	0.800	0.760	-	-	-	-	-	-
870	0.930	0.800	0.755	-	-	-	-	-	-
880	0.930	0.800	0.750	-	-	-	-	-	-
890	0.930	0.800	0.750	-	-	-	-	-	-
900	0.930	0.800	0.750	-	-	-	-	-	-

	361	362	363	364	365	366	367	368	369	370
S	G/G	G	G/G	G/G	G/G	G	G	G/G	G	P/P
N	1/2	1	2/1	2/1	2/1	2	2	2/1	1	
Sp	3/6	2	6/3	6/2	6/2	4	8	4/2	3	
400	0.182	0.053	0.165	0.115	0.210	0.062	0.142	0.151	0.204	0.075
410	0.185	0.053	0.167	0.121	0.211	0.063	0.149	0.152	0.224	0.081
420	0.188	0.055	0.170	0.125	0.212	0.063	0.153	0.154	0.240	0.086
430	0.192	0.058	0.176	0.130	0.215	0.064	0.159	0.159	0.253	0.092
440	0.197	0.060	0.181	0.136	0.220	0.066	0.161	0.162	0.259	0.099
450	0.201	0.062	0.188	0.141	0.228	0.068	0.164	0.168	0.260	0.105
460	0.207	0.064	0.191	0.147	0.236	0.069	0.168	0.177	0.260	0.113
470	0.214	0.069	0.211	0.152	0.248	0.070	0.173	0.187	0.260	0.121
480	0.225	0.072	0.224	0.158	0.260	0.071	0.180	0.194	0.262	0.130
490	0.233	0.079	0.234	0.161	0.269	0.072	0.189	0.204	0.272	0.140
500	0.250	0.082	0.243	0.167	0.279	0.073	0.196	0.213	0.290	0.150
510	0.261	0.087	0.249	0.172	0.289	0.075	0.201	0.222	0.310	0.160
520	0.270	0.090	0.250	0.177	0.298	0.078	0.204	0.230	0.327	0.171
530	0.278	0.092	0.251	0.181	0.305	0.079	0.207	0.239	0.344	0.182
540	0.284	0.095	0.264	0.183	0.312	0.080	0.207	0.247	0.353	0.194
550	0.289	0.097	0.270	0.189	0.322	0.080	0.205	0.252	0.360	0.204
560	0.290	0.099	0.274	0.191	0.328	0.081	0.203	0.259	0.367	0.214
570	0.289	0.100	0.280	0.194	0.333	0.082	0.207	0.263	0.380	0.225
580	0.282	0.101	0.283	0.197	0.339	0.082	0.219	0.267	0.397	0.232
590	0.276	0.103	0.286	0.200	0.342	0.083	0.226	0.270	0.410	0.239
600	0.272	0.107	0.288	0.201	0.344	0.084	0.232	0.271	0.420	0.243
610	0.268	0.109	0.289	0.202	0.346	0.084	0.239	0.272	0.427	0.246
620	0.266	0.111	0.290	0.203	0.347	0.084	0.242	0.272	0.429	0.249
630	0.264	0.115	0.290	0.203	0.347	0.084	0.246	0.271	0.424	0.251
640	0.263	0.120	0.290	0.204	0.346	0.084	0.245	0.269	0.420	0.253
650	0.262	0.126	0.291	0.203	0.342	0.084	0.243	0.268	0.422	0.255
660	-	-	-	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-	-
680	-	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	-	-	-	-	-
700	-	-	-	-	-	-	-	-	-	-
710	0.372	-	-	-	-	-	-	-	-	-
720	0.382	-	-	-	-	-	-	-	-	0.690
730	0.390	-	-	-	0.272	-	-	-	-	0.718
740	0.397	-	0.334	-	0.265	-	-	-	-	0.731
750	0.406	-	0.339	-	0.258	-	-	0.159	-	0.742
760	0.414	-	0.342	0.168	0.252	-	-	0.149	-	0.748
770	0.423	-	0.347	0.167	0.248	-	-	0.149	-	0.750
780	0.431	-	0.351	0.169	0.244	-	-	0.151	-	0.750
790	0.439	-	0.357	0.172	0.245	-	-	0.158	-	0.749
800	0.447	-	0.363	0.179	0.250	-	-	0.167	-	0.747
810	0.454	-	0.372	0.185	0.258	-	-	0.178	-	0.743
820	0.462	-	0.382	0.191	0.269	-	-	0.190	-	0.741
830	0.467	-	0.396	0.196	0.283	-	-	0.198	-	0.740
840	0.477	-	0.410	0.198	0.297	-	-	0.201	-	0.740
850	0.484	-	-	0.199	0.309	-	-	-	-	0.743
860	-	-	-	-	-	-	-	-	-	0.748
870	-	-	-	-	-	-	-	-	-	0.755
880	-	-	-	-	-	-	-	-	-	0.761
890	-	-	-	-	-	-	-	-	-	-
900	-	-	-	-	-	-	-	-	-	-

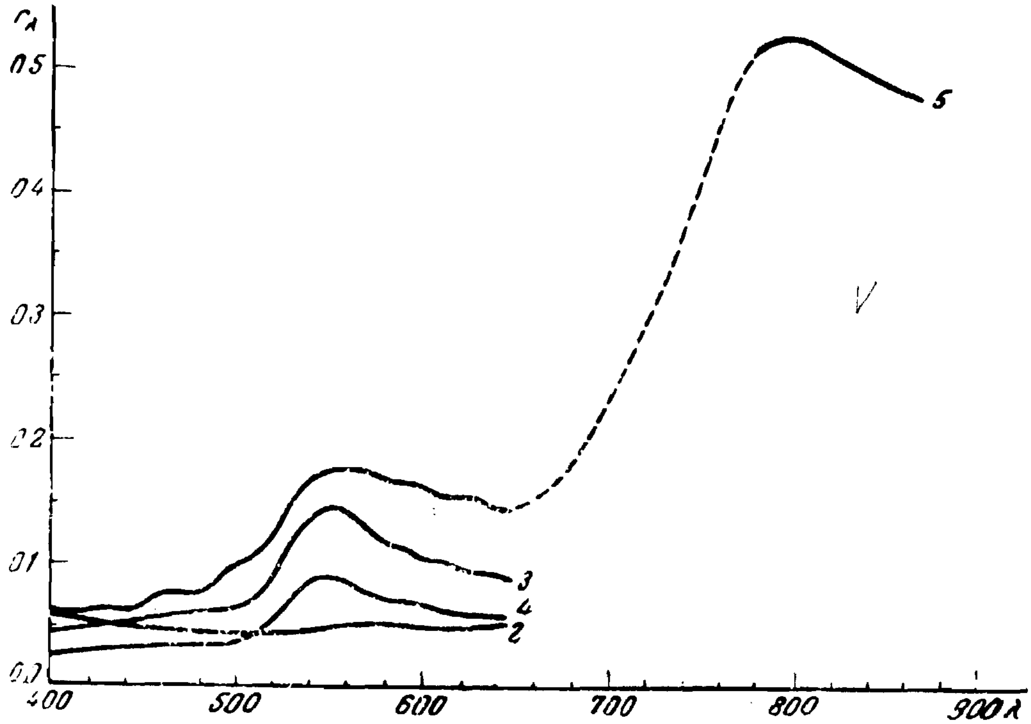
APPENDIX II

Atlas of Reflectance Curves of Natural Formations



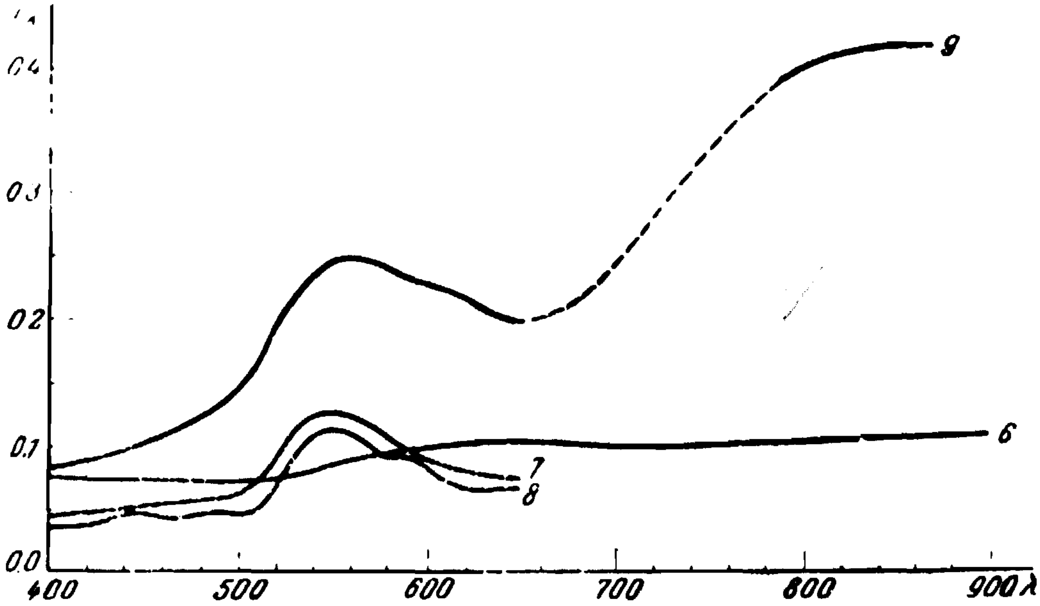
I. Birch, shoots

1. Full leaf



II. Birch, young forest

2. Winter stage ; 3. Young leaf ;
4. Old leaf ; 5. Late summer green



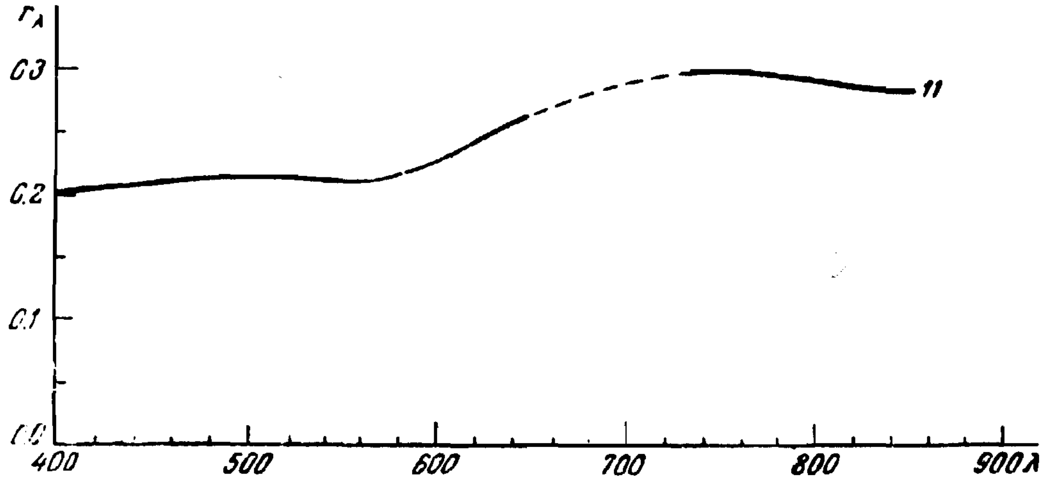
III. Birch, mature forest

6. Winter stage; 7. Young leaf;

8. Full leaf; 9. Late summer green

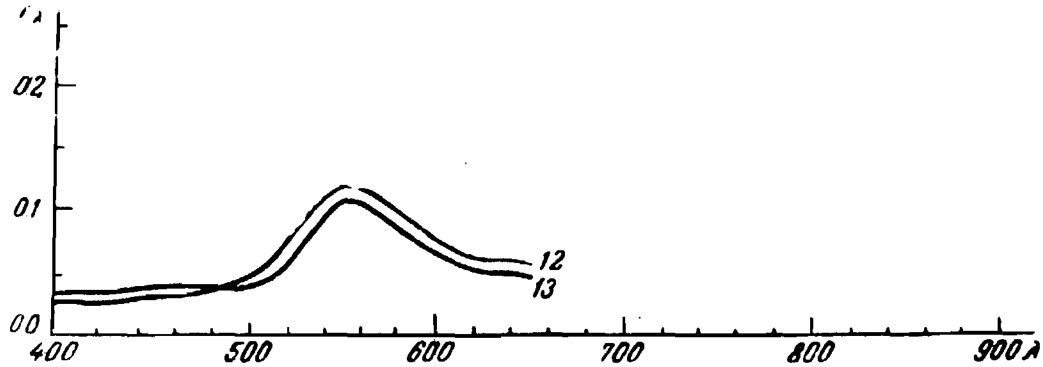
IV. Birch, dwarf

10. Full leaf;



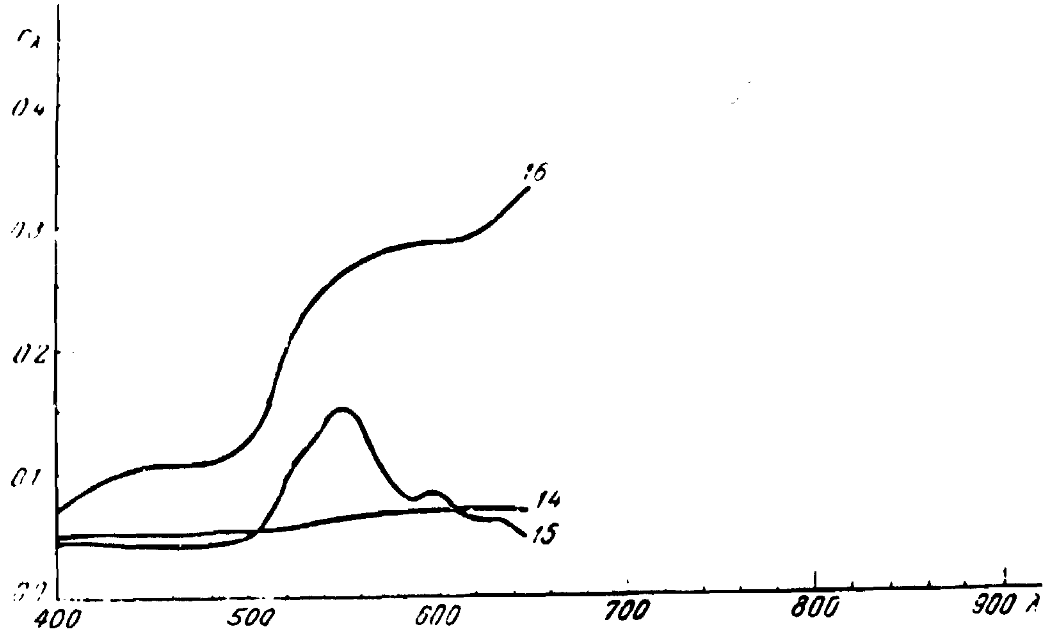
V. Birch bark

11. On a growing tree



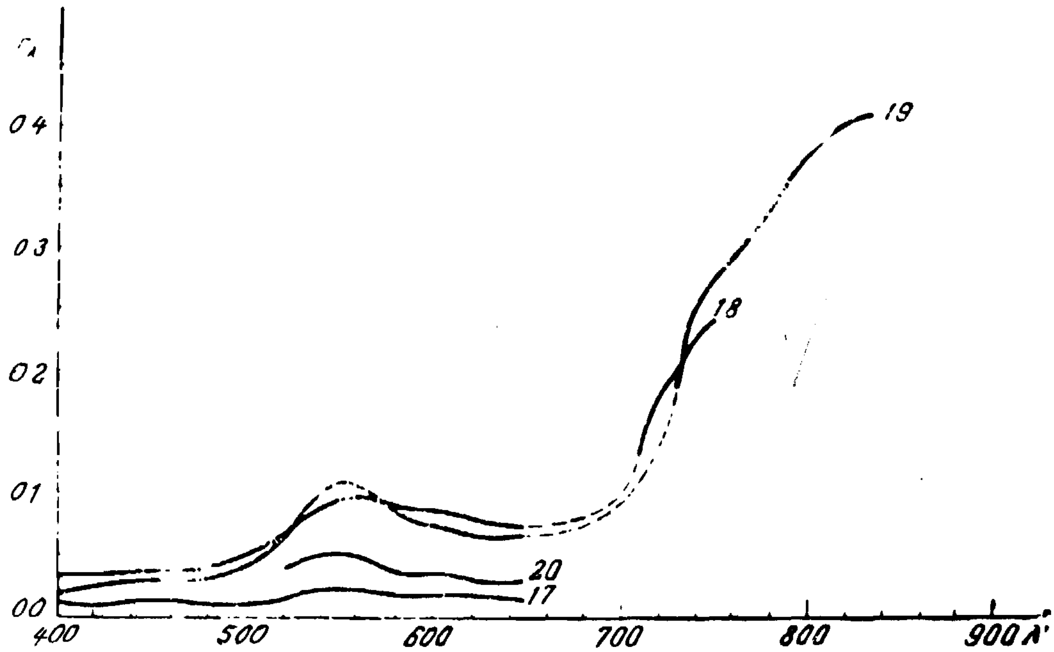
VI. Elm, mature forest

12. Young leaf; 13. Full leaf



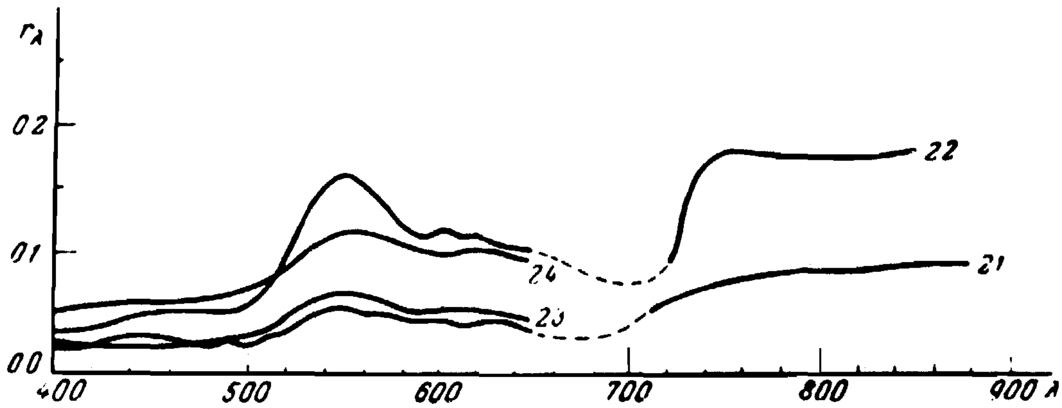
VII. Oak, young forest

14. Winter stage. Mature forest;
15. Full leaf; 16. Autumn color



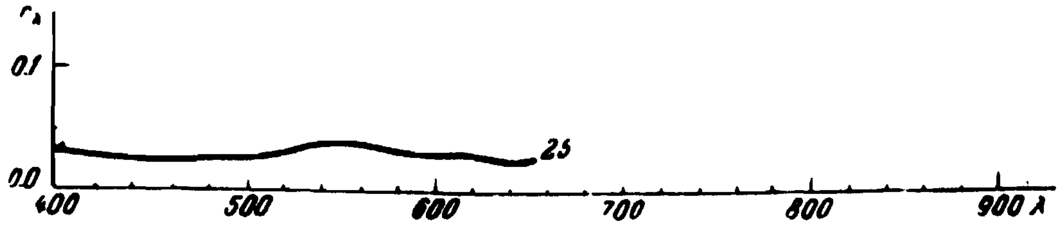
VIII. Fir, young forest

17. Winter stage; 18. Young leaf;
19. Full leaf; 20. Late summer



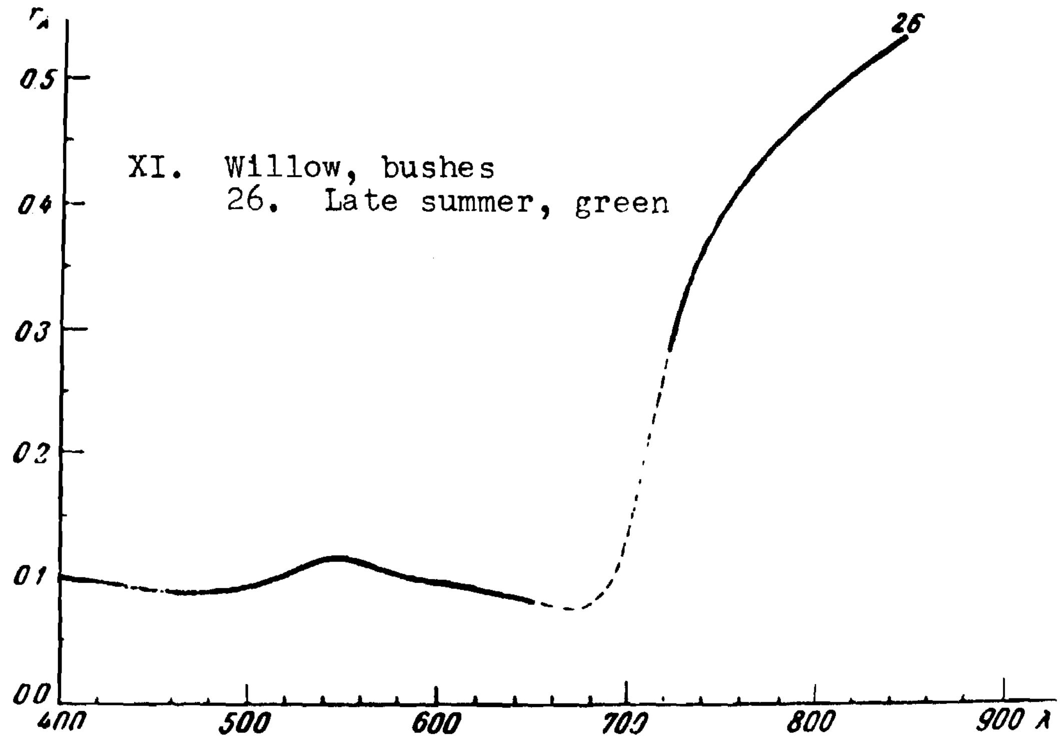
IX. Fir, mature forest

21. Winter stage; 22. Young leaf;
23. Full leaf; 24. Late summer

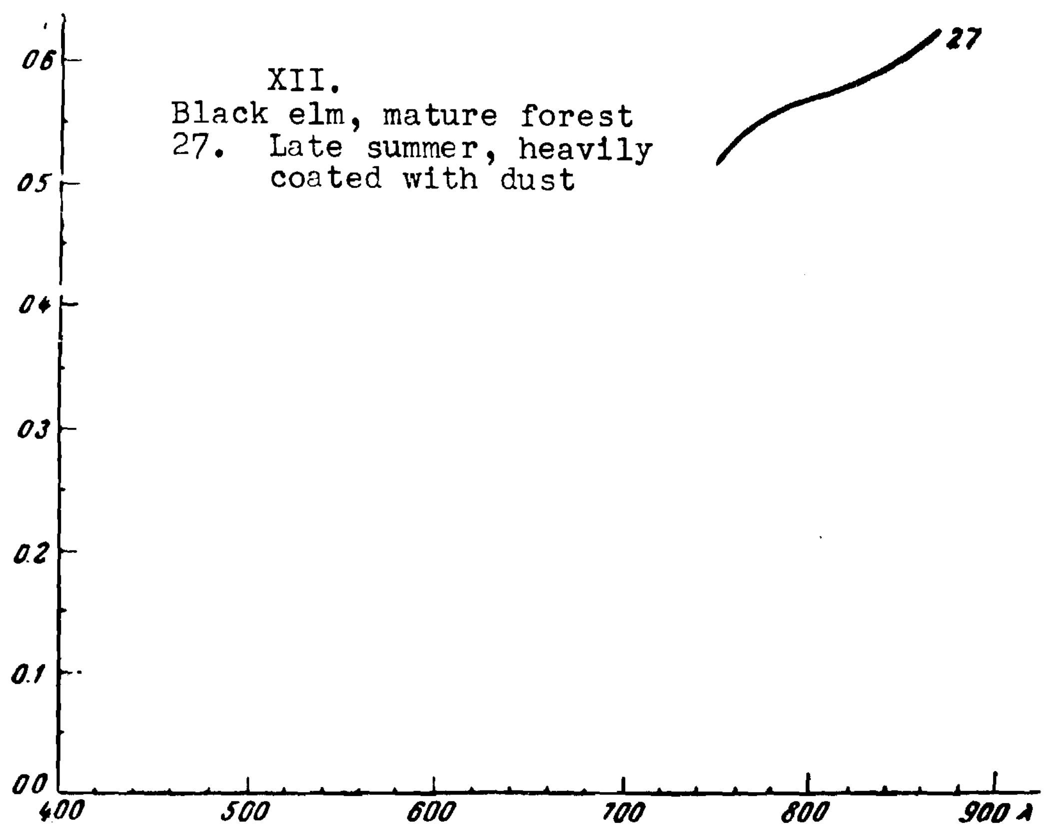


X. Fir, mature forest (from the air, alt. = 300 m.)

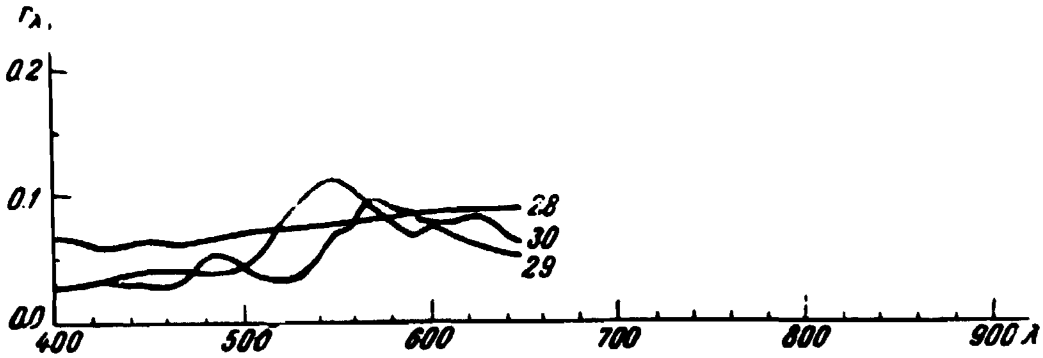
25. Late summer



r_λ
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900 λ
26
XI. Willow, bushes
26. Late summer, green

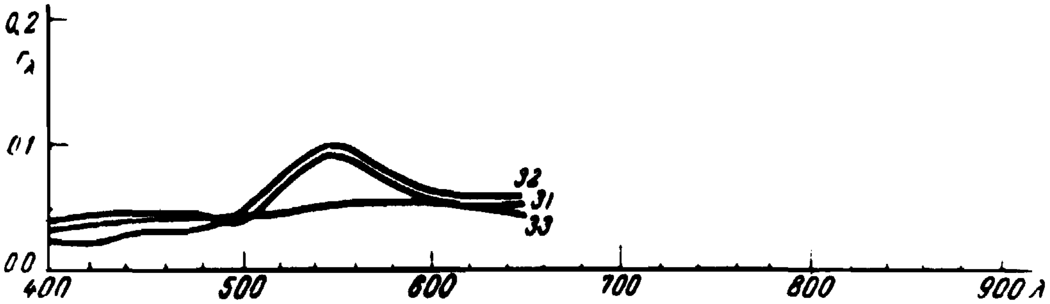


0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900 λ
27
XII.
Black elm, mature forest
27. Late summer, heavily
coated with dust



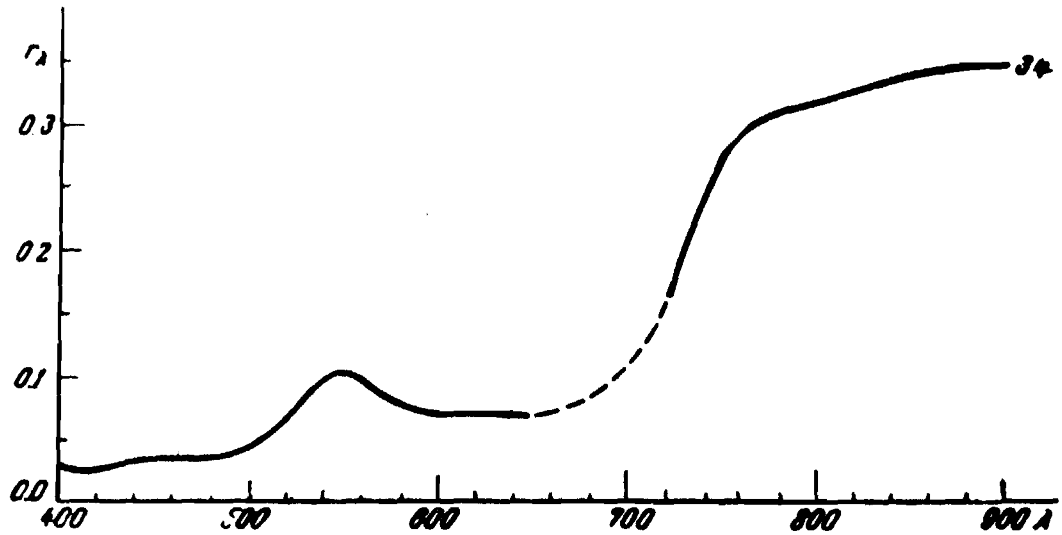
XIII. Linden, mature forest

28. Winter stage; 29. Full leaf; 30. Autumn color



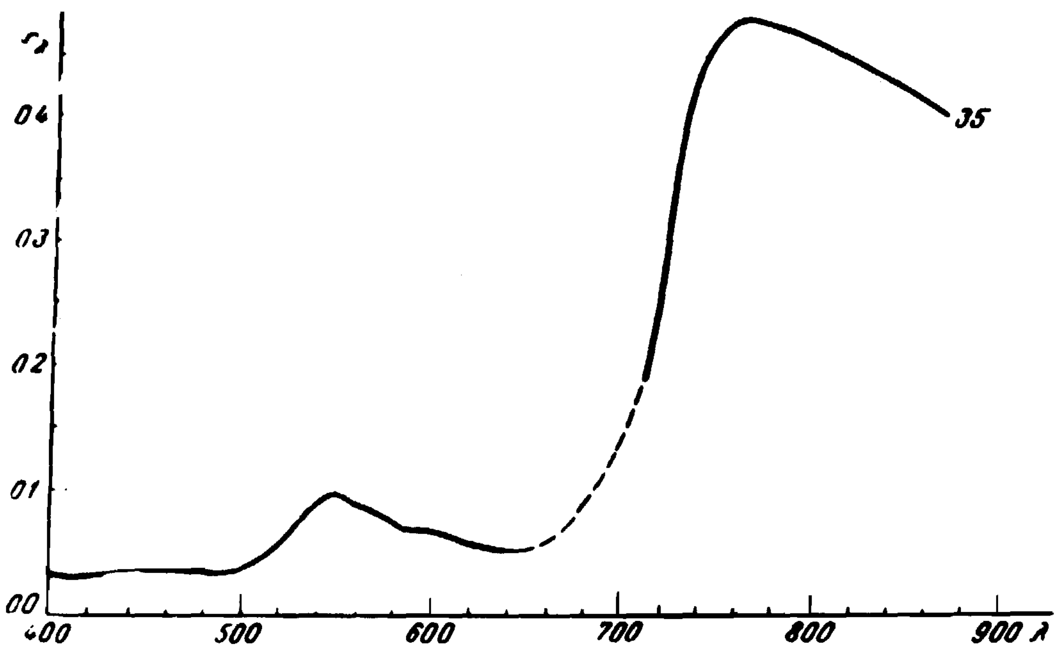
XIV. Larch, young forest

31. Winter stage; 32. Young leaf; 33. Full leaf



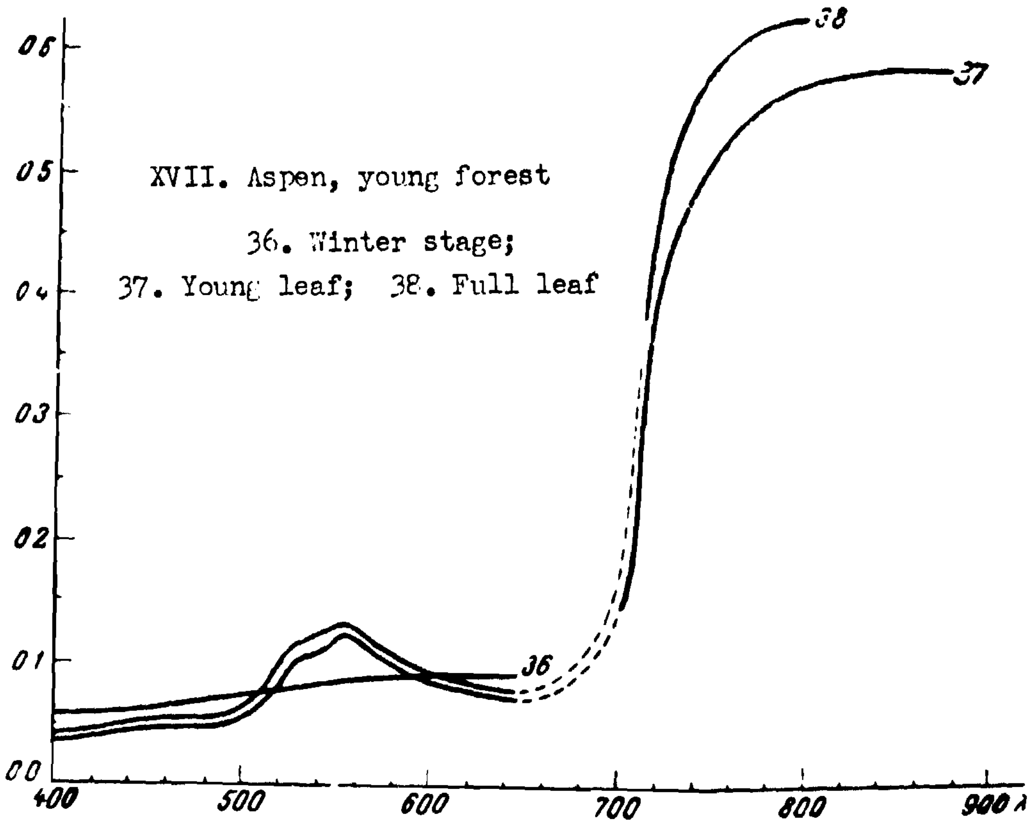
XV. Juniper

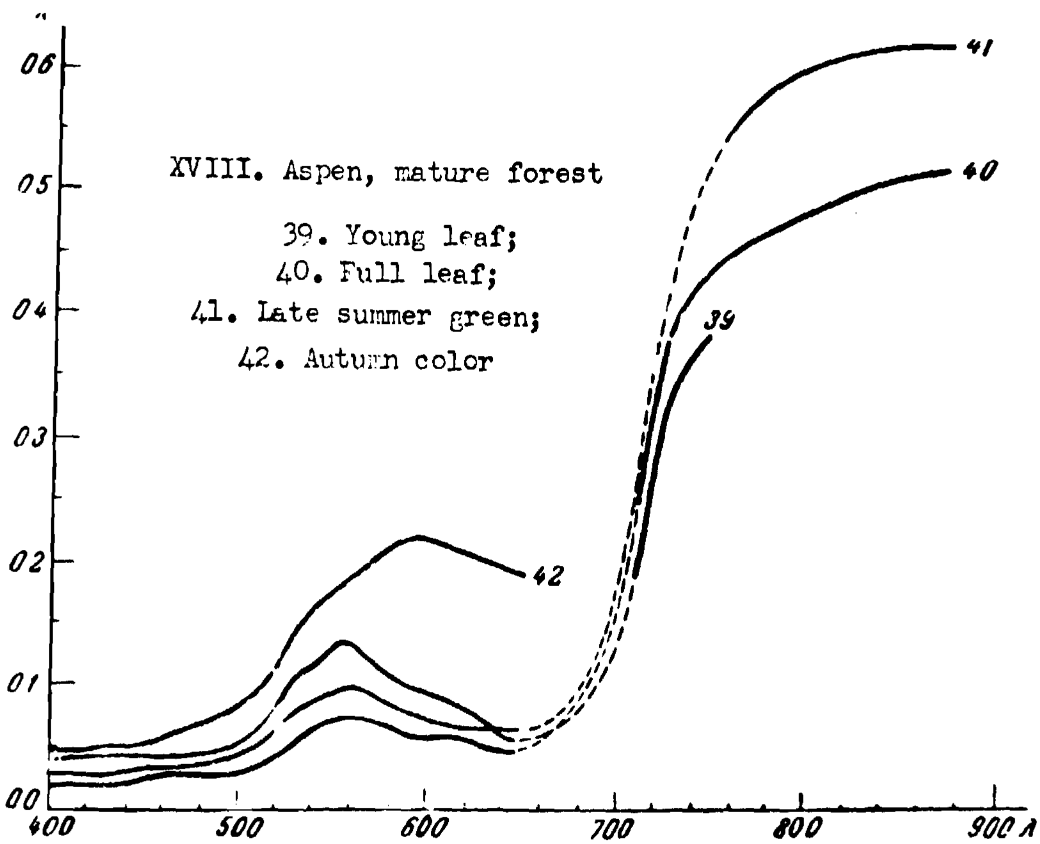
34. Full leaf

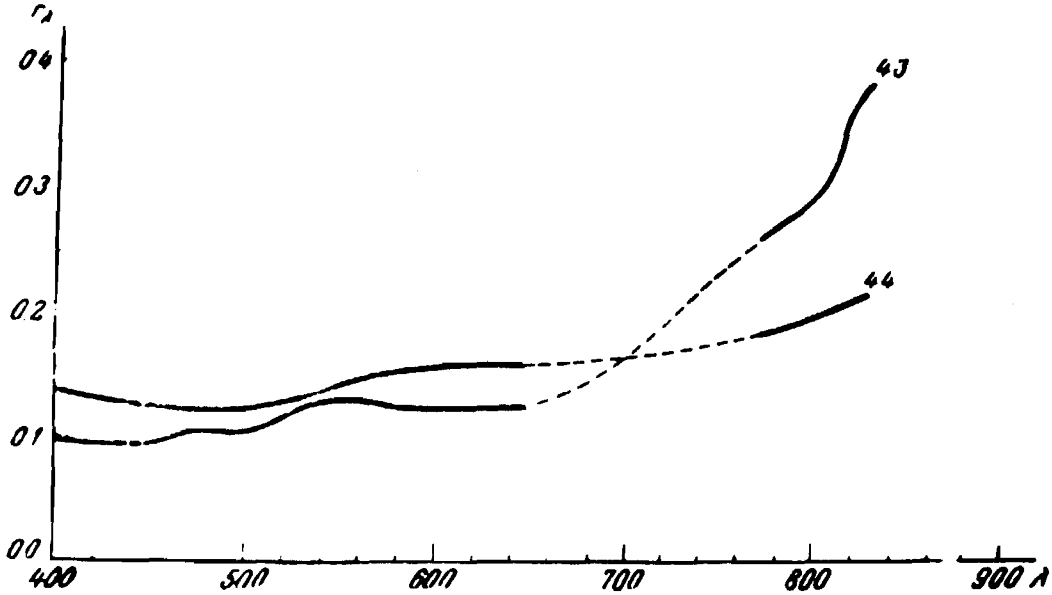


XVI. Alder, young forest

35. Young leaf

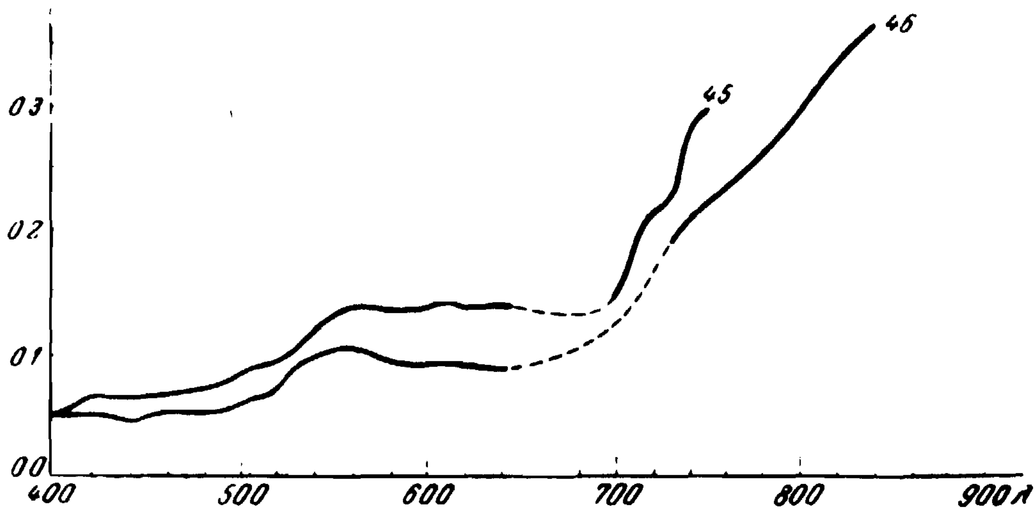

XVII. Aspen, young forest
36. Winter stage;
37. Young leaf; 38. Full leaf
36
37
38
06
05
04
03
02
01
00
400
500
600
700
800
900 λ


XVIII. Aspen, mature forest
39. Young leaf;
40. Full leaf;
41. Late summer green;
42. Autumn color
39
40
41
42
06
05
04
03
02
01
00
400
500
600
700
800
900 λ



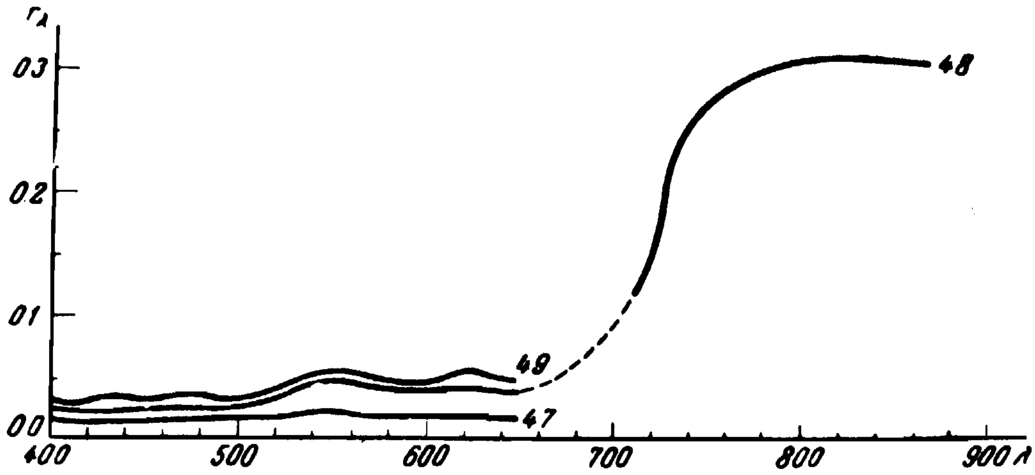
XIX. Haloxylon, mature forest

43. Late summer green; 44. Dried



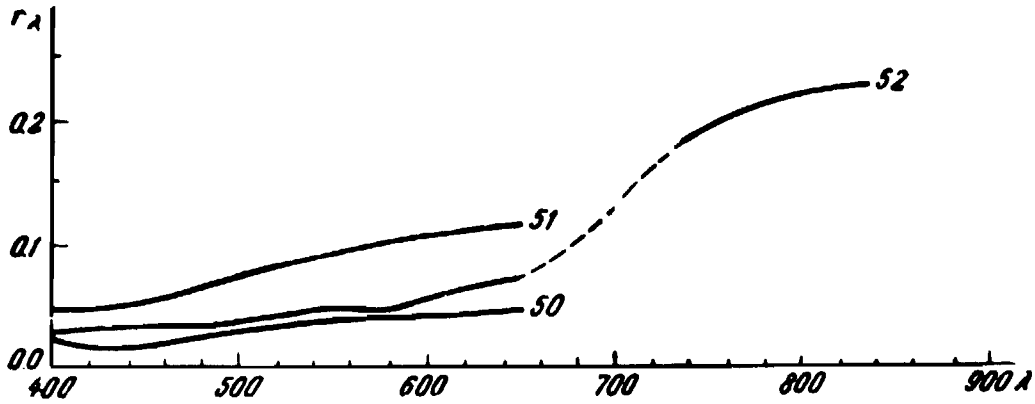
XX. Pine, young forest

45. Young leaf; 46. Full leaf



XXI. Pine, mature forest

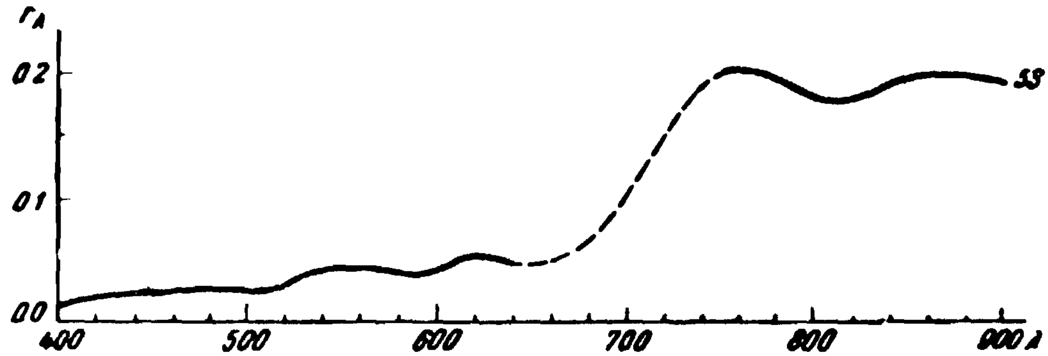
47. Winter stage; 48. Young leaf; 49. Full leaf



XXII. Weeds, dense growth (drying, brownish)

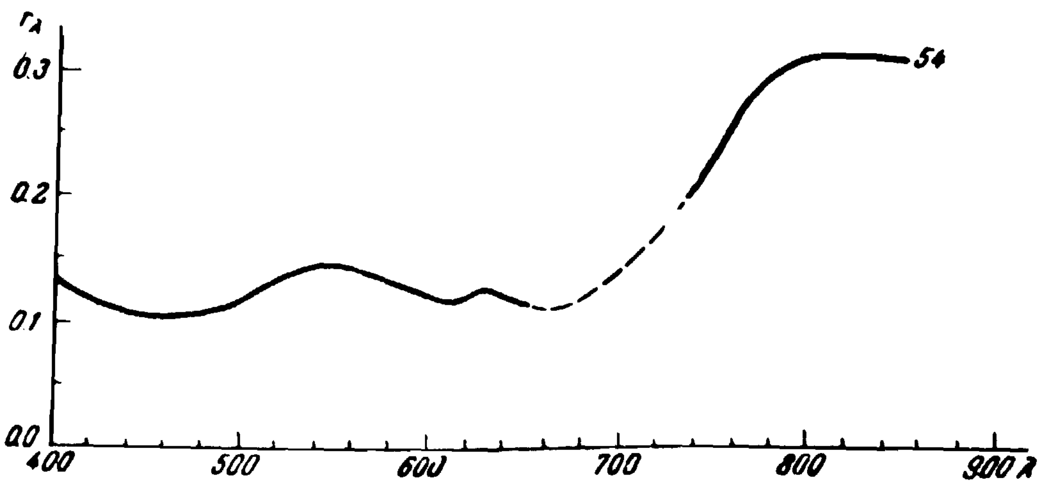
50. Normal, cloudy sky; 51. <= 30°, cloudy sky;

52. <= 45°, A = 90°



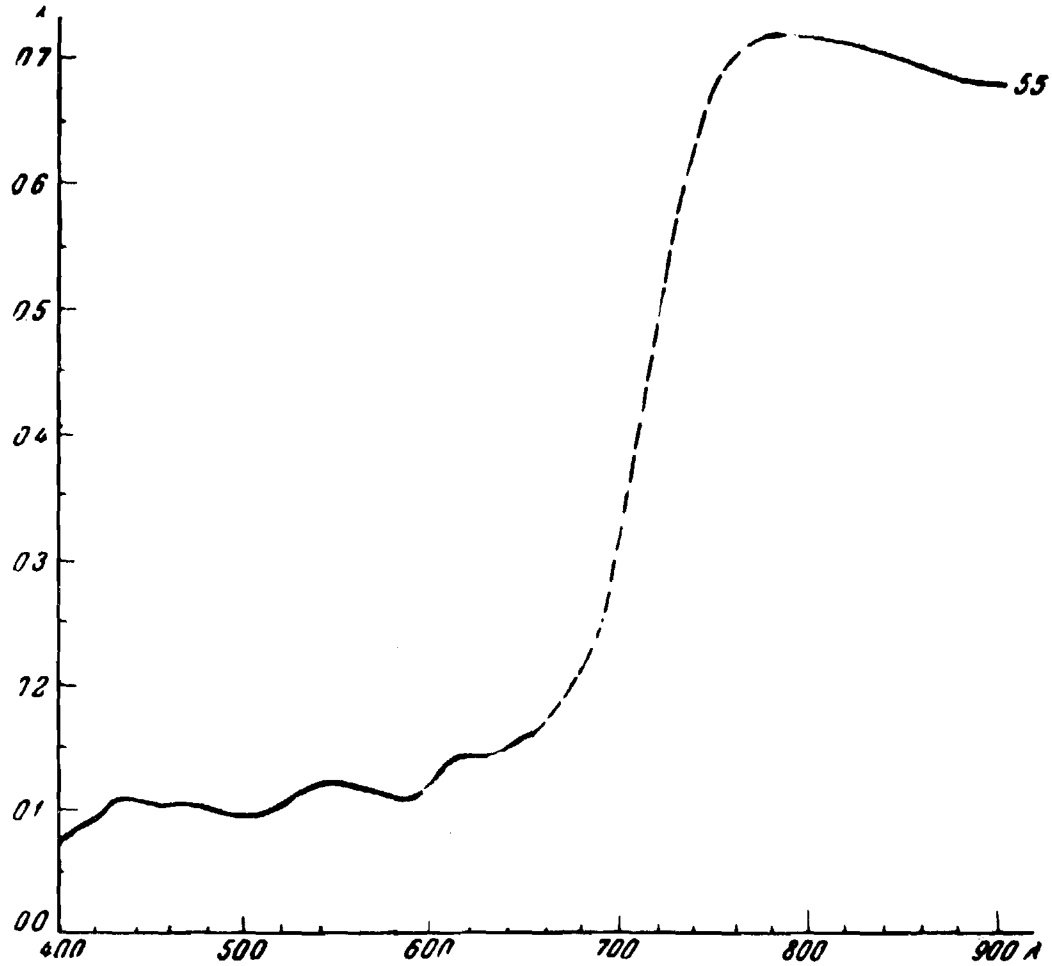
XXIII. Heather, dense growth

53. Before flowering



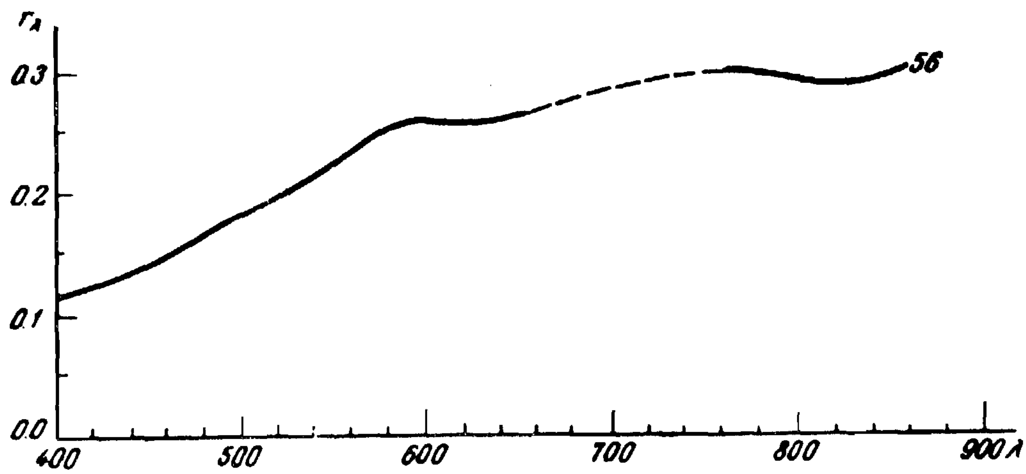
XXIV. River valley with meadows

54. End of summer



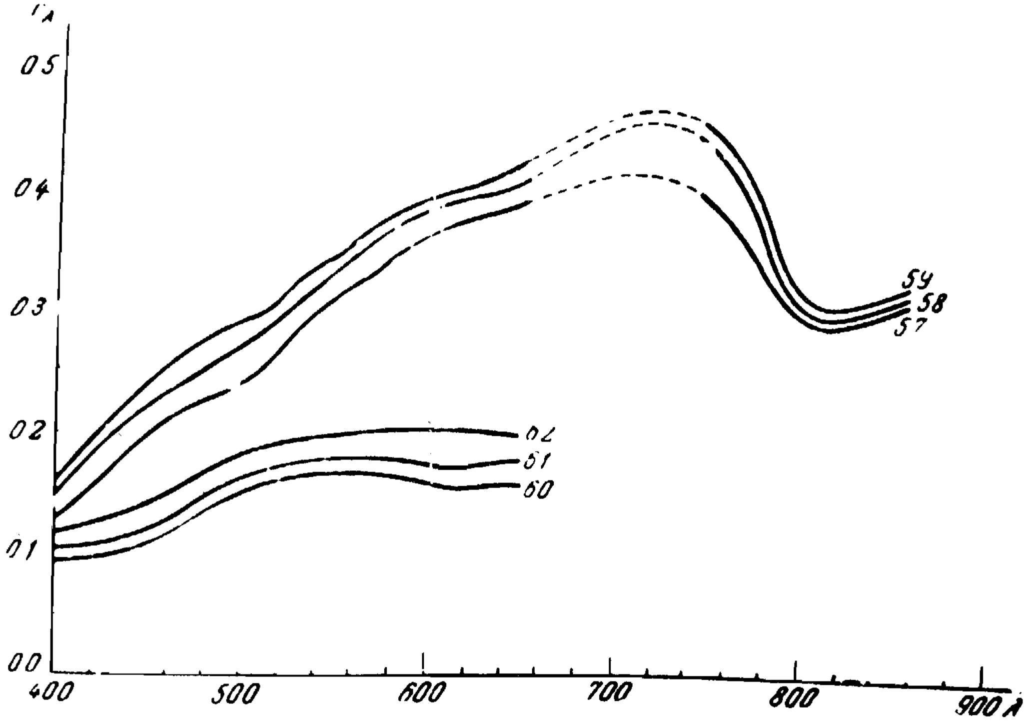
XXV. Willow herb, dense growth

55. Flowering period



XXVI. Ilyas, dried

56. Normal

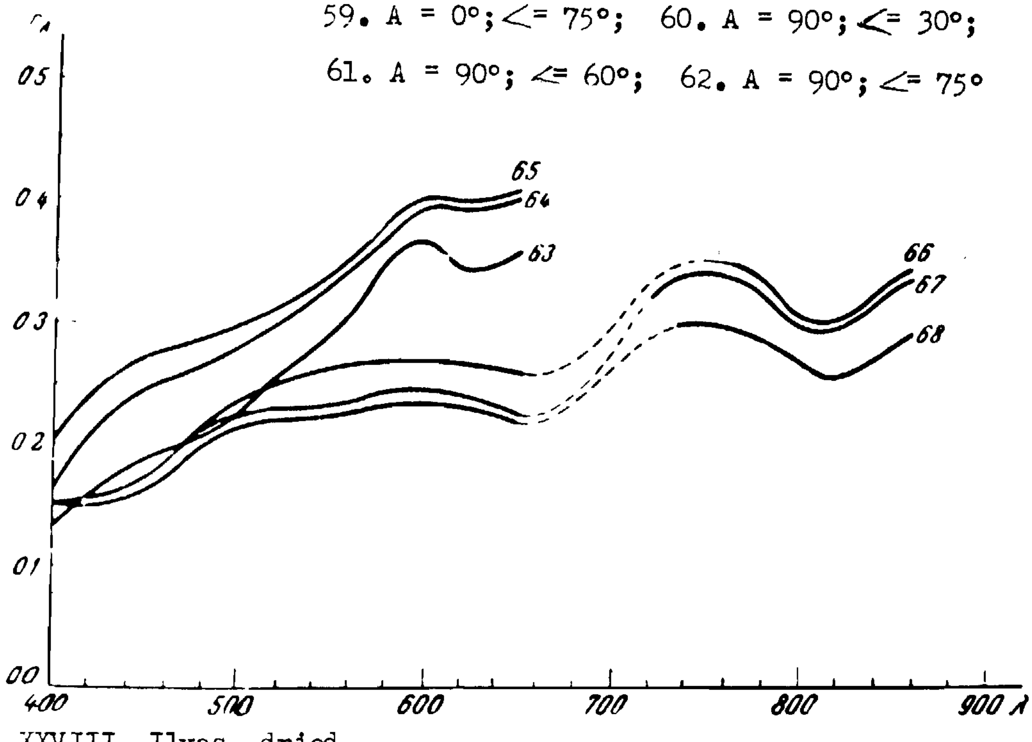


XXVII. Ilyas, dried

57. A = 0°; ∠= 30°; 58. A = 0°; ∠= 60°;

59. A = 0°; ∠= 75°; 60. A = 90°; ∠= 30°;

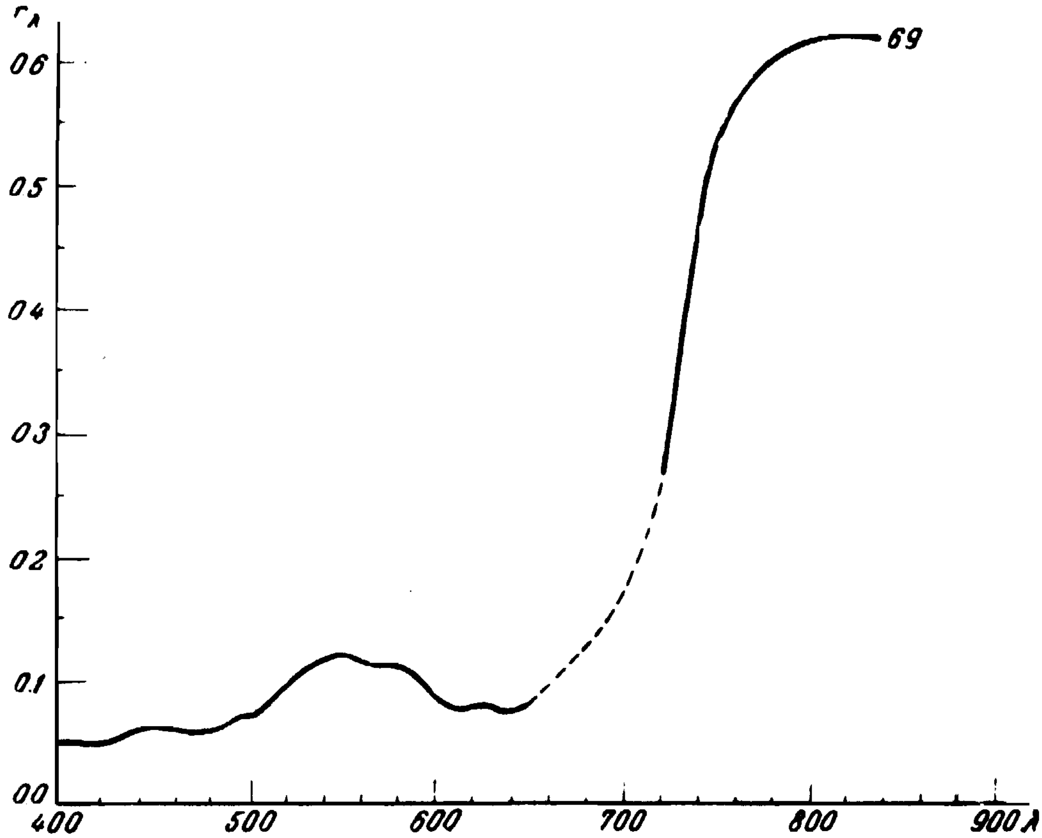
61. A = 90°; ∠= 60°; 62. A = 90°; ∠= 75°



XXVIII. Ilyas, dried

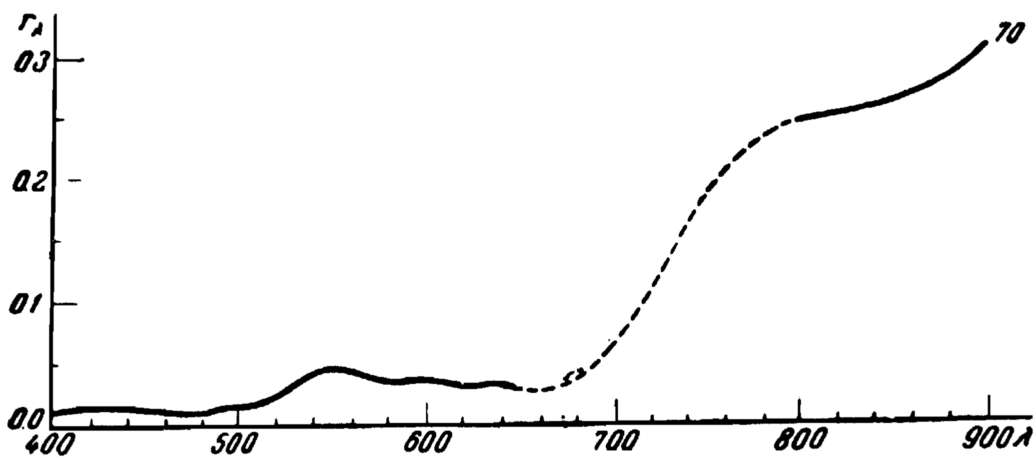
63. A = 180°; ∠= 30°; 64. A = 180°; ∠= 60°; 65. A = 180°; ∠= 75°;

66. A = 270°; ∠= 30°; 67. A = 270°; ∠= 60°; 68. A = 270°; ∠= 75°



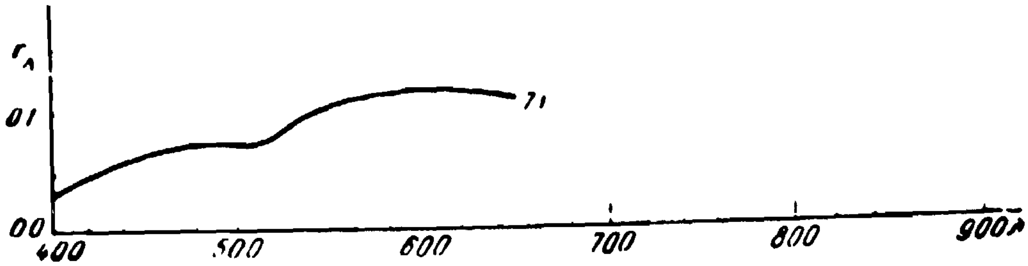
XXIX. Reeds, in lake near shore

69. Bright green



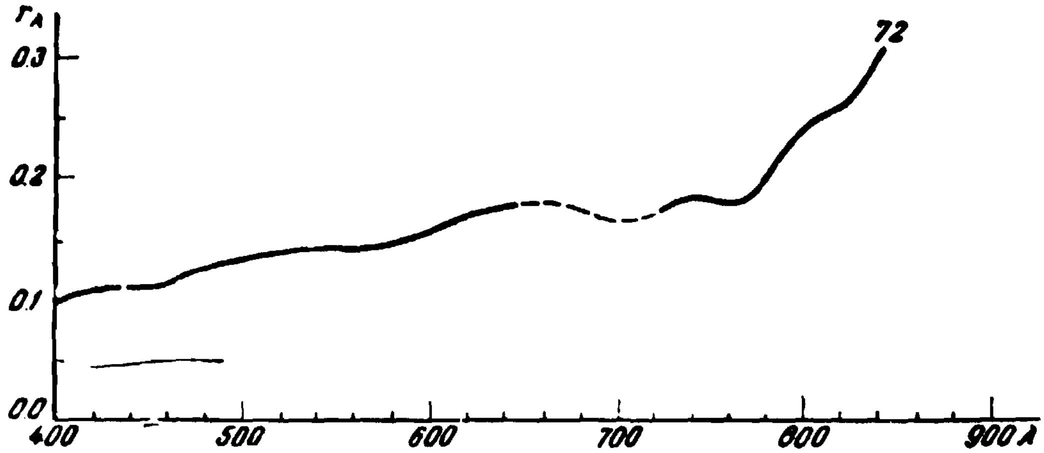
XXX. Turf hillock, covered with grass & European blueberry

70. Normal



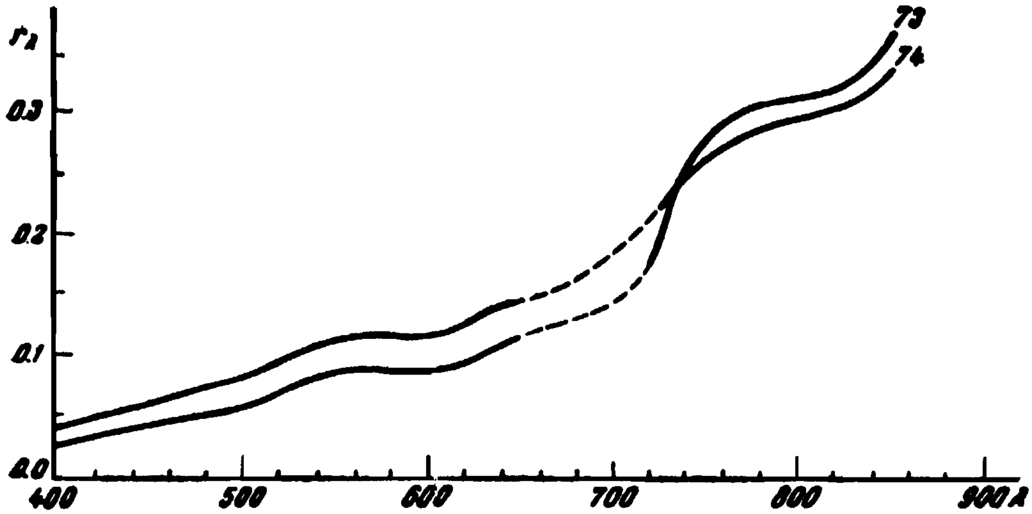
XXXI. Edge of ravine

71. Normal



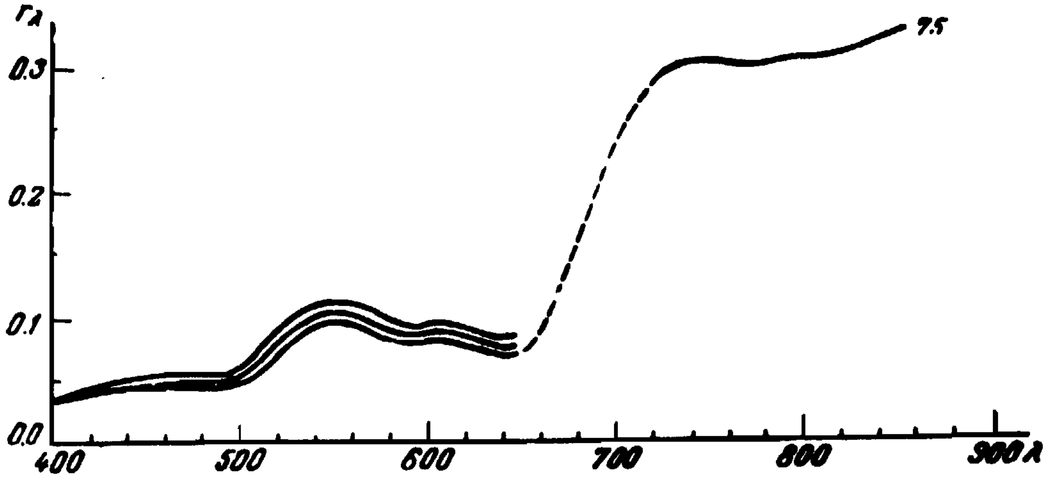
XXXII. Edge of river bank, with sparse semi-dried grass

72. Normal



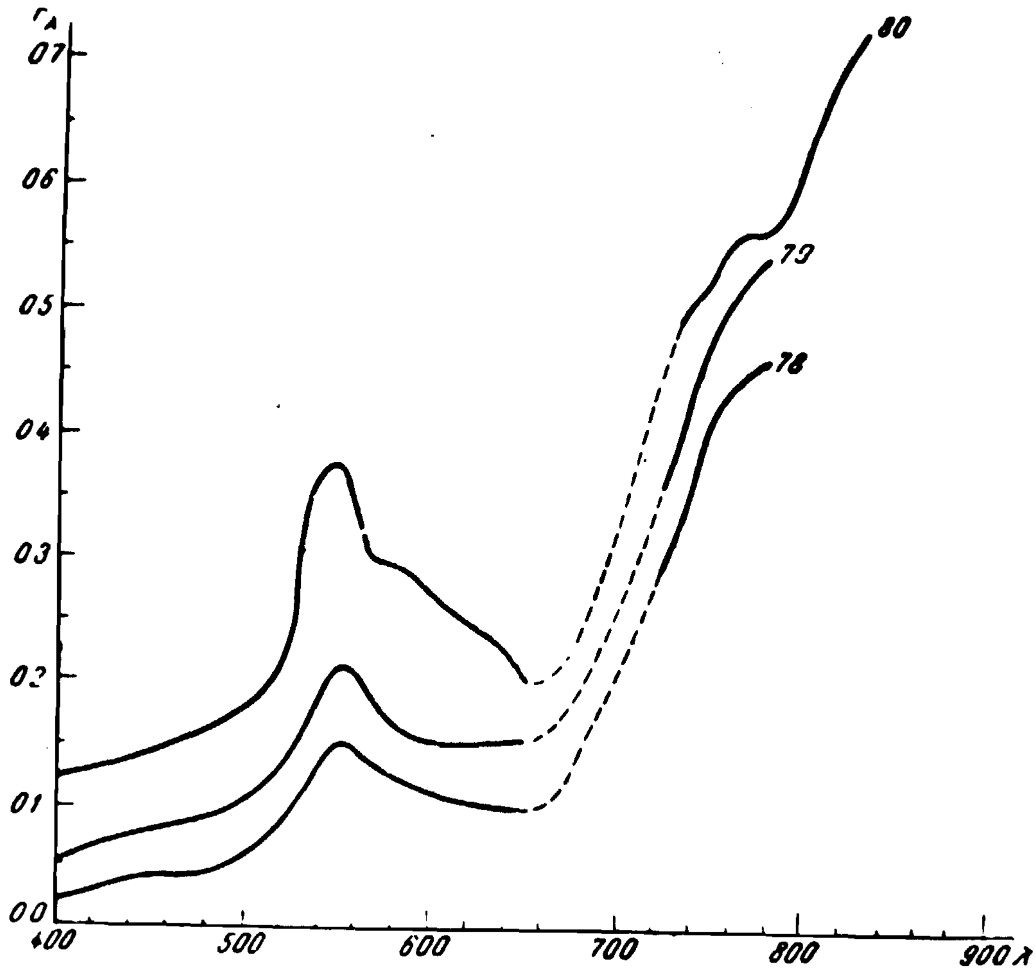
XXXIII. Meadow, alpine

73. Sparse, drying grass; 74. Mowed



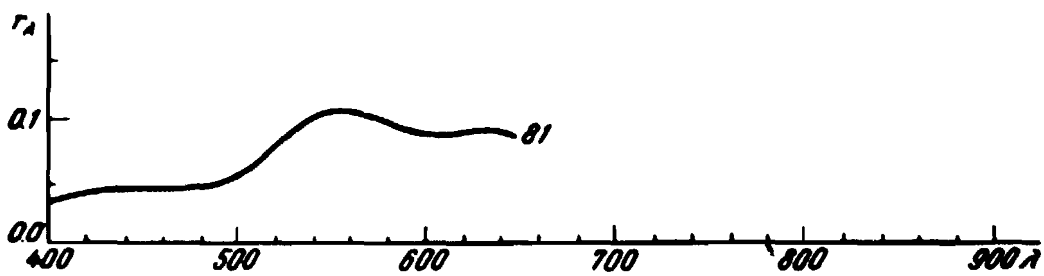
XXXIV. Pasture meadow, in black earth region

75. Normal



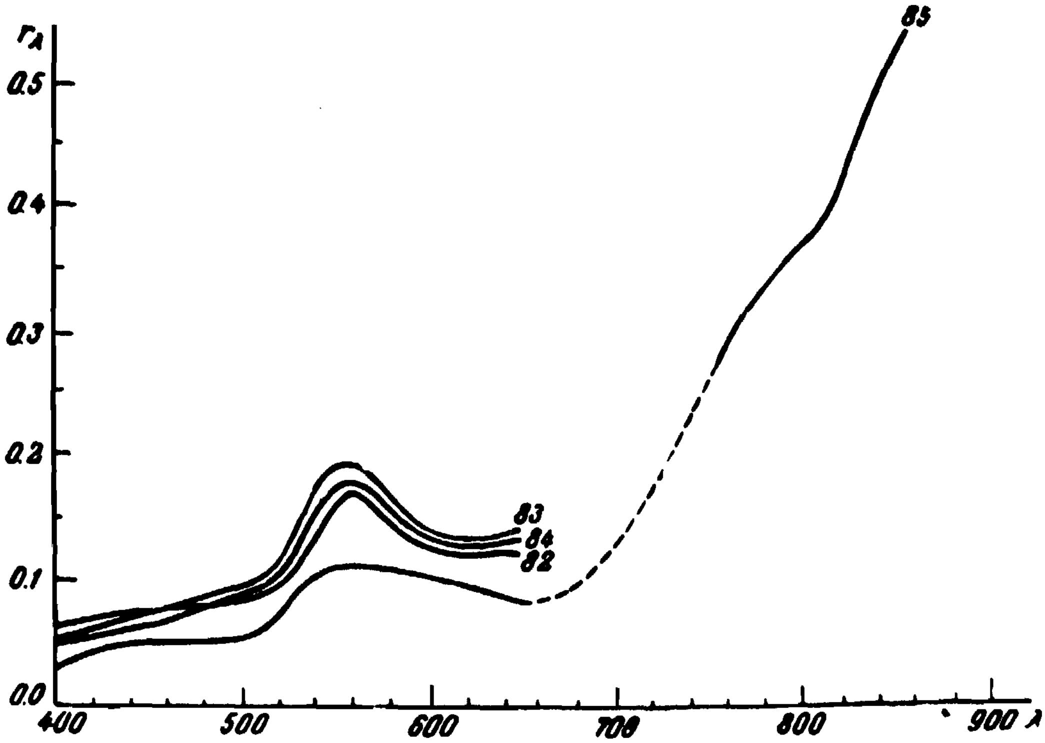
XXXV. Pasture meadow in steppe region

78. Normal; 79. ∠= 30°; cloudy sky; 80. ∠= 60°; cloudy sky;



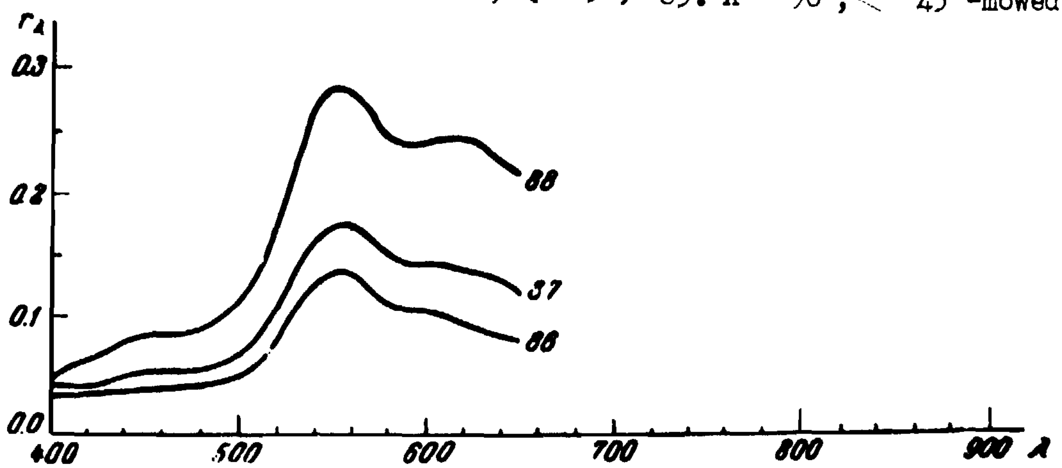
XXXVI. Pasture meadow in mountain region

81. Normal



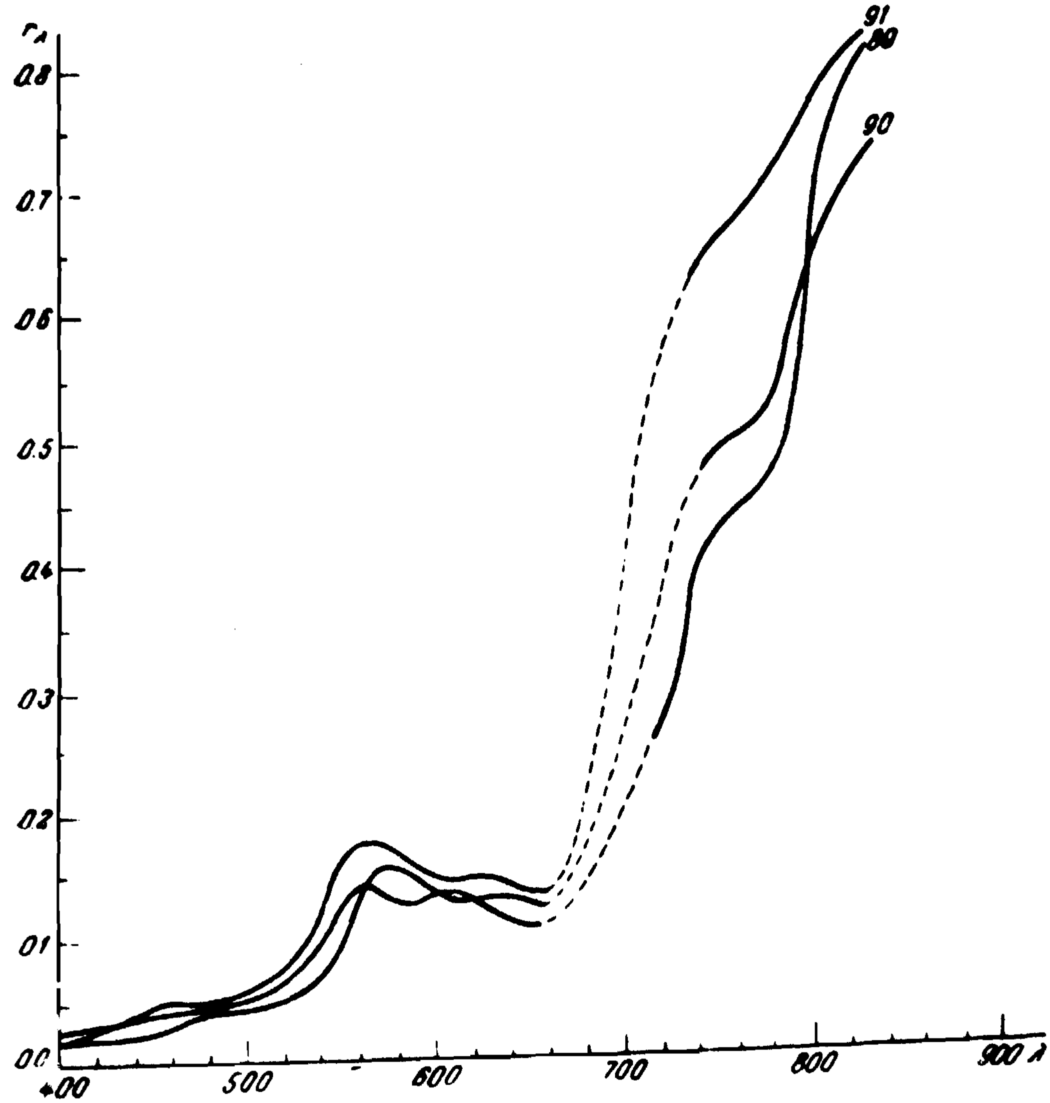
XXXVII. Meadow with clover and timothy in bloom

82. A = 90°; ∠ = 45°; 83. A = 90°; ∠ = 65°;
84. A = 90°; ∠ = 85°; 85. A = 90°; ∠ = 45°-mowed



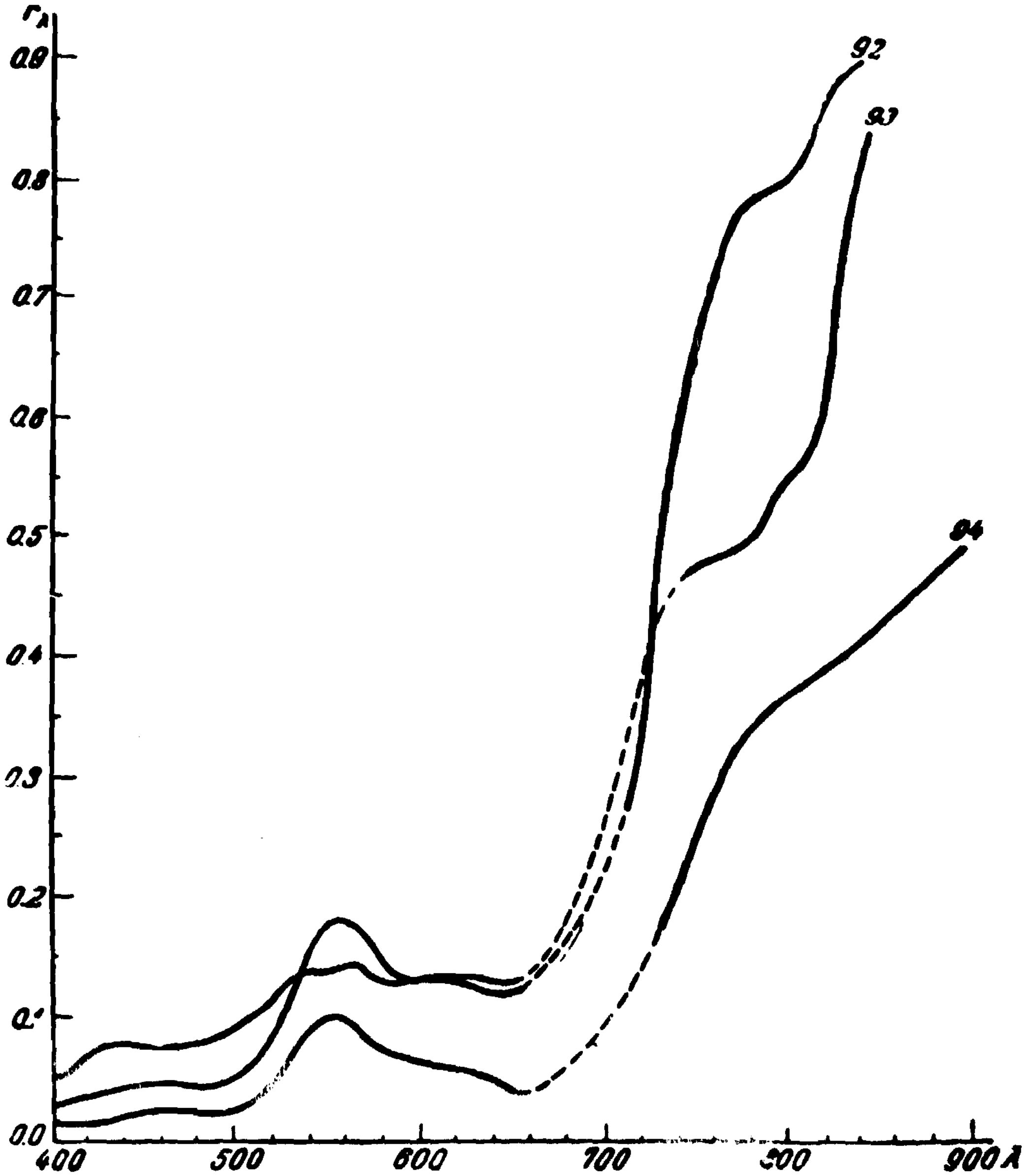
XXXVIII. Meadow with clover and timothy, mowed and wet

86. ∠ = 45°; cloudy sky; 87. ∠ = 65°, cloudy sky;
88. ∠ = 85°, cloudy sky



XXXIX. Meadow with crow foot, abundant bloom

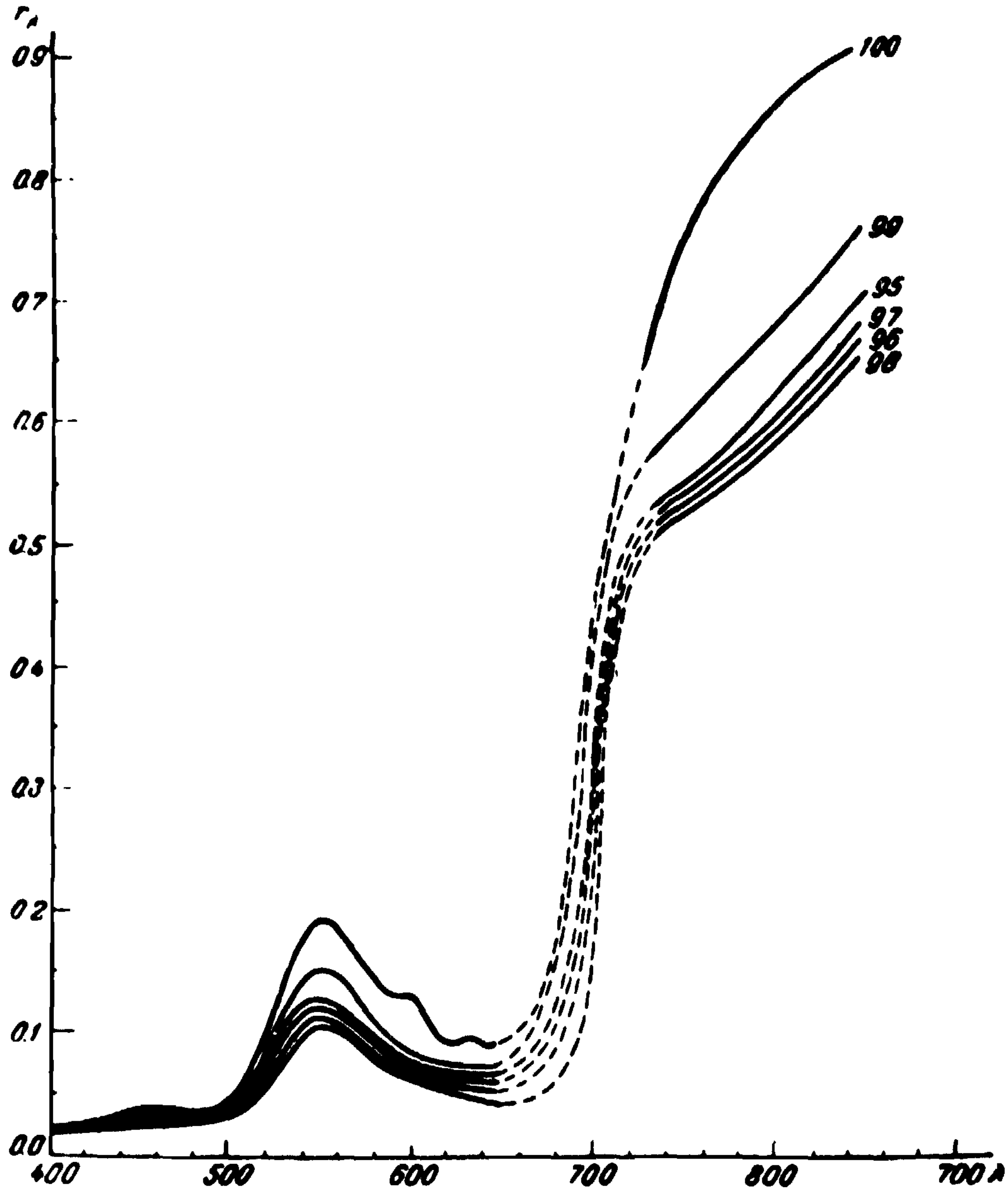
89. A = 90°; ∠ = 45°; 90. A = 90°; ∠ = 65°; 91. A = 90°; ∠ = 85°



XL. Meadows

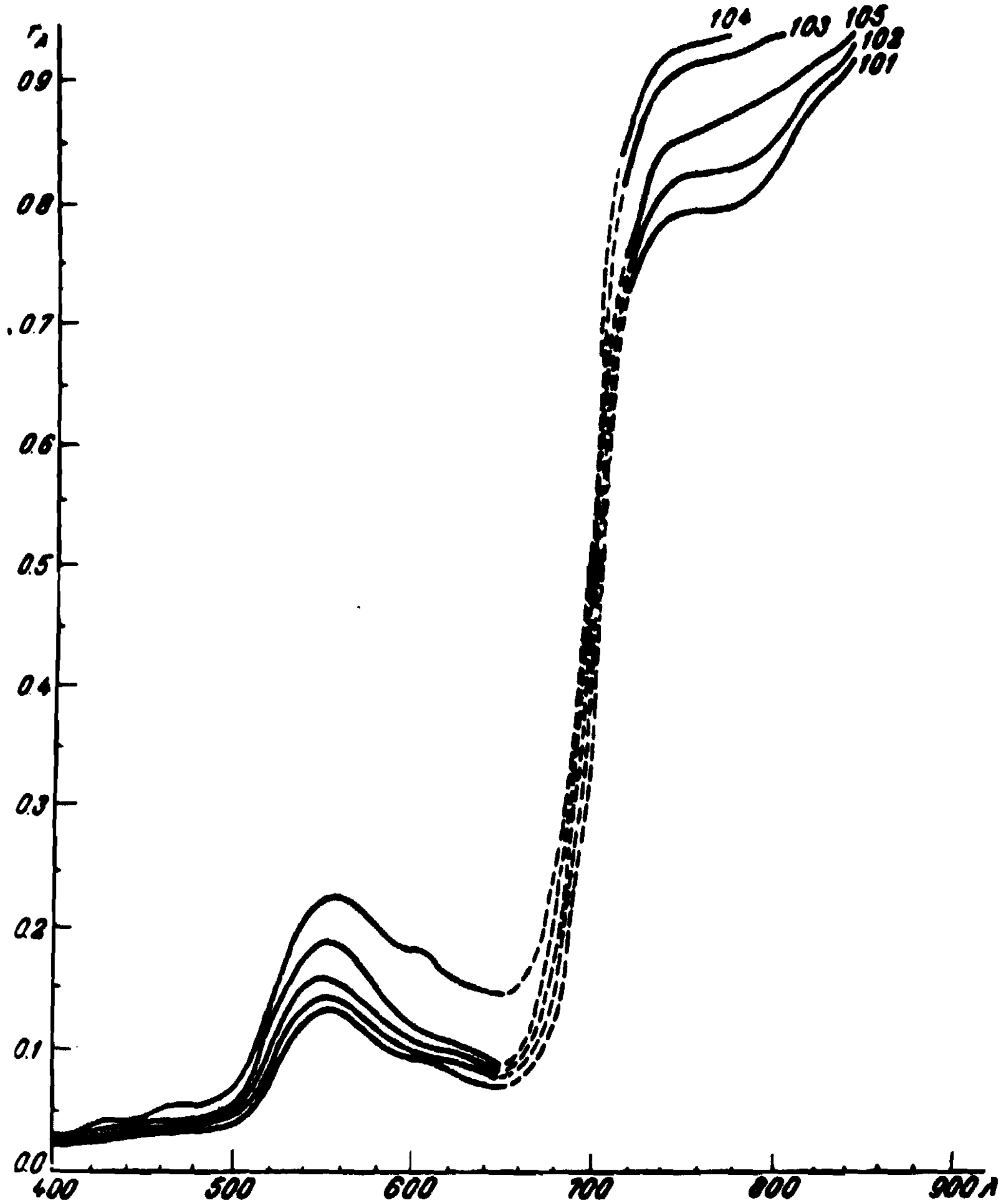
92. **Sedge,** A = 90°; < = 45°; 93. With daisies, A = 90°; < = 45°

94. Lush, normal



XLI. Meadow, dry, alt. of sum 25°

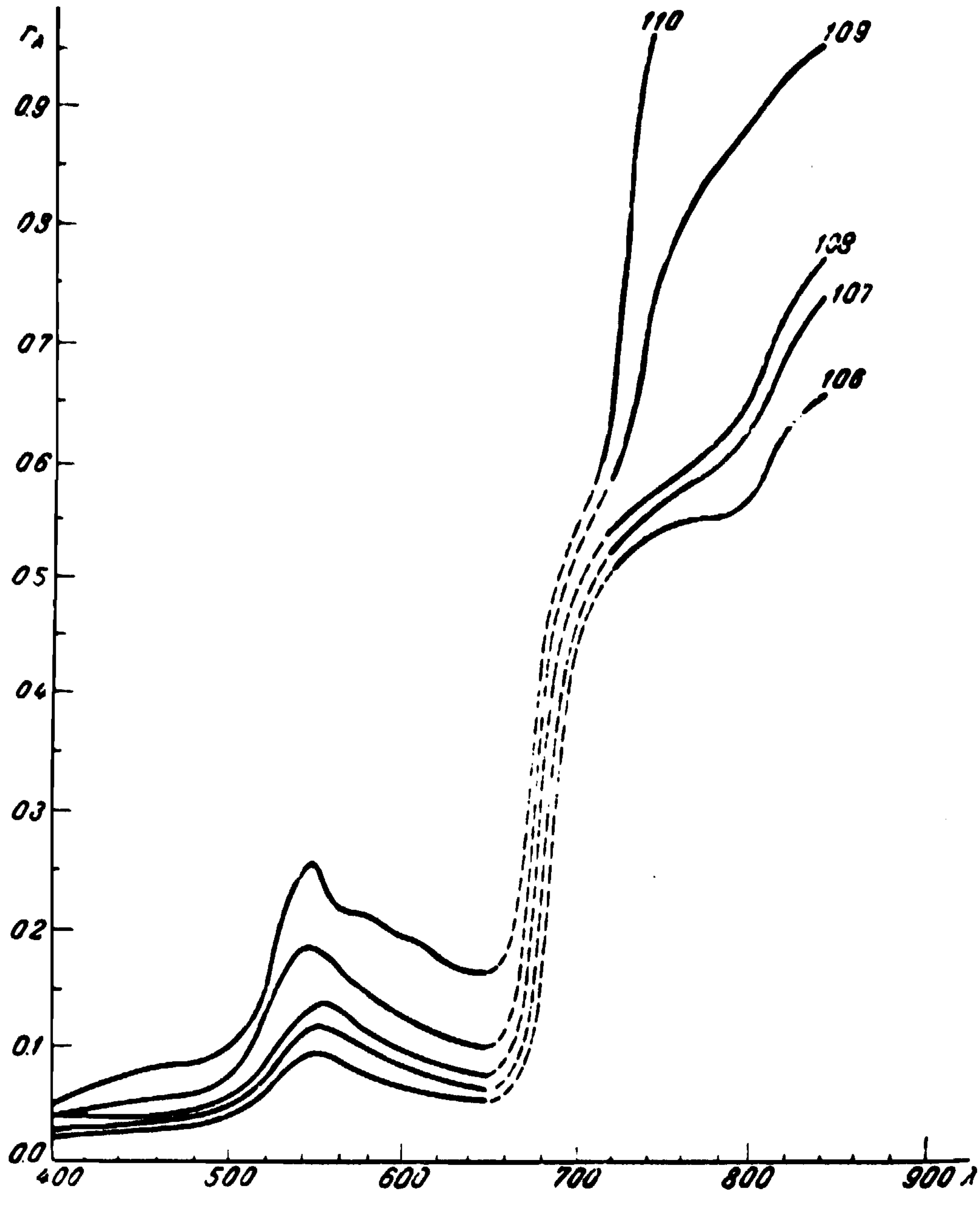
95. Normal; 96. A = 0°; <= 15°; 97. A = 0°; <= 30°; 98. A = 0°; <= 45°; 99. A = 0°; <= 60°; 100. A = 0°; <= 75°



XLII. Meadow, dry, alt. of sun 25°

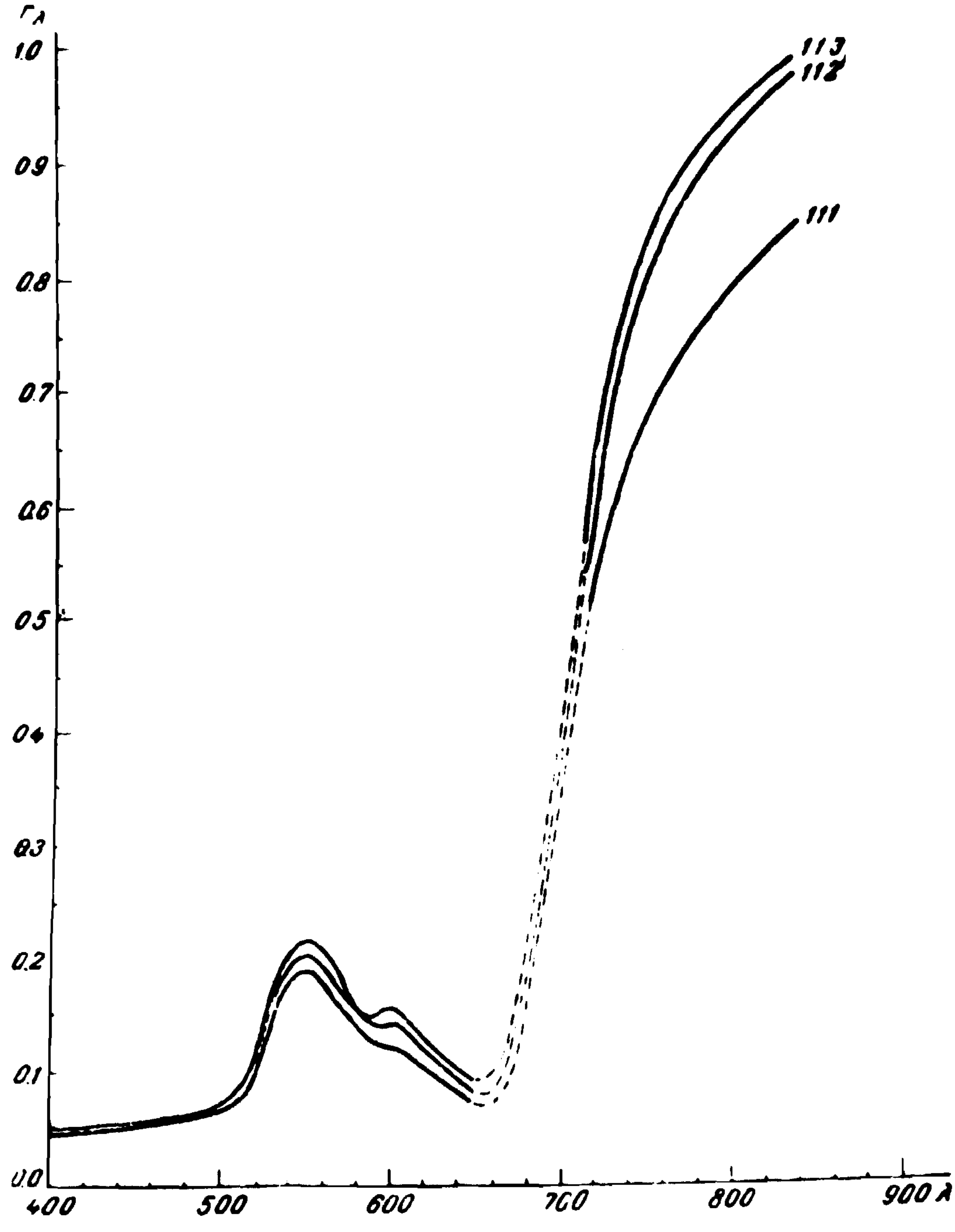
101. A = 90°; ∠= 15°; 102. A = 90°; ∠= 30°; 103. A = 90°; ∠= 45°;

104. A = 90°; ∠= 60°; 105. A = 90°; ∠= 75°



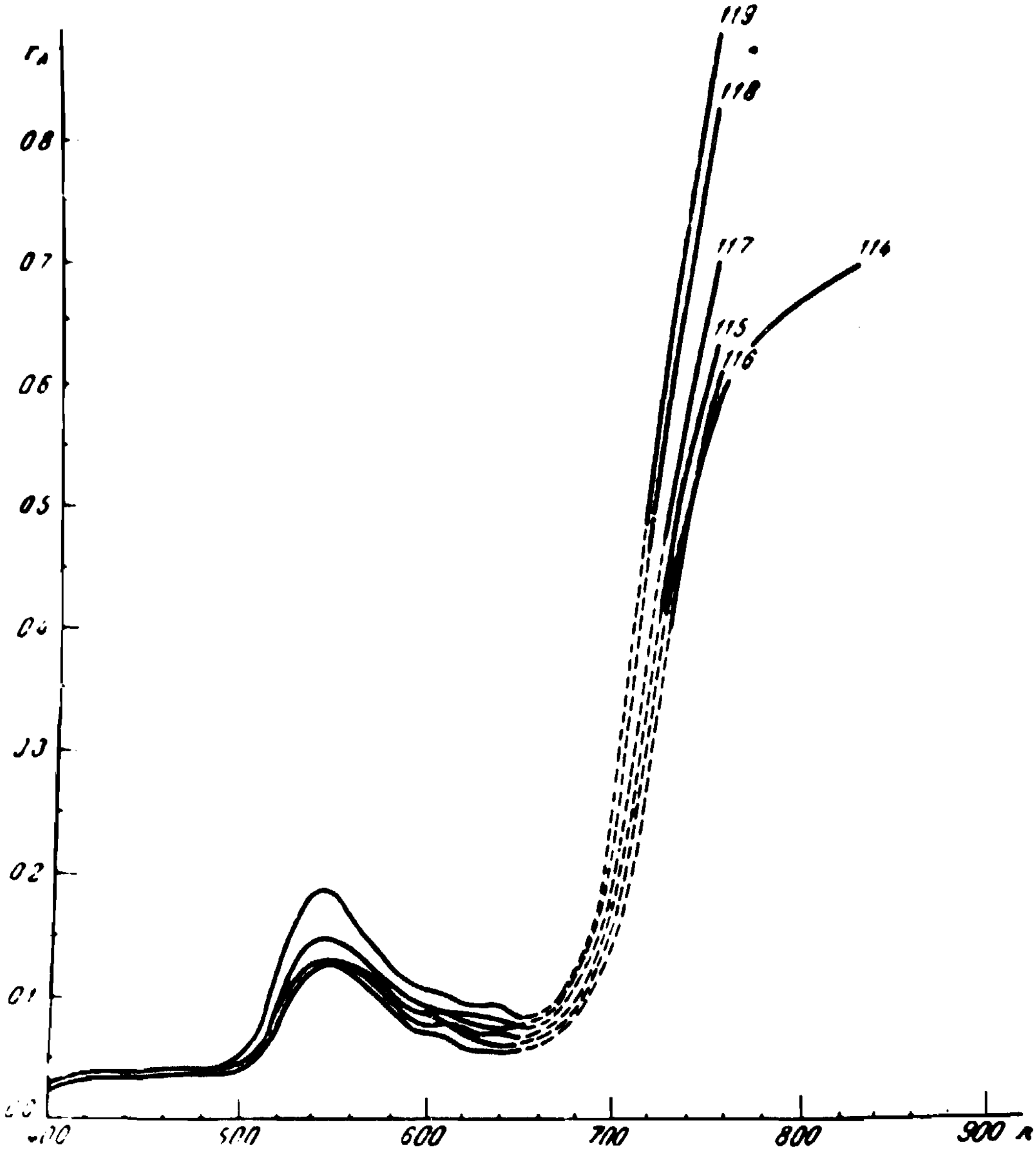
XLIII. Meadow, dry, alt. of sun 25°.

106. A = 180°, ∠ = 15°; 107. A = 180°, ∠ = 30°;
108. A = 180°, ∠ = 45°; 109. A = 180°, ∠ = 60°;
110 A = 180°, ∠ = 75°.



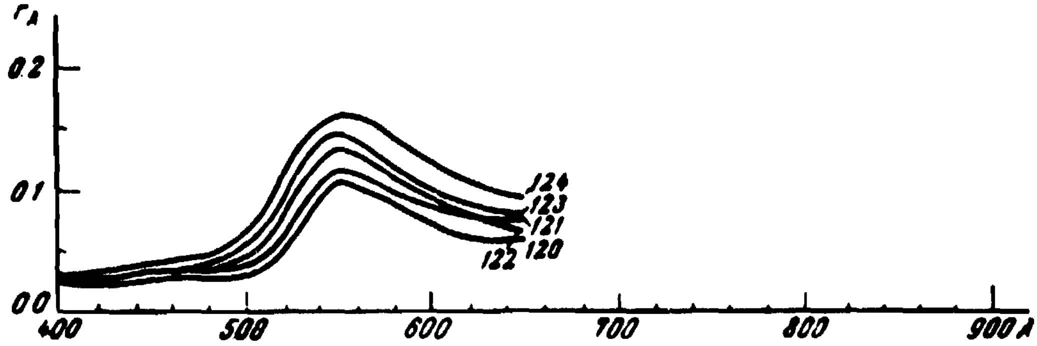
XLIV. Meadow, dry, alt. of sun 25°.

111. A = 270°, < = 45°; 112. A = 270°, < = 60°;
113. A = 270°, < = 75°.



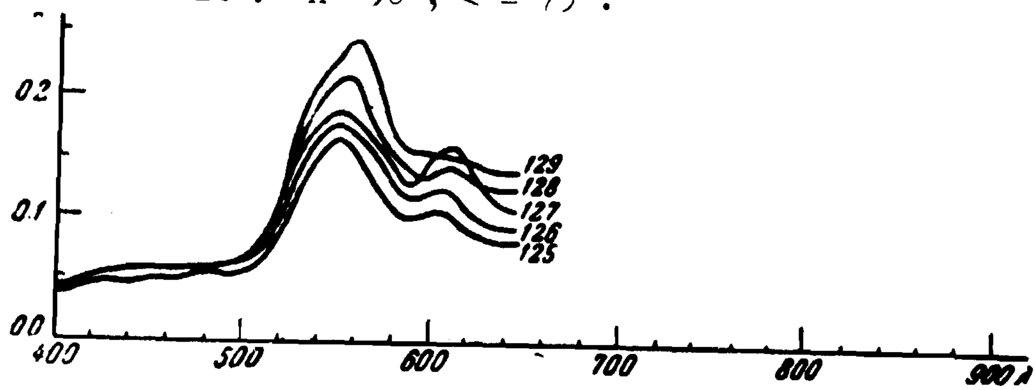
XLV. Meadow, dry, alt. of sun 45°.

114. Normal; 115. A = 0°, < = 15°; 116. A = 0°, < = 30°; 117. A = 0°, < = 45°; 118. A = 0°, < = 60°; 119. A = 0°, < = 75°.



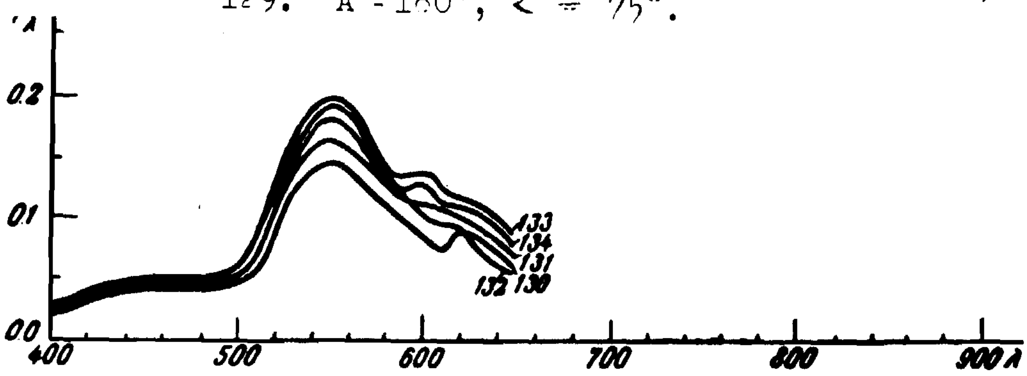
XLVI. Meadow, dry, alt. of sun 45°.

120. A = 90°, < = 15°; 121. A = 90°, < = 30°;
122. A = 90°, < = 45°; 123. A = 90°, < = 60°;
124. A = 90°, < = 75°.



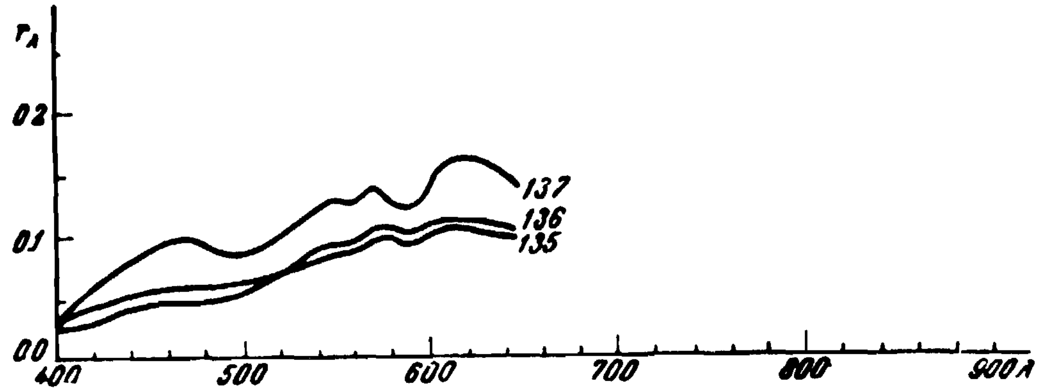
XLVII. Meadow, dry, alt. of sun 45°.

125. A = 180°, < = 15°; 126. A = 180°, < = 30°;
127. A = 180°, < = 45°; 128. A = 180°, < = 60°;
129. A = 180°, < = 75°.



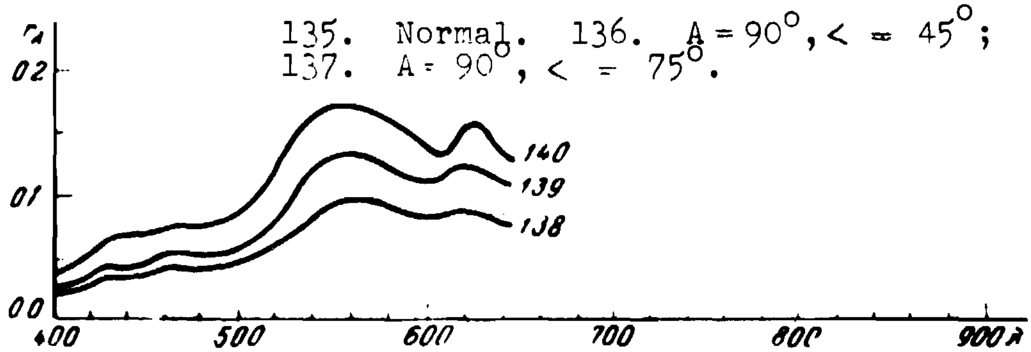
XLVIII. Meadow, dry, alt. of sun 15°.

130. A = 270°, < = 15°; 131. A = 270°, < = 30°;
132. A = 270°, < = 45°; 133. A = 270°, < = 60°;
134. A = 270°, < = 75°.



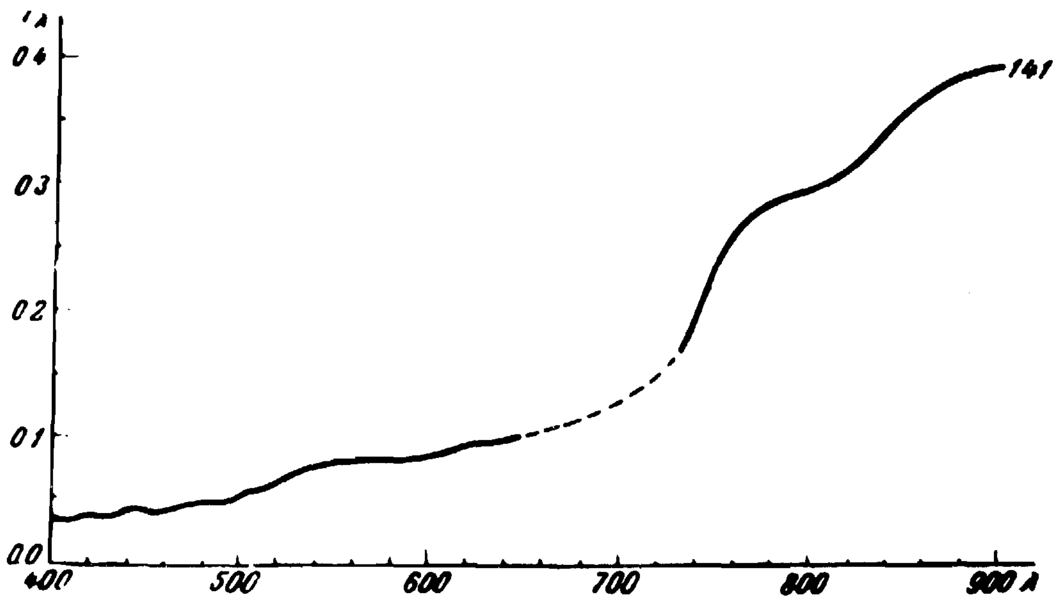
XLIX. Meadow, dry, with sparse low grass.

135. Normal. 136. A = 90°, < = 45°;
137. A = 90°, < = 75°.



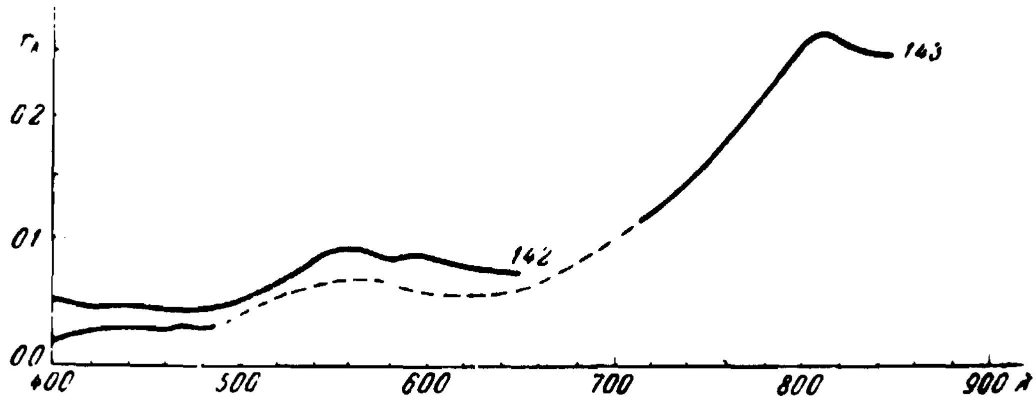
L. Meadow, dry, before mowing.

138. Normal. 139. A = 90°, < = 45°; 140. A = 180°, < = 45°.



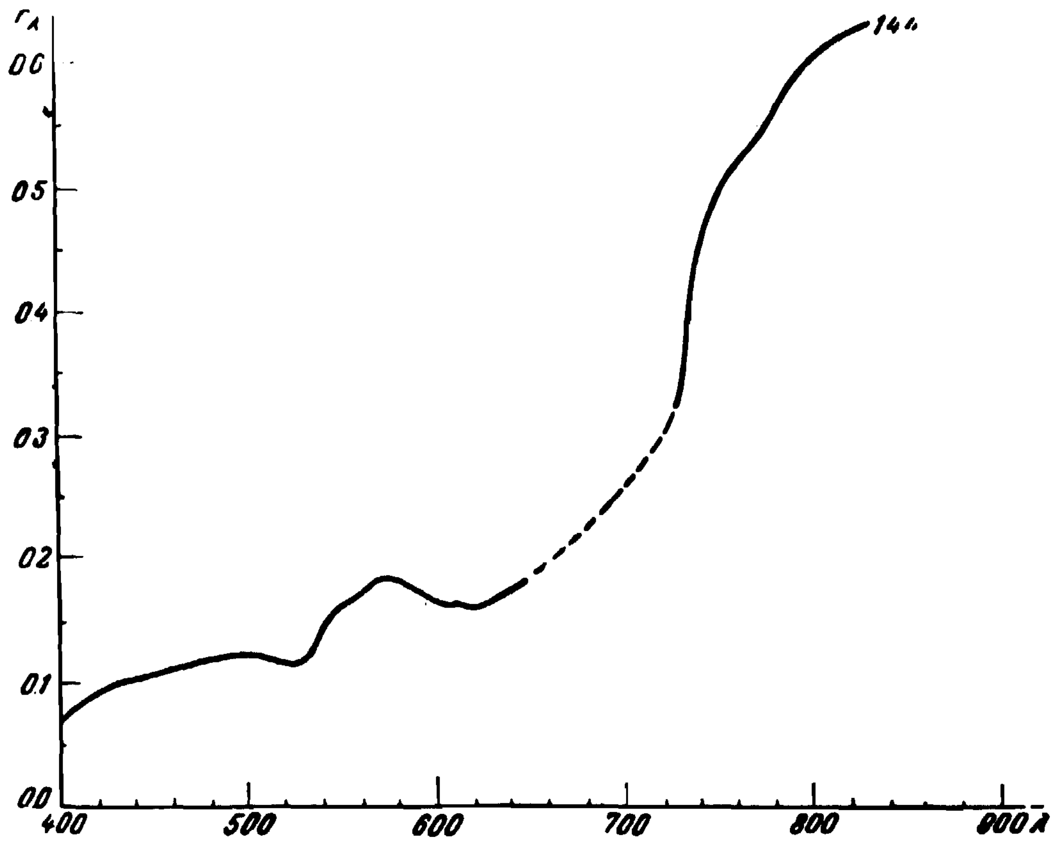
LI. Meadow, dry, on hills.

141. Normal.



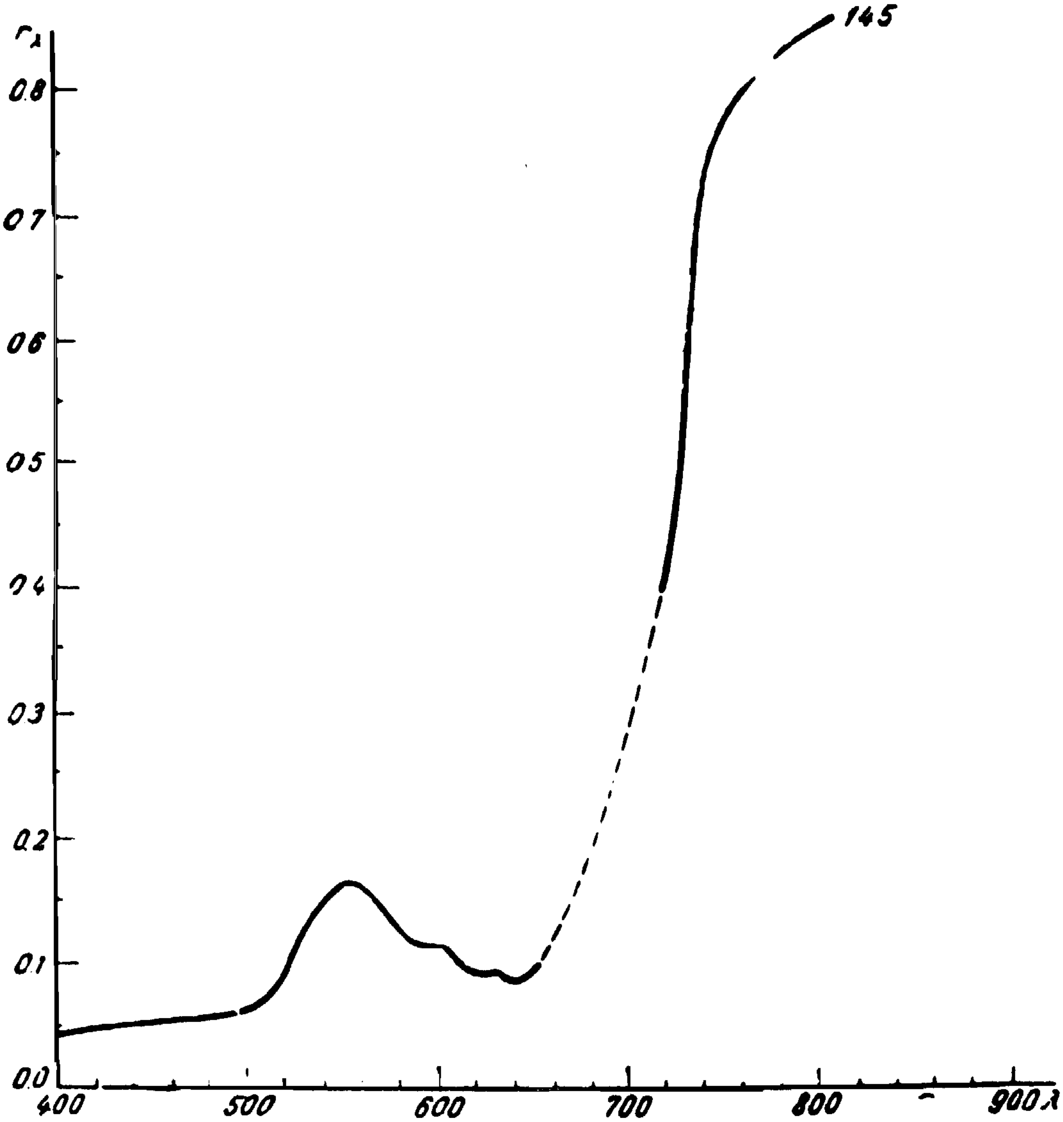
LII. Meadow, from alt. of 300 m. (from the air), nadir

142. Dense, low grass; 143. Pasture



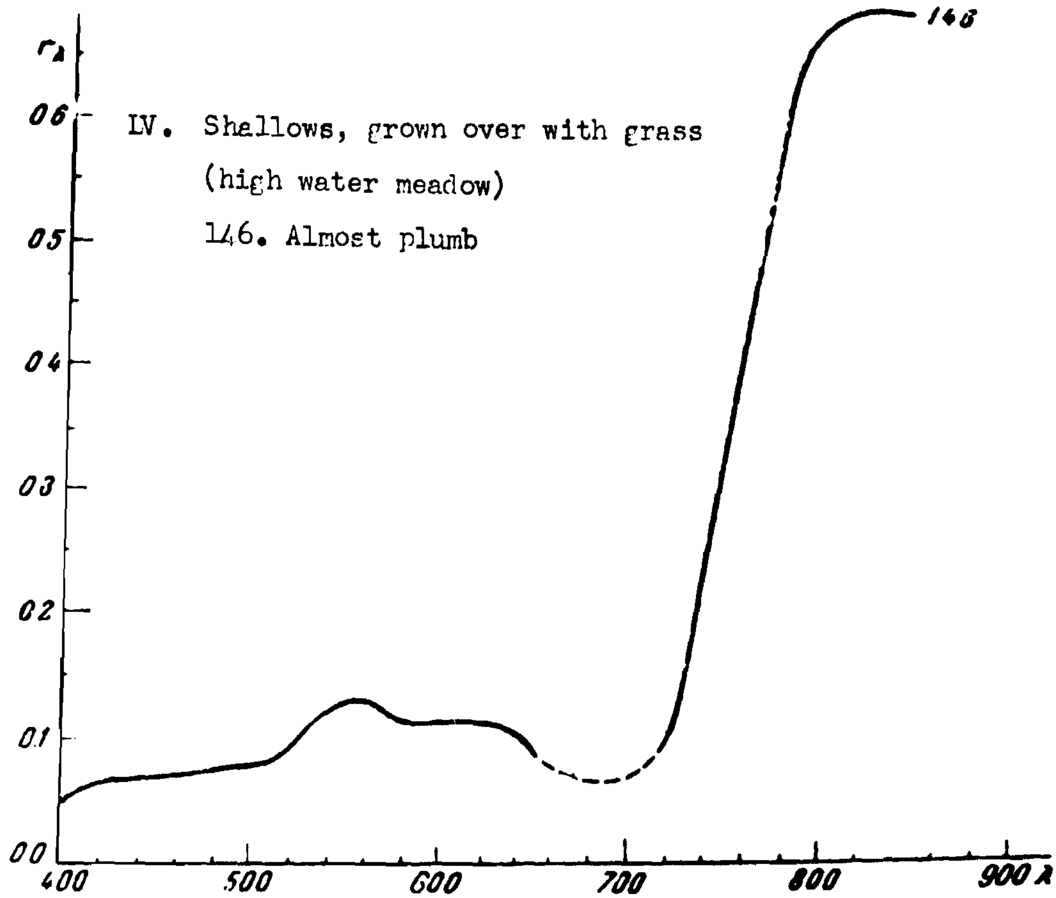
LIII. Lake, half grown over (duckweed, sedge, etc.)

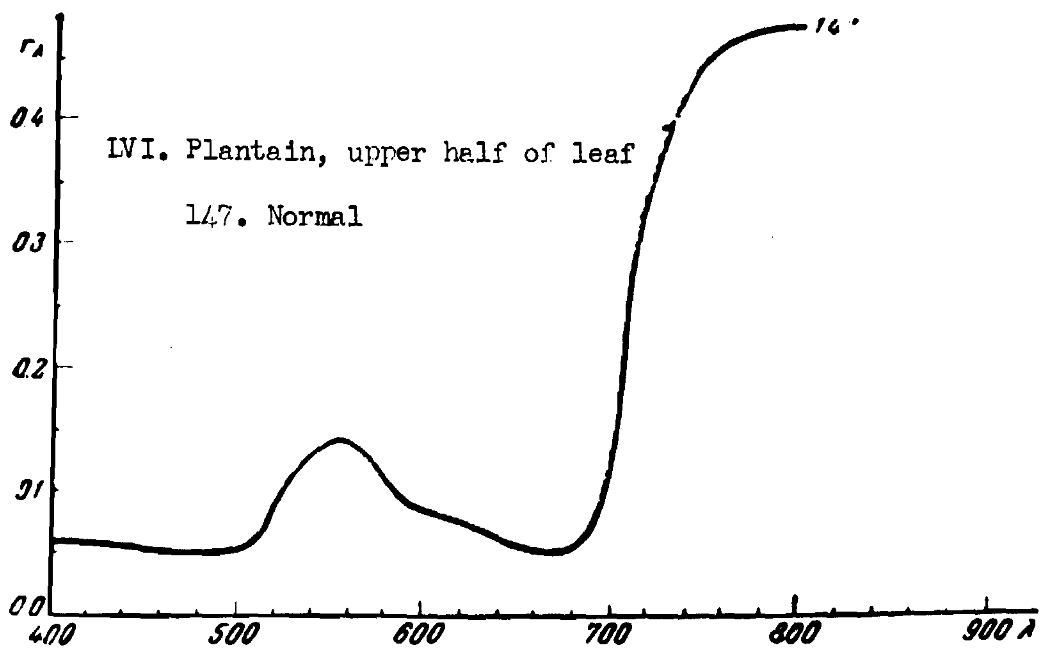
144 A = 90°, ∠ = 60°.

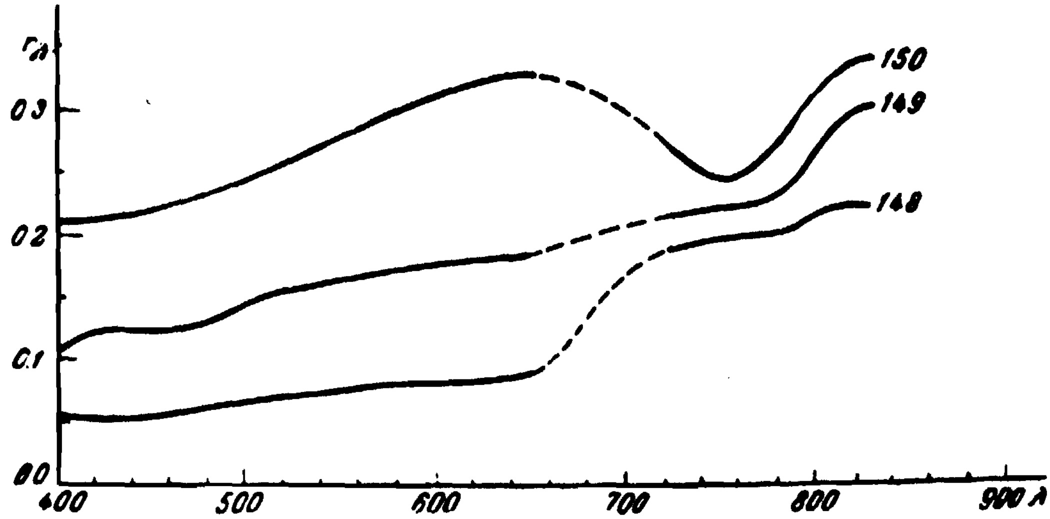


LIV. Sedge

145. A = 90°, < = 45°.

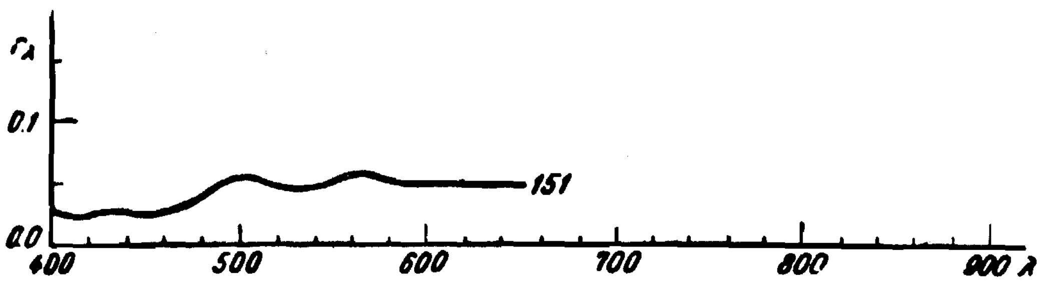

rλ
06
05
04
03
02
0.1
00
LV. Shallows, grown over with grass
(high water meadow)
146. Almost plumb
148
400
500
600
700
800
900 λ


rλ
04
03
0.2
01
00
LVI. Plantain, upper half of leaf
147. Normal
14
400
500
600
700
800
900 λ



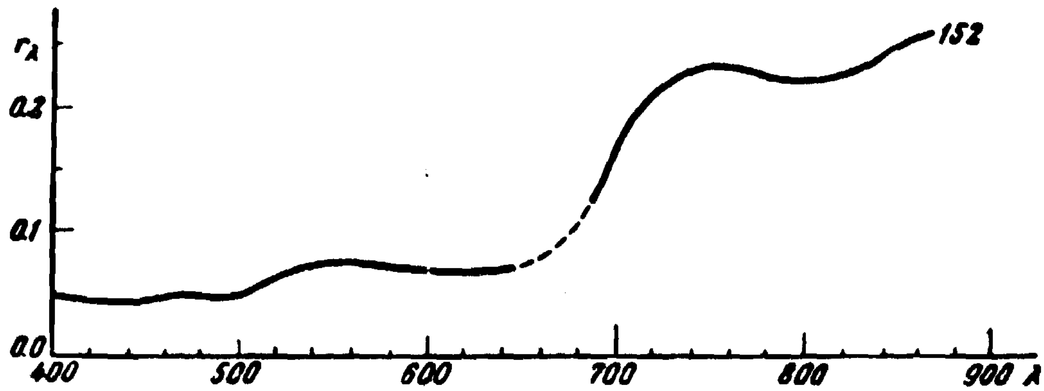
LVII. Wormwood, flowering

148. Normal ; 149. ∠ = 30°; cloudy sky; 150. ∠ = 60°; cloudy sky



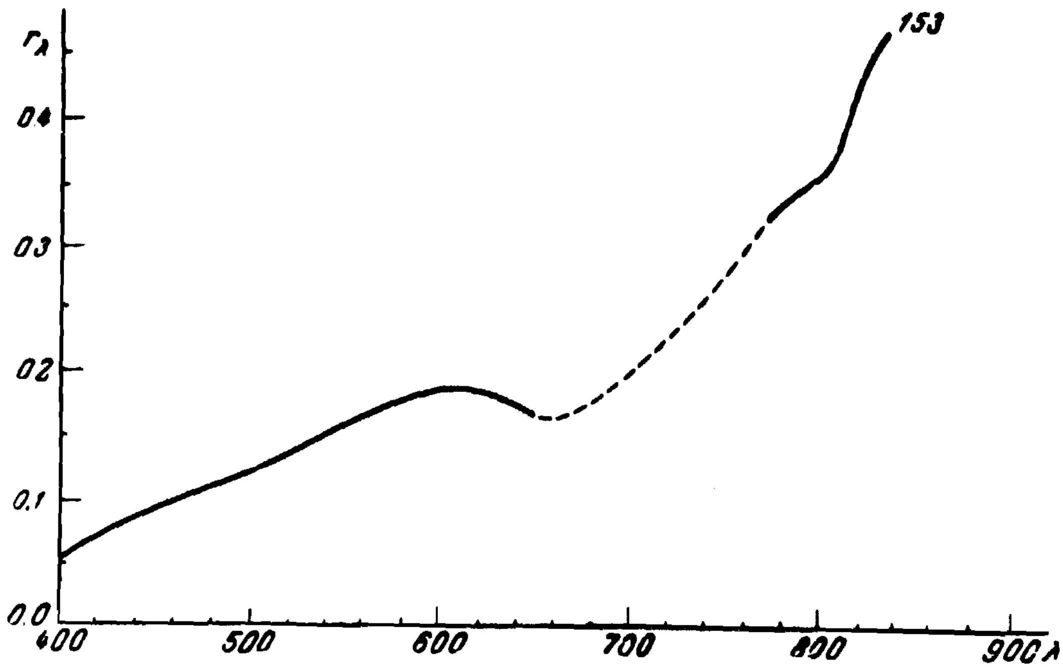
LVIII. Stream grown over with water weeds and sedge

151 · A = 90°, ∠ = 45°.



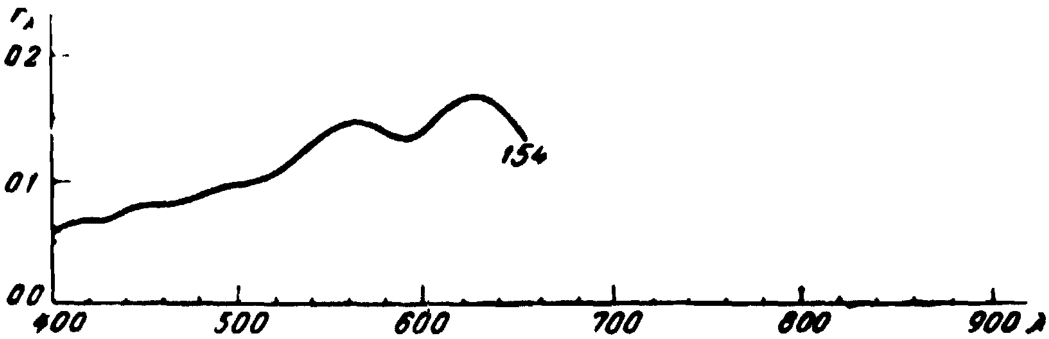
LIX. Duckweed

152 -- $A = 90°$, $\angle = 45°$.



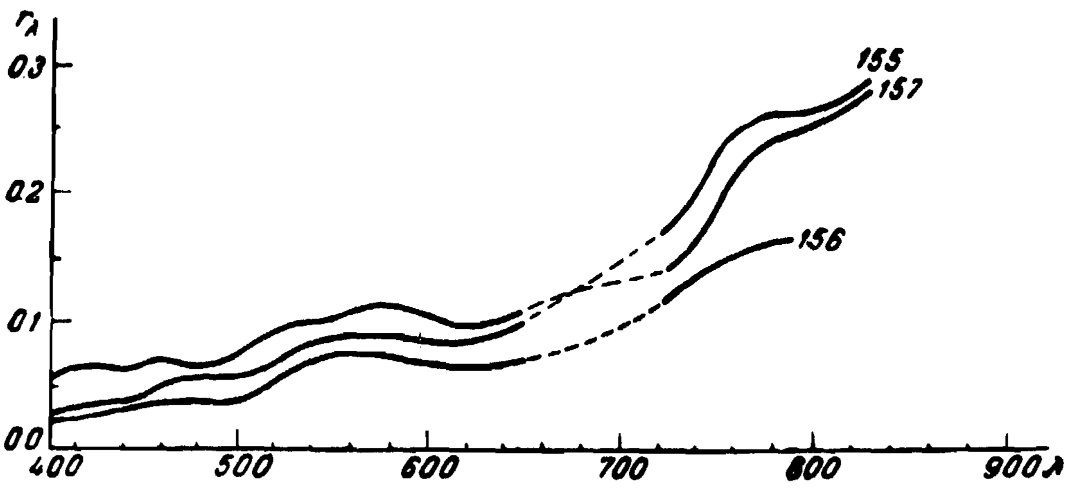
LX. Selin, dried

153. Normal



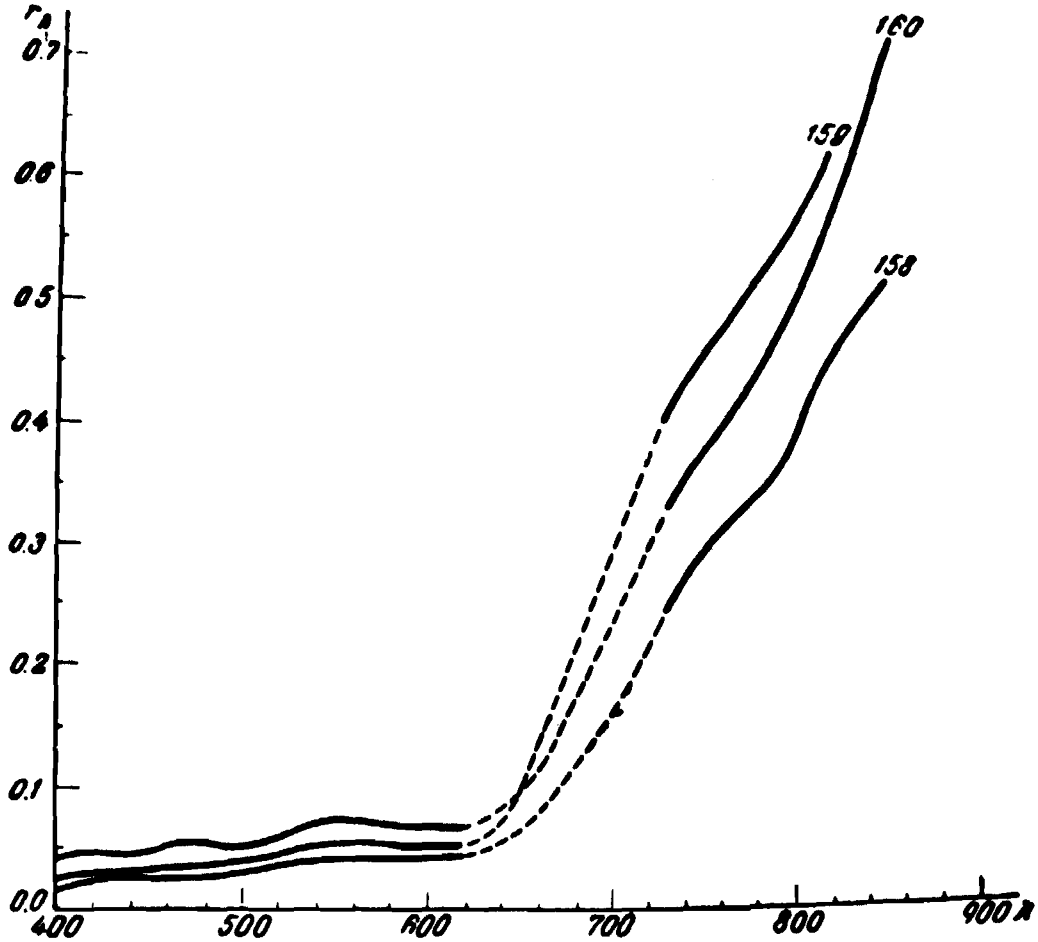
LXI. Mountain slope, with low sparse grass

154. Normal



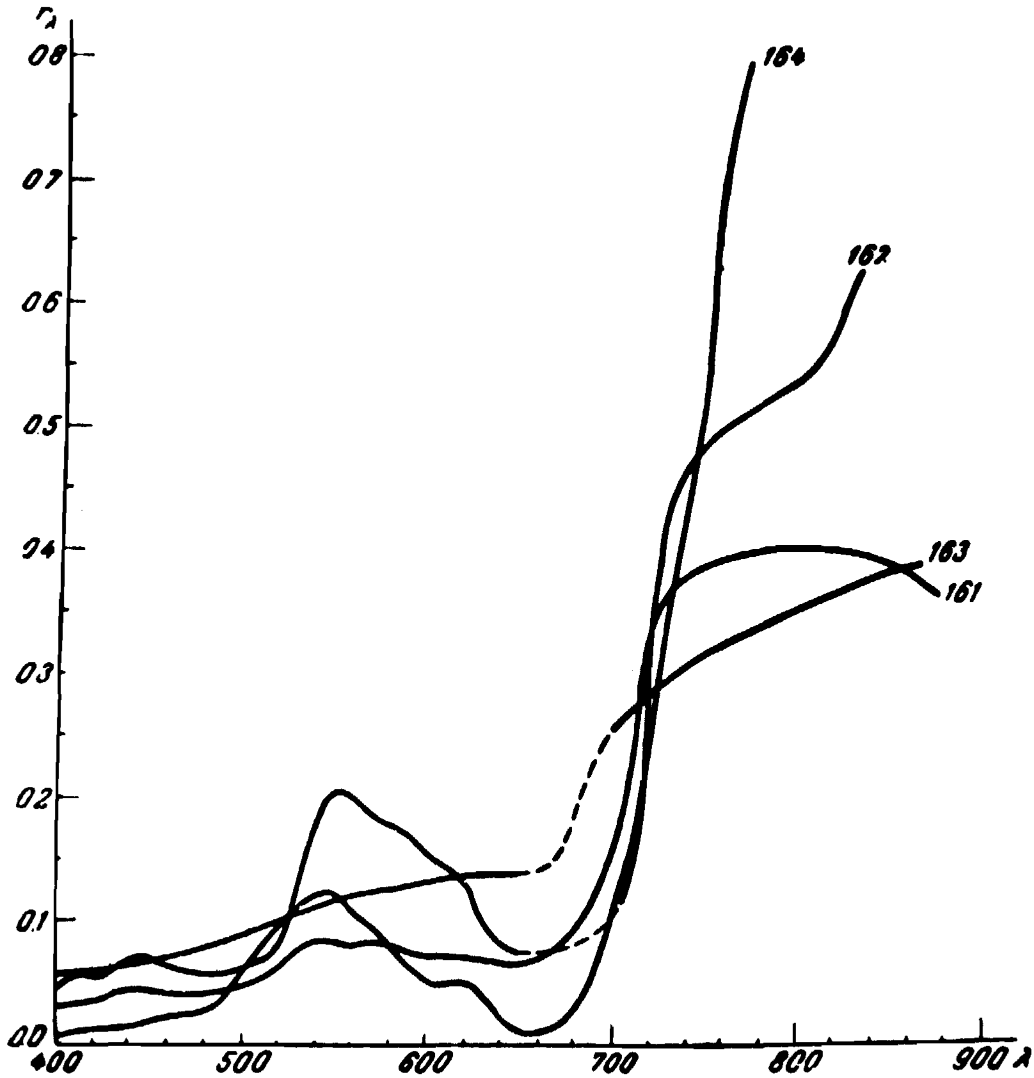
LXII. Virgin Steppe, with sun dried grass

155. Normal; 156. <= 30°; cloudy sky; 157. <= 60°; cloudy sky



LXIII. Virgin Steppe

158. Normal; 159. ∠= 30°; cloudy sky; 160. ∠= 60°; cloudy sky

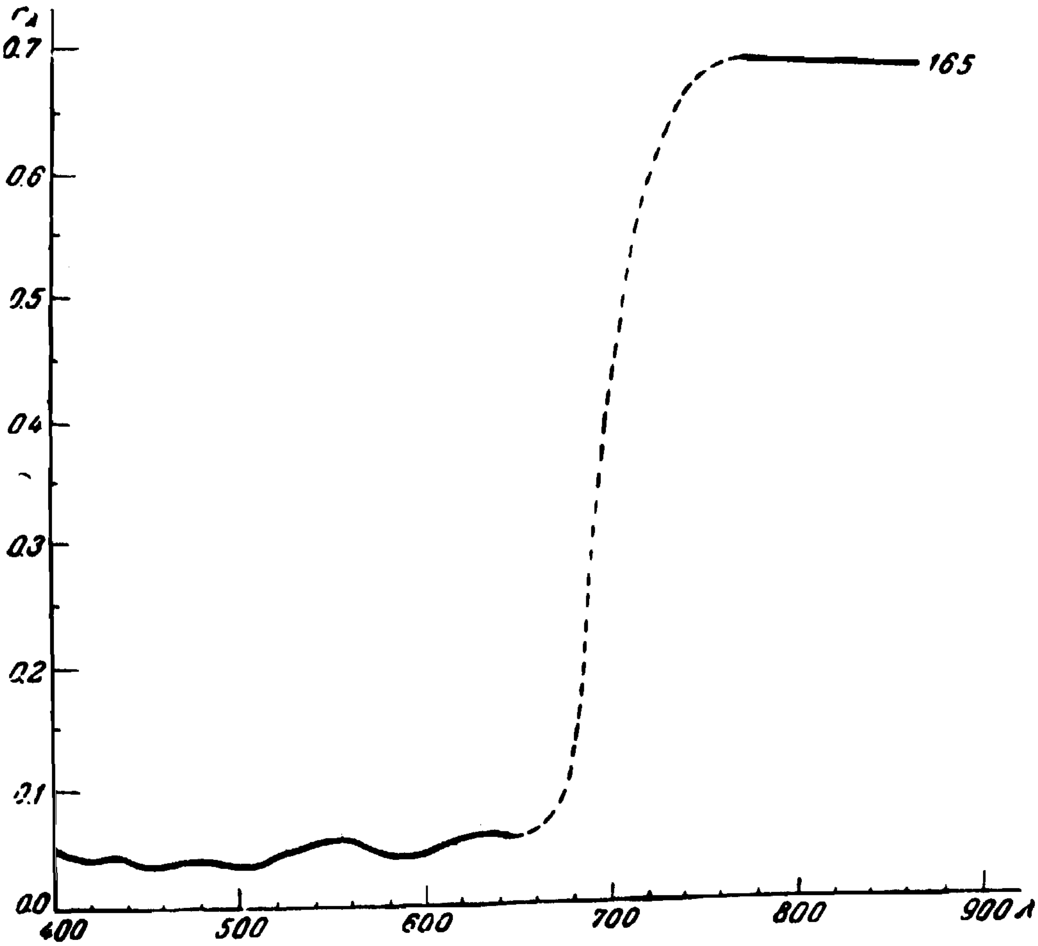


LXIV. Grass

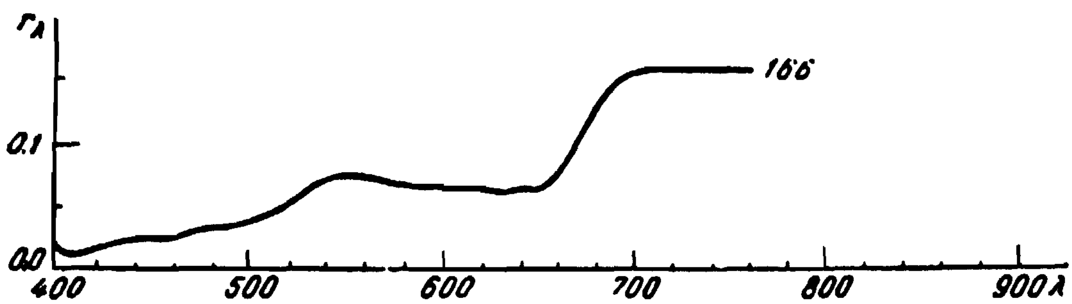
161. Dusty, normal; 162. Young, A = 90°; ∠= 45°;

163. Last year's A = 90°; ∠=45°;

164. Summer, A = 90°; ∠= 45°

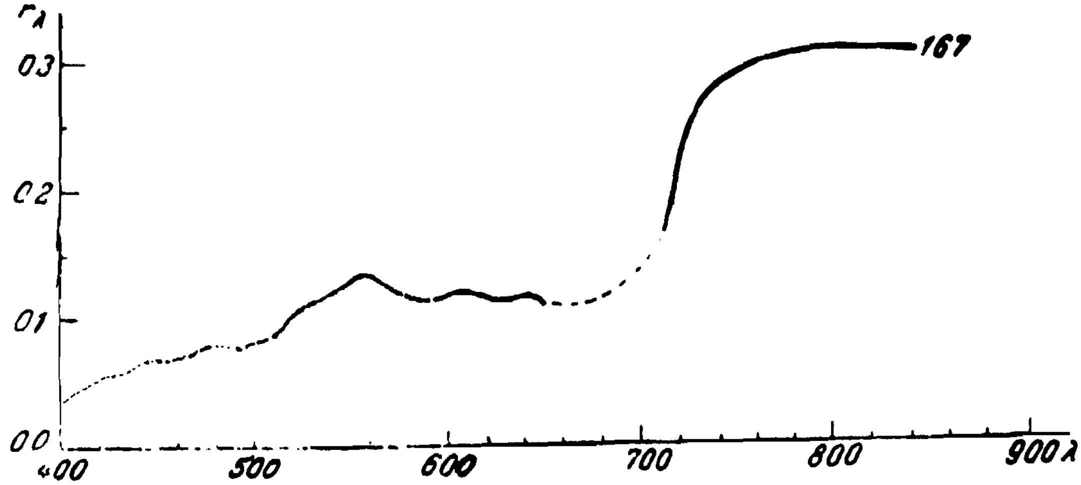


LXV. Camel grass, with heavy-coated dust
165. Normal.



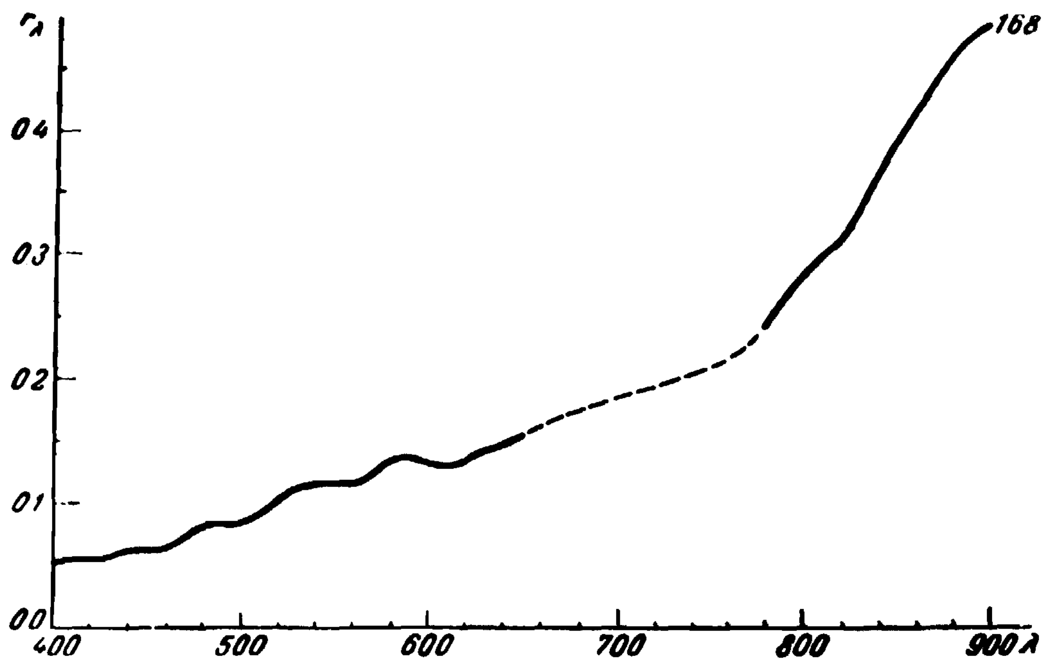
LXVI. Fallow, green, flowering

166. Normal



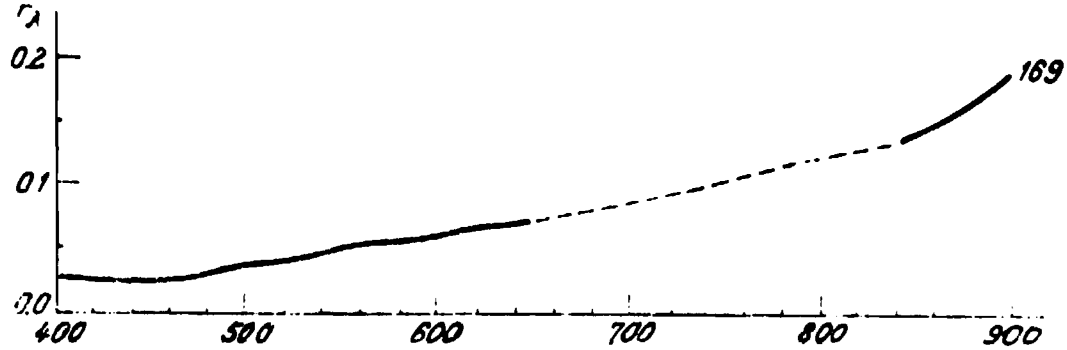
LXVII. Hillside, covered with low grass

167. Normal



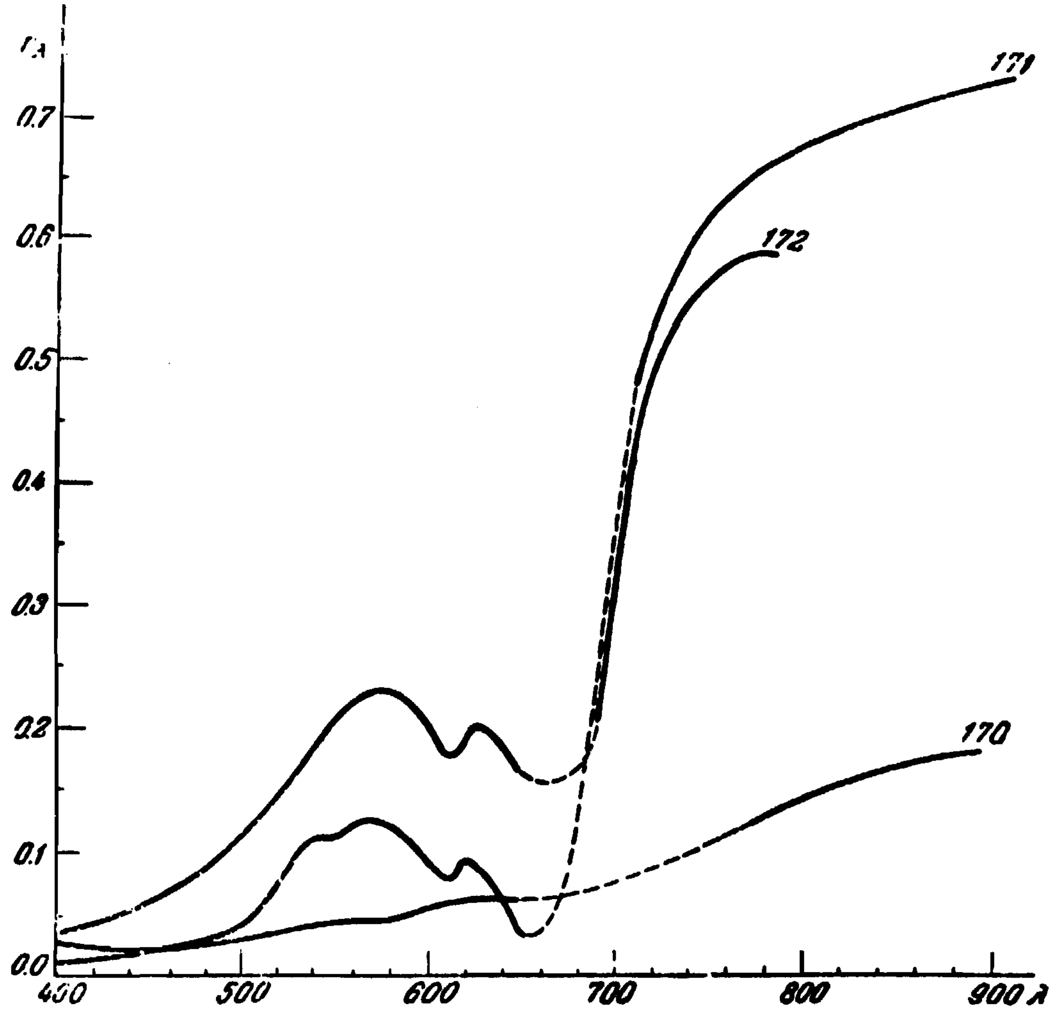
LXVIII. Hay, dry

168. A = 110°.



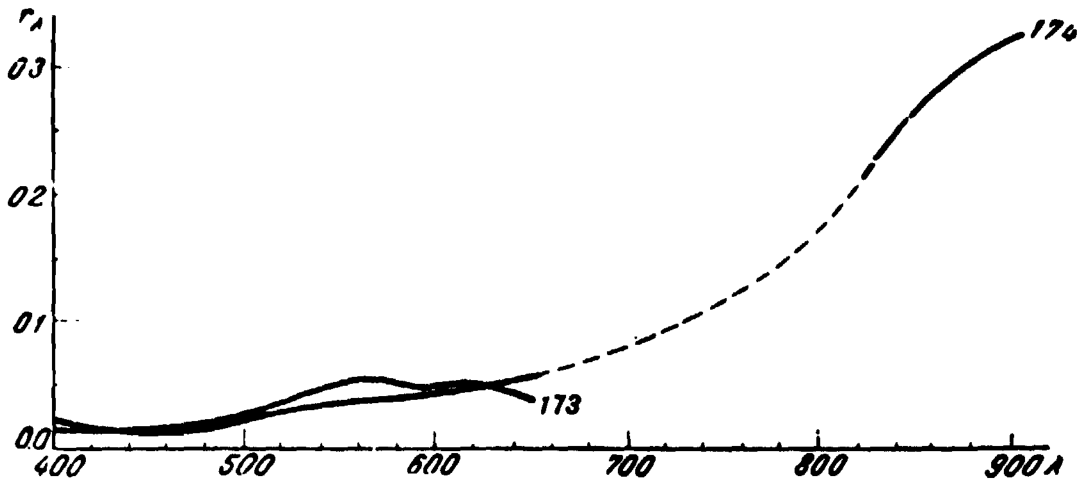
LXIX. Lichens

169. On turf path



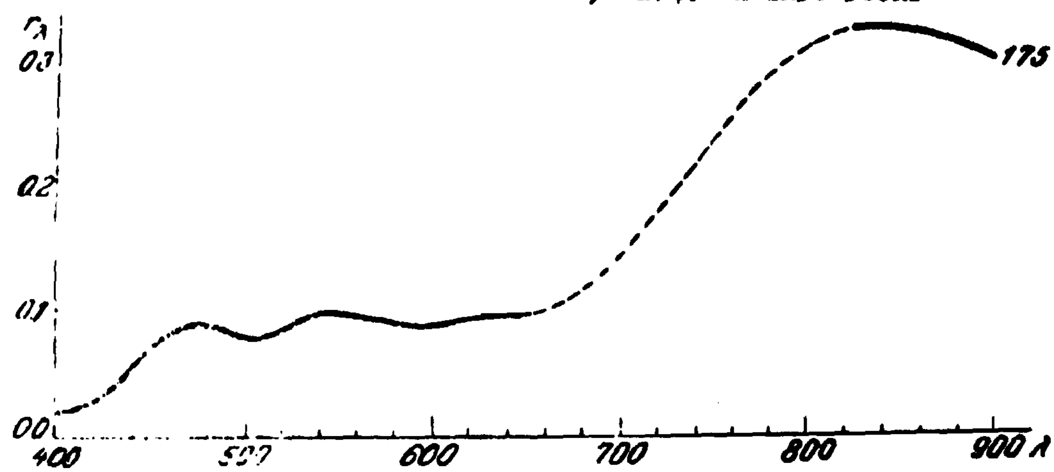
LXX. Mosses.

170. Hypnum, wet; 171. Sphagnum, moist; 172. Sphagnum, dry.



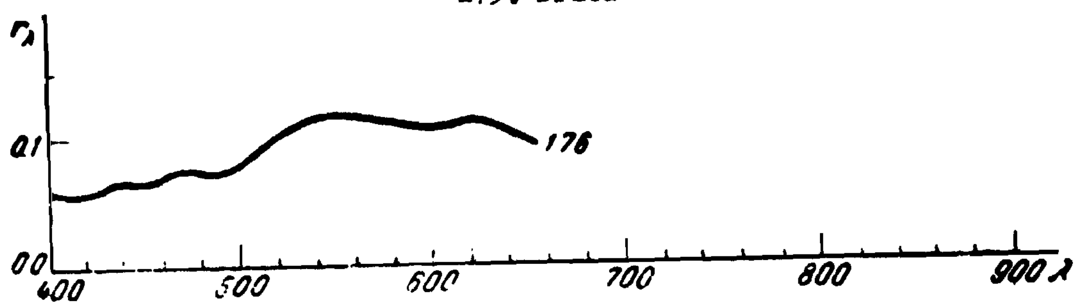
LXXI. Mosses

173. On cliffs; 174. On bare rocks



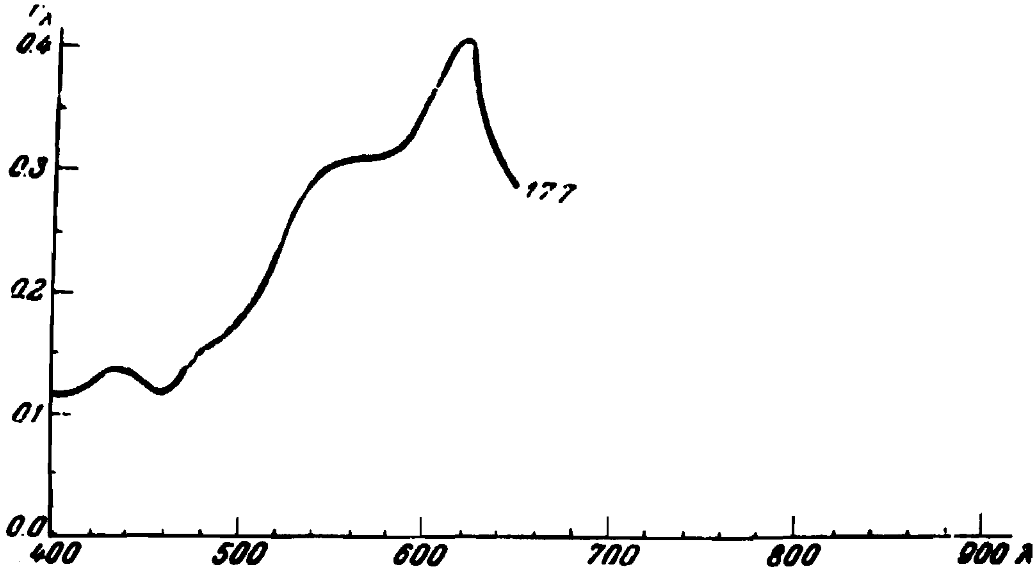
LXXII. Moss, reindeer

175. Dried



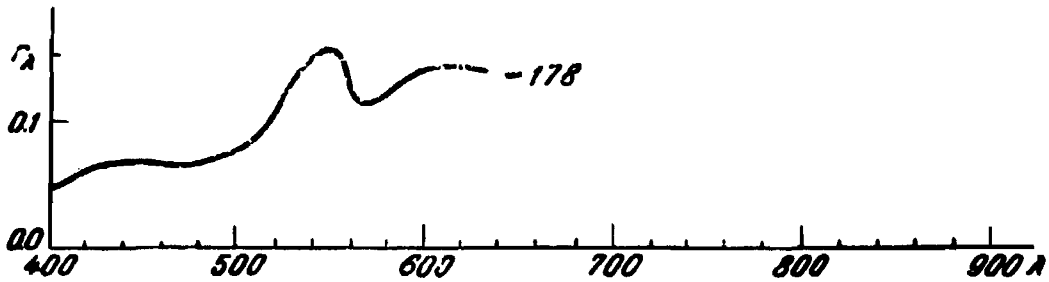
LXXIII. Vetch

176. Before flowering



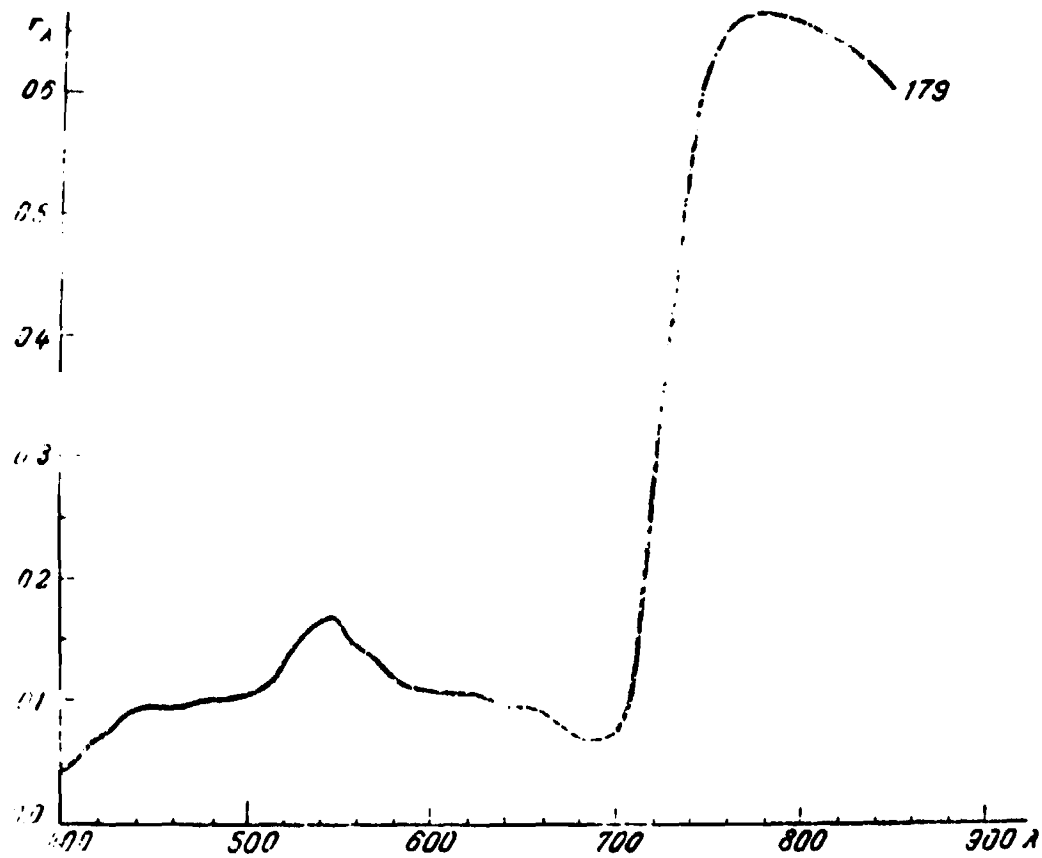
LXXIV. Peas

177. Ripening period



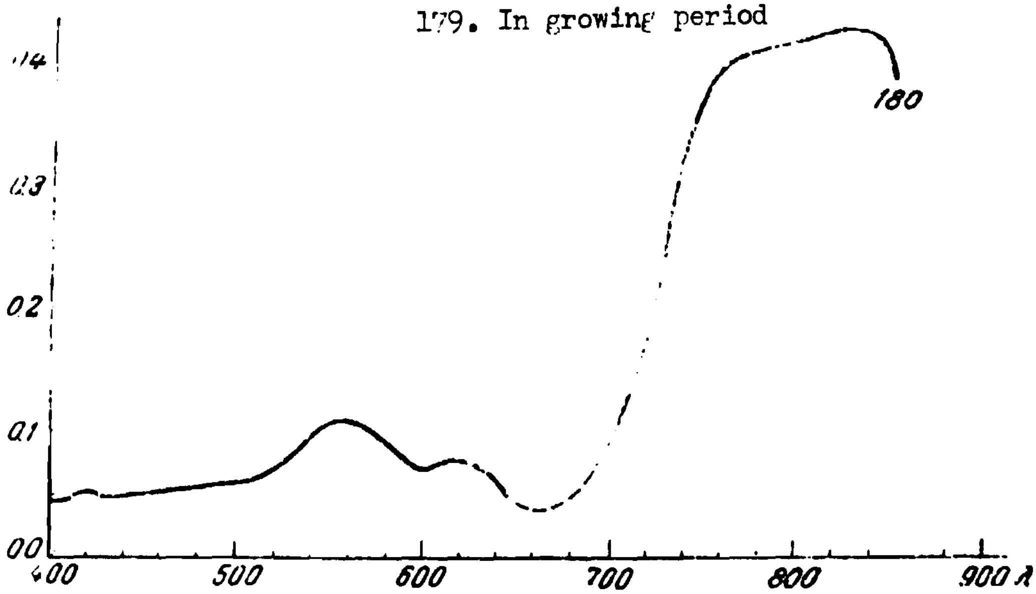
LXXV. Buckwheat

178. Before flowering



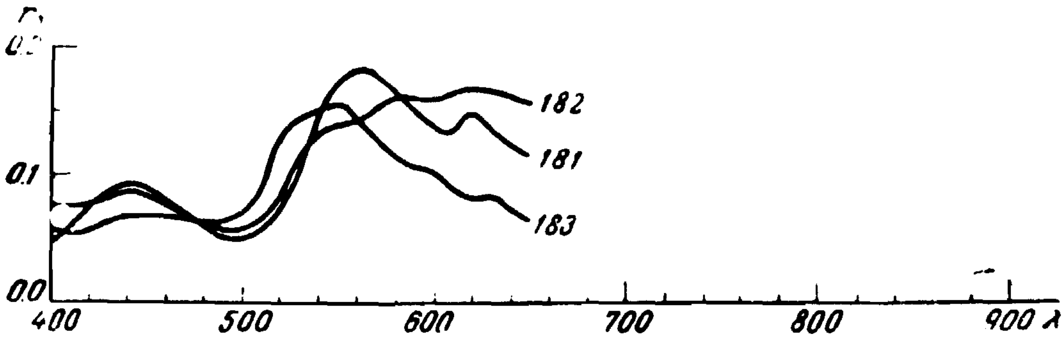
LXXVI. Cabbage

179. In growing period



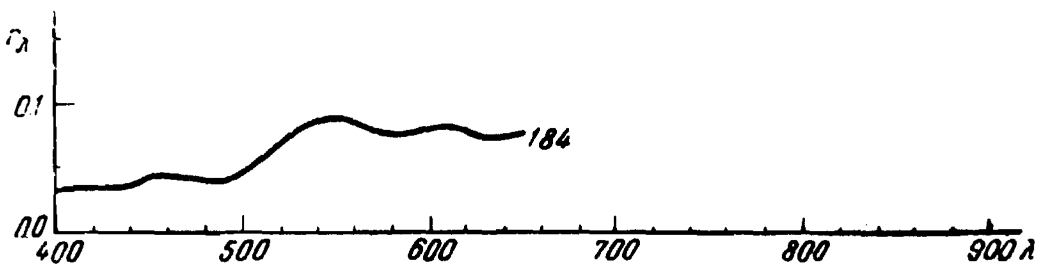
LXXVII. Potatoes

180. After flowering



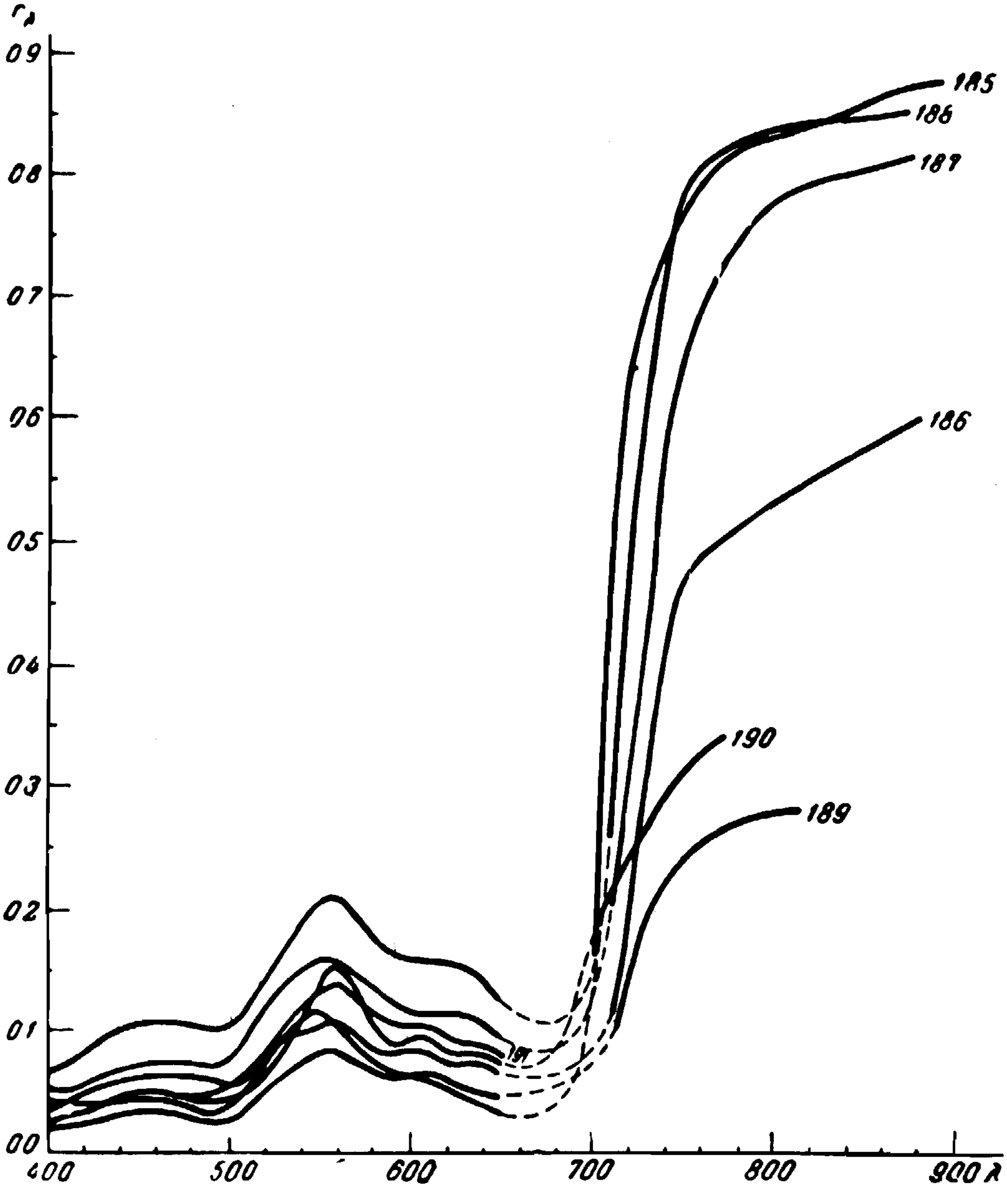
LXXVIII. Clover

181. White in flowering period; 182. Red, in flowering period; 183. Red, new growth

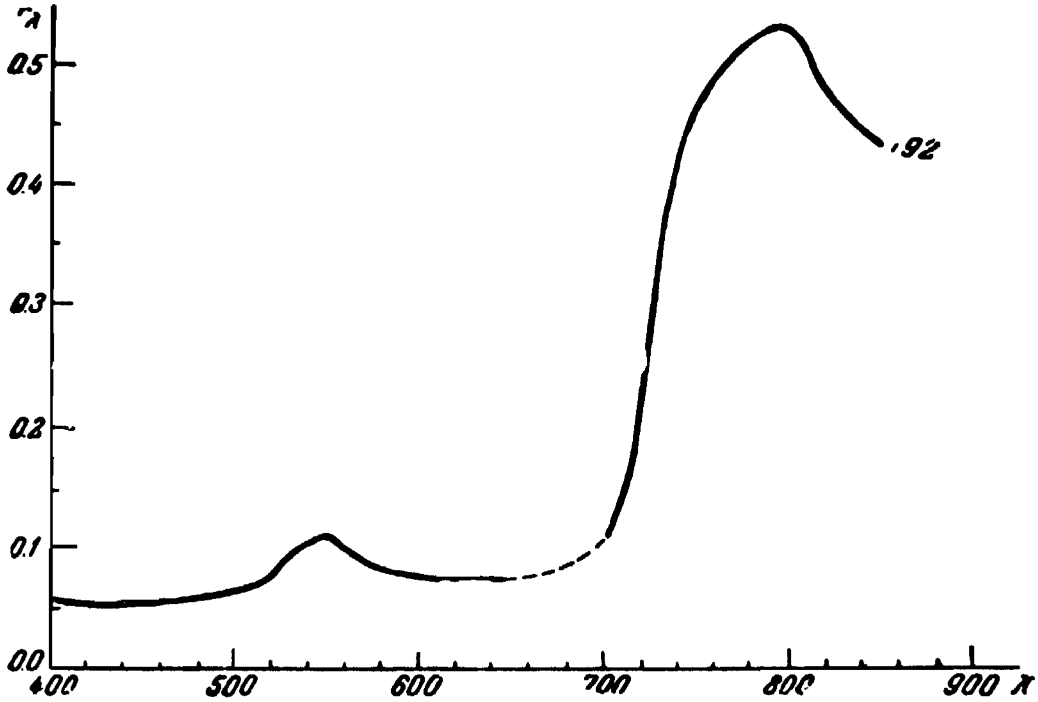


LXXIX. Corn

184. Ripening period

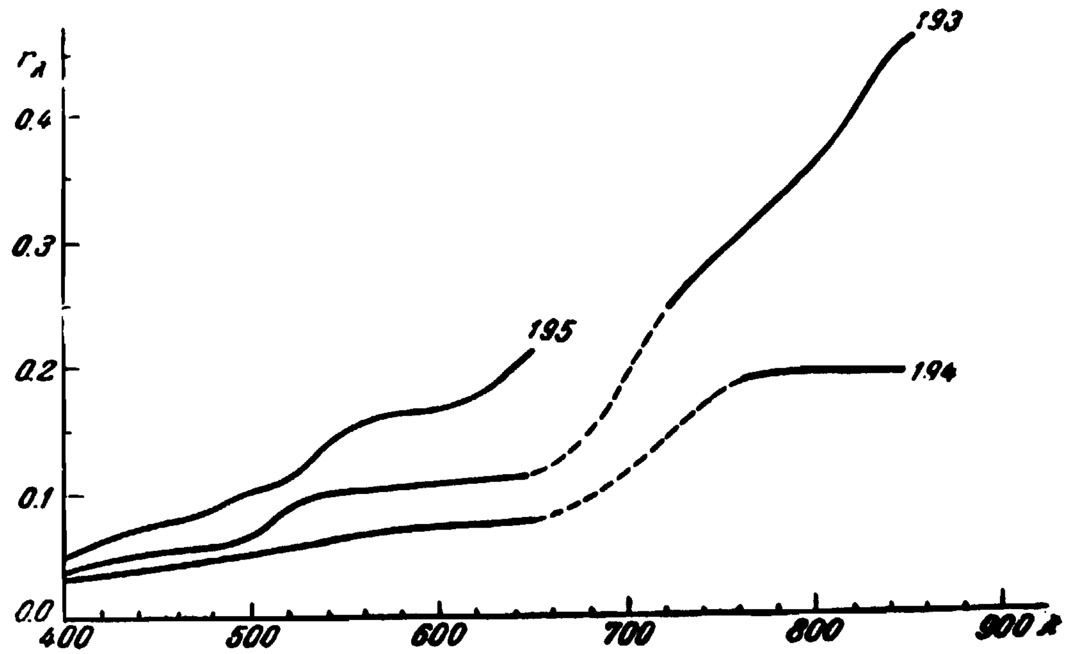


LXXX. Oats. 185. Spike-forming, normal; 186. Spikes formed. A = 90° $\angle = 45^\circ$; 187. A = 90°, $\angle = 65^\circ$; 188. A = 90°, $\angle = 85^\circ$; 189. $\angle = 45^\circ$ 190. $\angle = 65^\circ$; 191. $\angle = 85^\circ$; (No. 189-191, with cloudy sky).



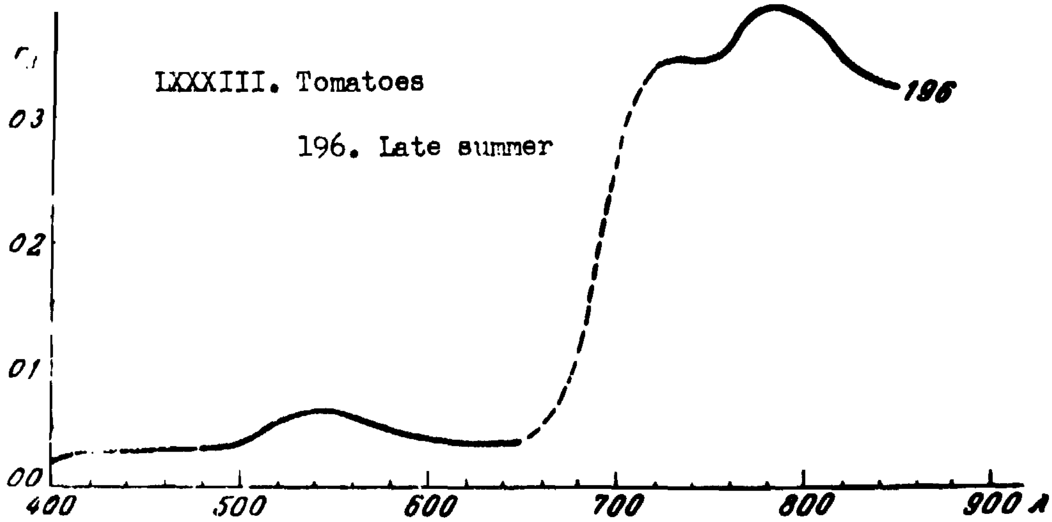
LXXXI. Sunflower

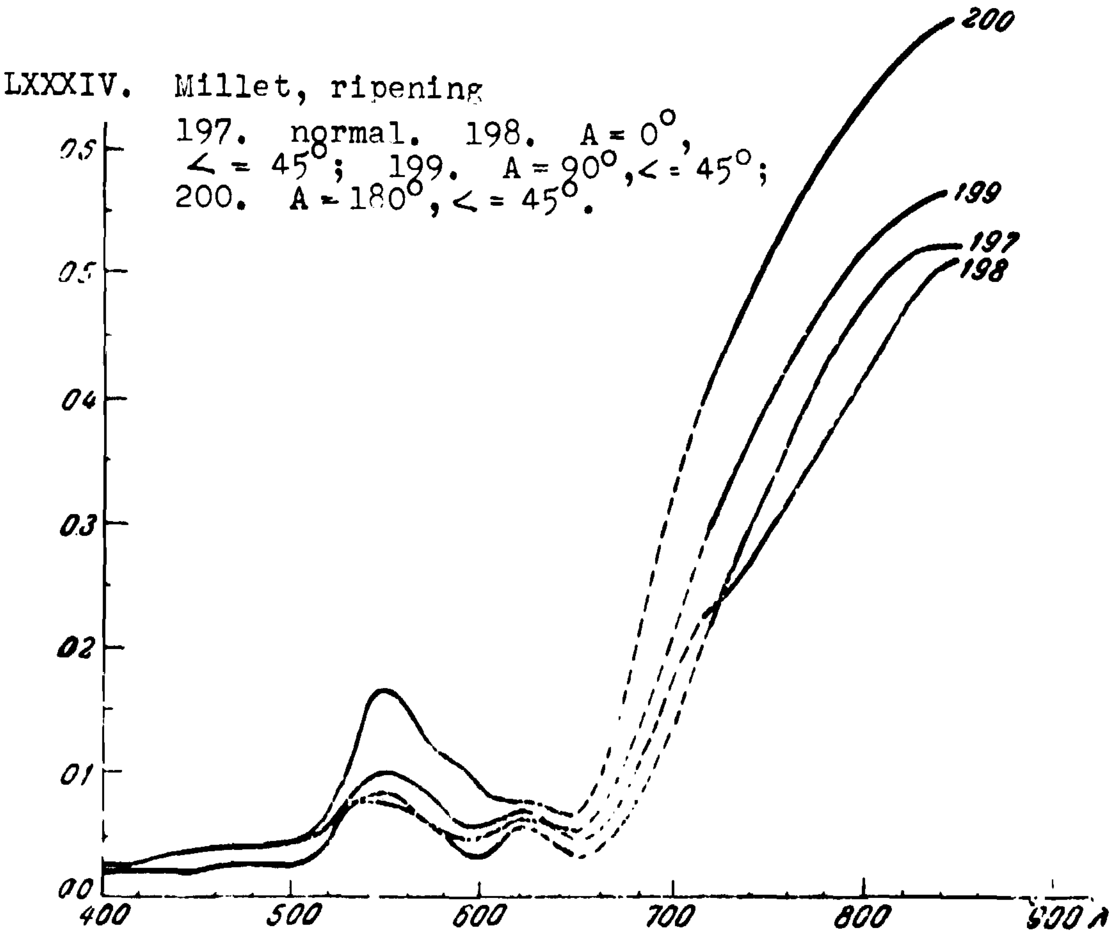
192. In flower

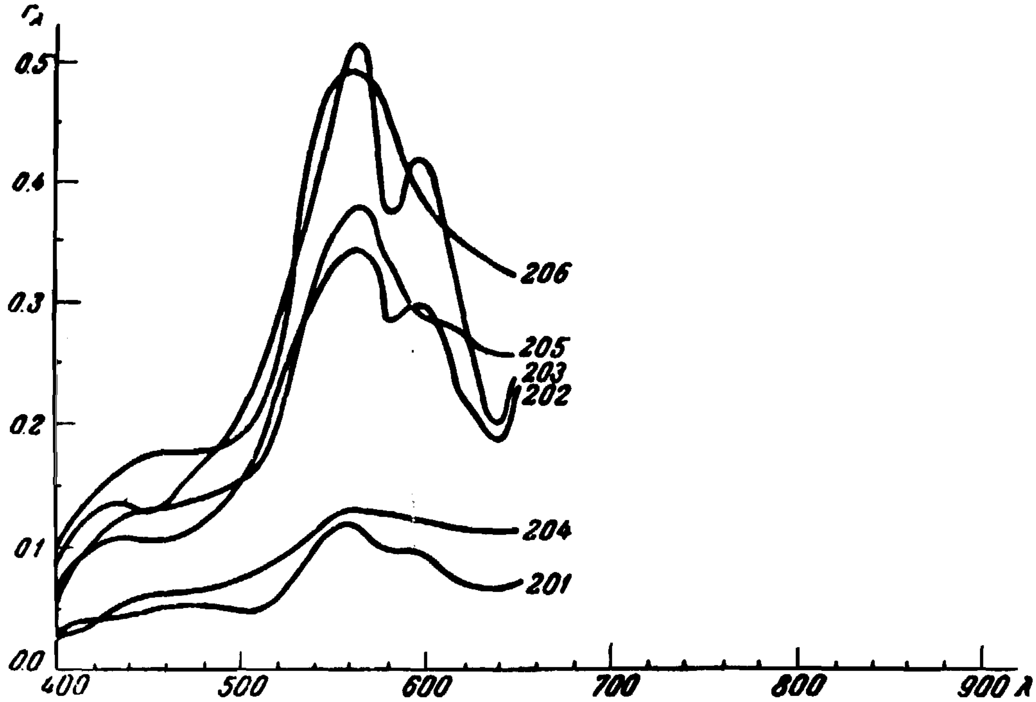


LXXXII. Field (stubble)

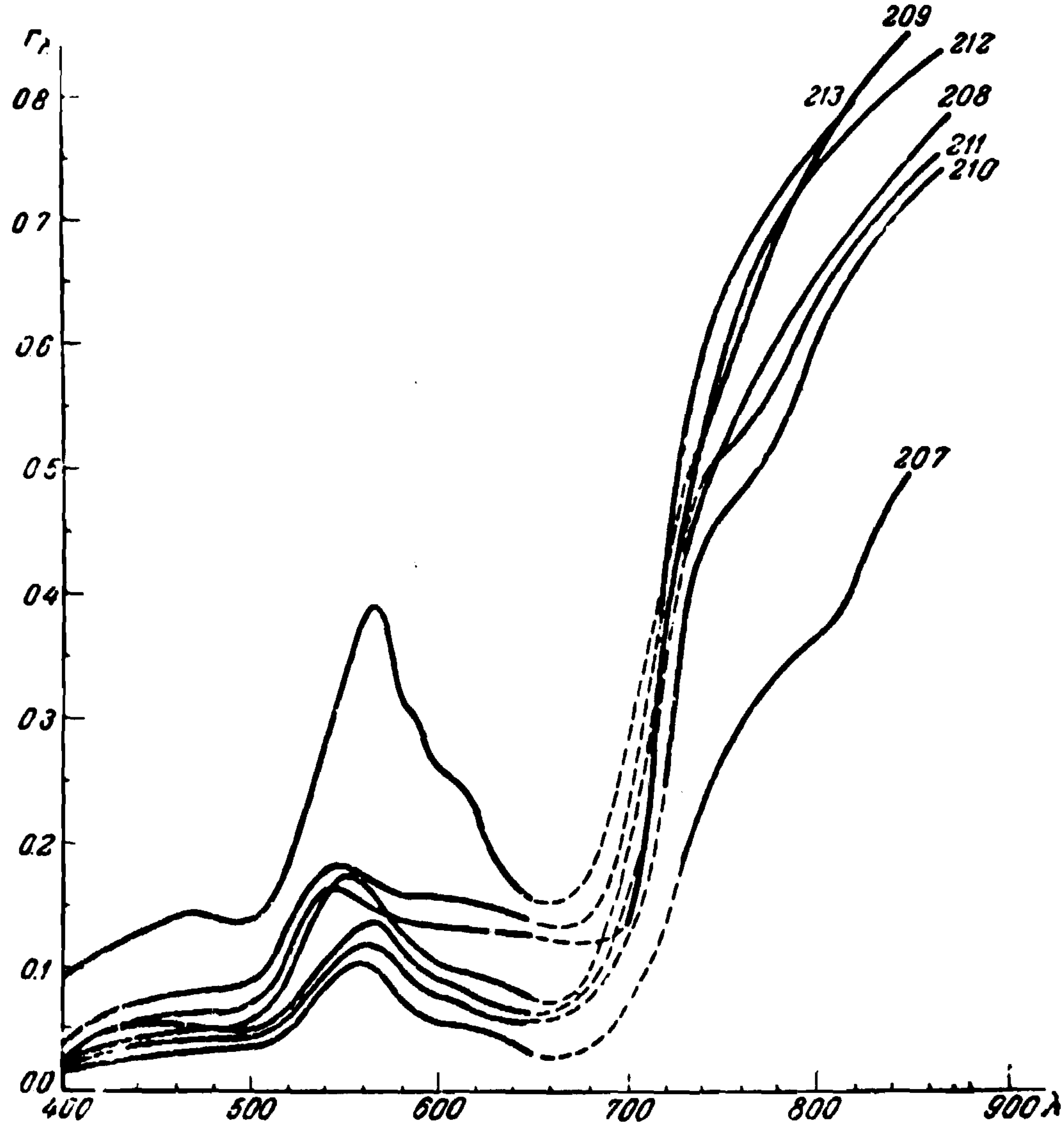
193. Oats; 194. Lentil; 195. Barley


LXXXIII. Tomatoes
196. Late summer
r
03
02
01
00
400
500
600
700
800
900 A
196


LXXXIV. Millet, ripening
197. normal. 198. A = 0°, ∠ = 45°; 199. A = 90°, ∠ = 45°; 200. A = 180°, ∠ = 45°.
0.5
0.5
04
03
02
01
00
400
500
600
700
800
900 A
200
199
197
198

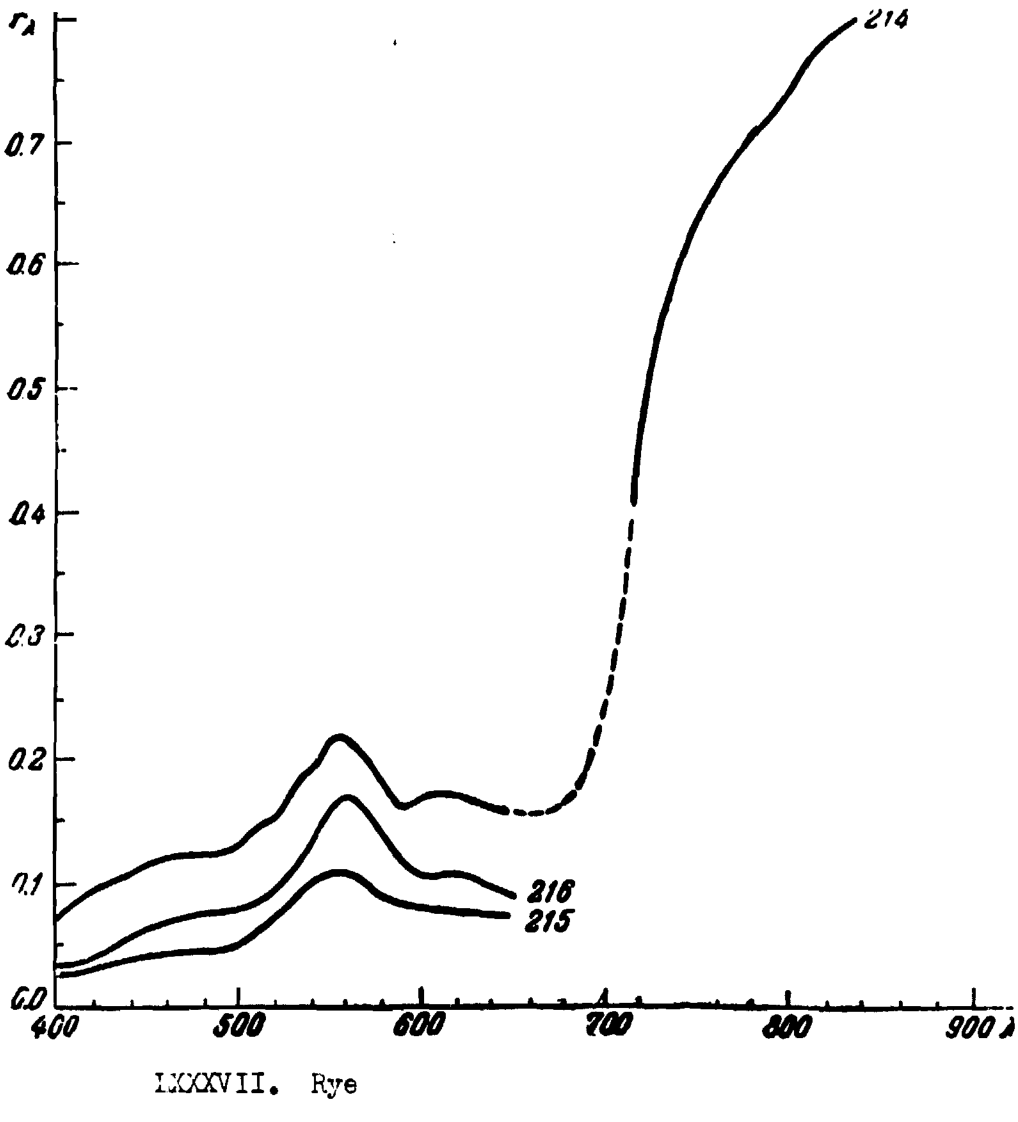


LXXXV. Wheat before spike-forming
201. A = 0°, < = 45°; 202. A = 0°, < = 65°; 203. A = 0°, < = 85°; 204, A = 180°, < = 45°; 205. A = 180°, < = 65°; 206. A = 180°, < = 85°.



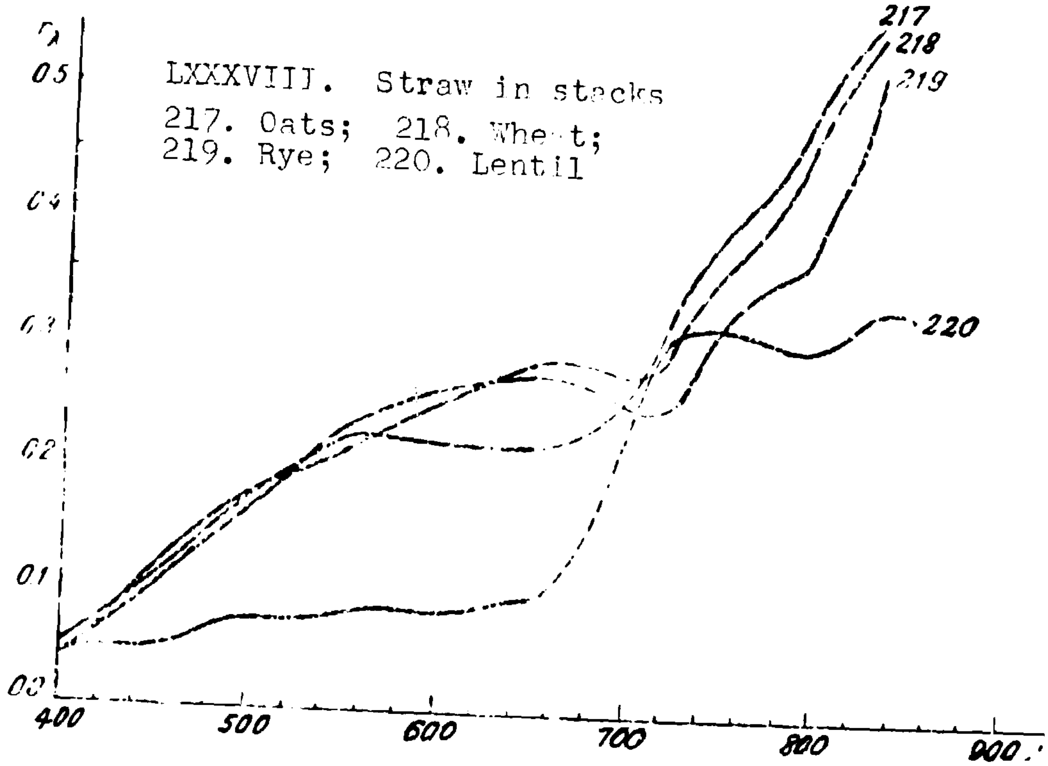
LXXXVI. Wheat

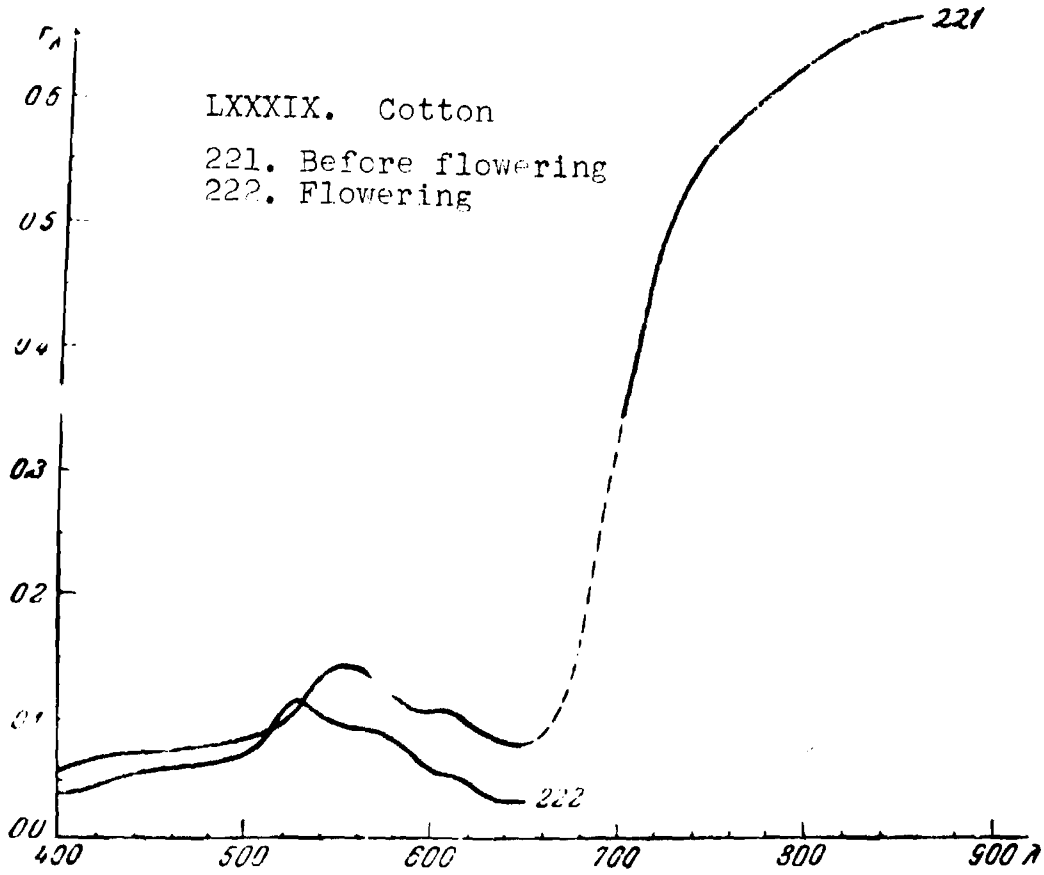
In flowering period: 207. A = 0°, ∠ = 45°; 208. A = 0°, ∠ = 65°; 209. A = 0°, ∠ = 85°; 210. A = 90°, ∠ = 65°; 211. A = 90°, ∠ = 85°; After spike-forming: 212. A = 90°, ∠ = 65°; 213. A = 90°, ∠ = 85°.

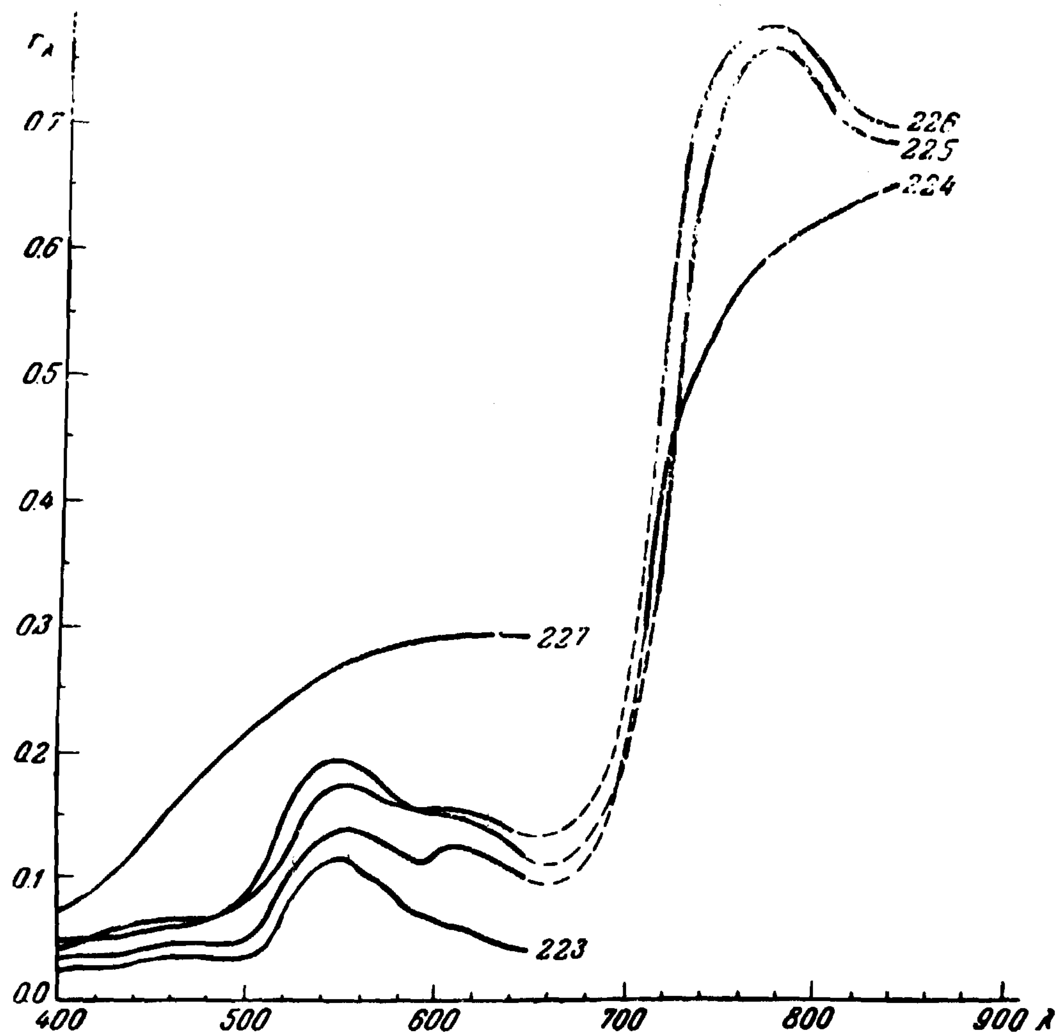


LXXXVII. Rye

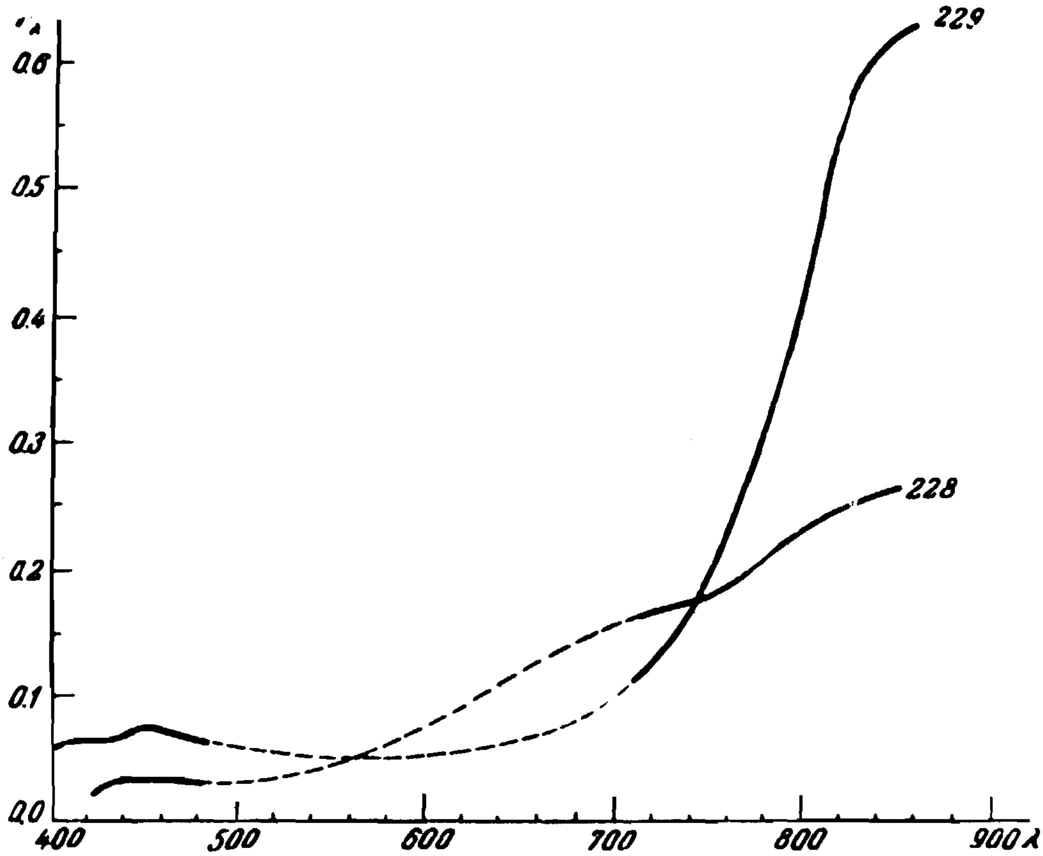
214. Spikes formed; 215. Winter, flowering; 216. Summer, spikes formed


LXXXVIII. Straw in stacks
217. Oats; 218. Wheat; 219. Rye; 220. Lentil
217
218
219
220
r_λ
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900


LXXXIX. Cotton
221. Before flowering
222. Flowering
221
222
r_λ
0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900 λ

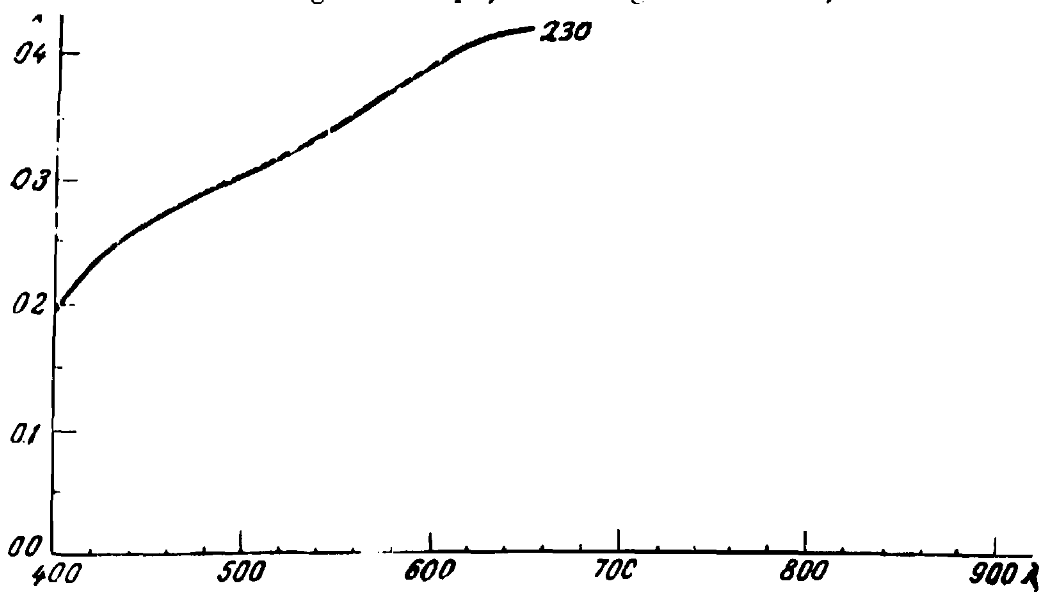


XC. Barley. 223. Before spikes, A = 90°, < = 45°. Spikes formed: 224. A = 90°, < = 45°; 225. A = 90°, < = 65°; 226. A = 90°, < = 85°; 227. Ripened, A = 90°, < = 45°.



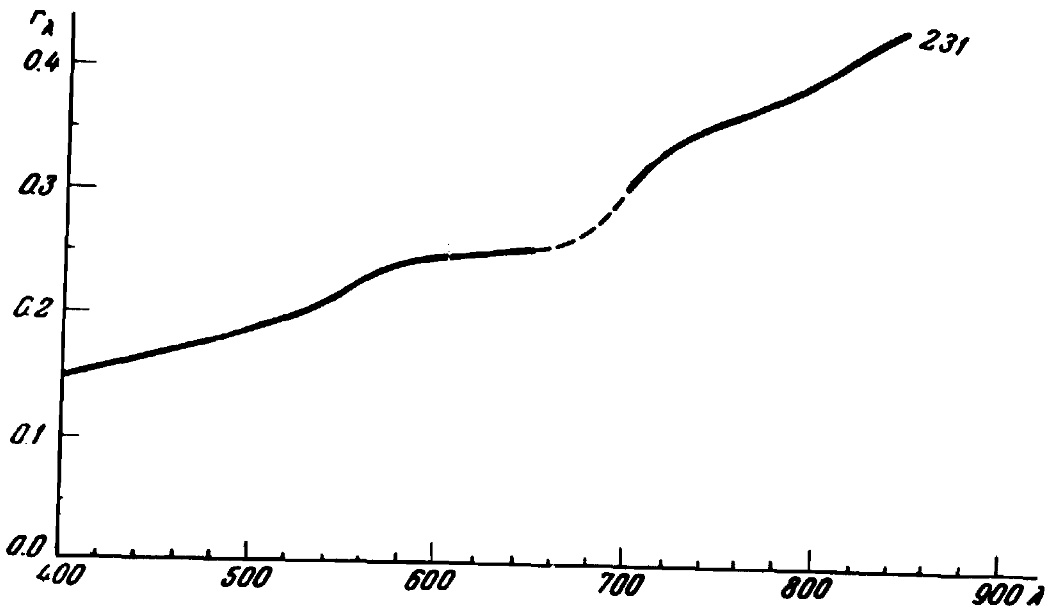
XCI. Field from the air alt. = 300m.

228. With green crops, buildings and roads; 229. With green crops

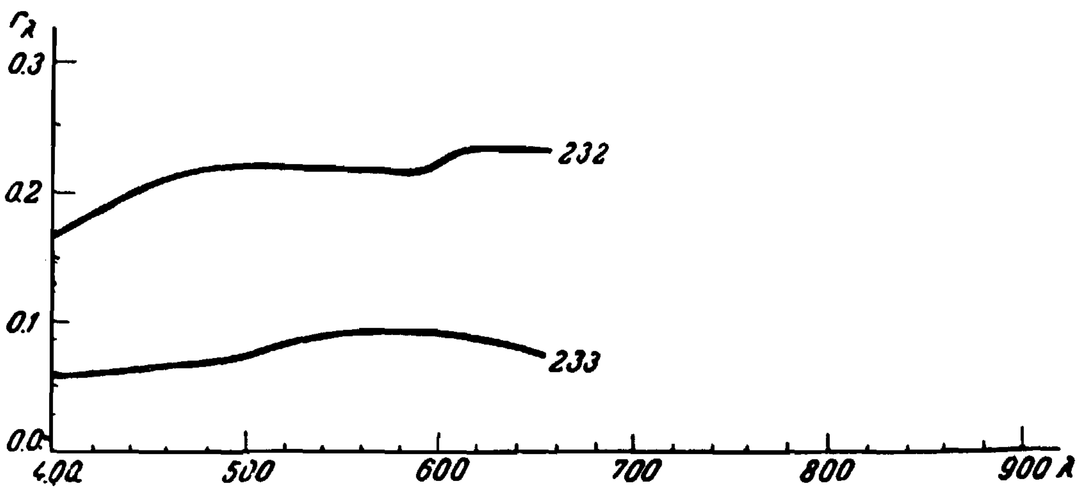


XCII. Ravines

230. Dry, light gray

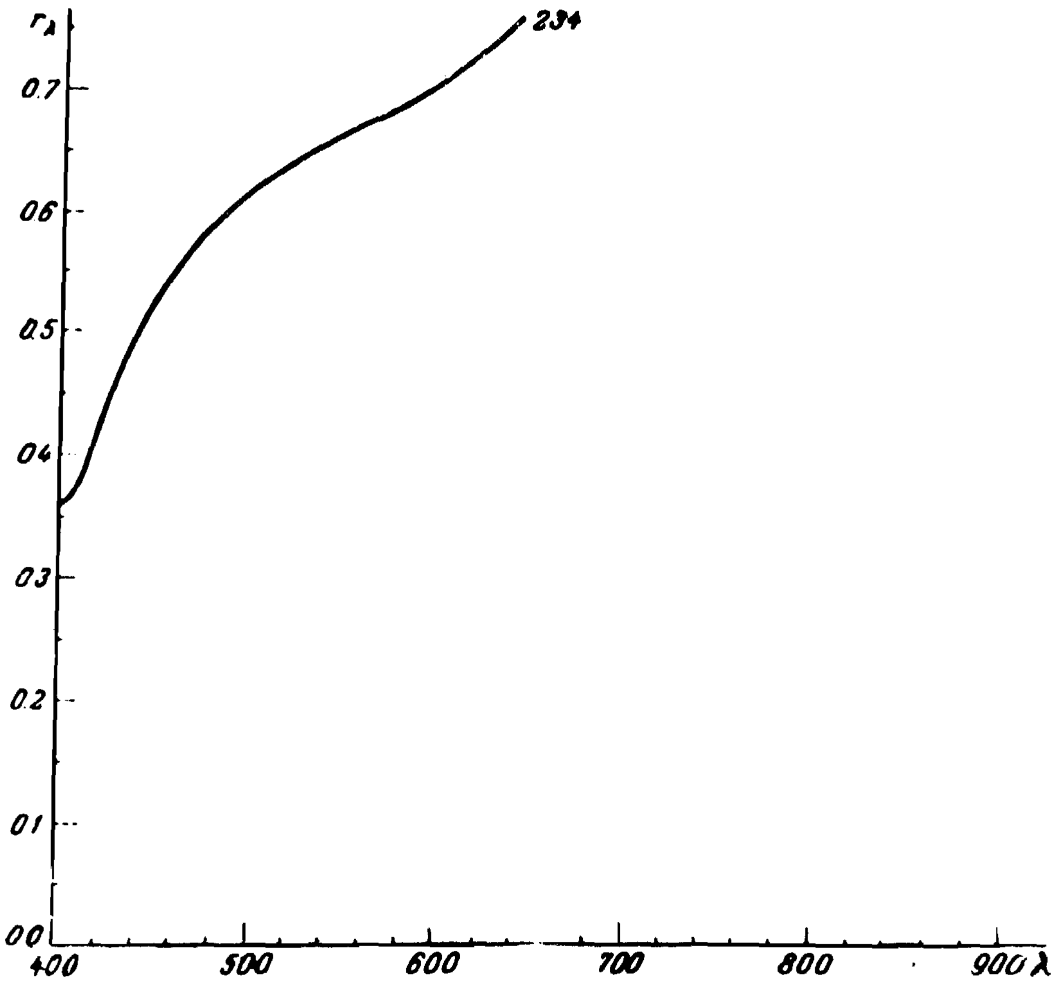


XCIII. River bank (slope), bare
231. A = 90°



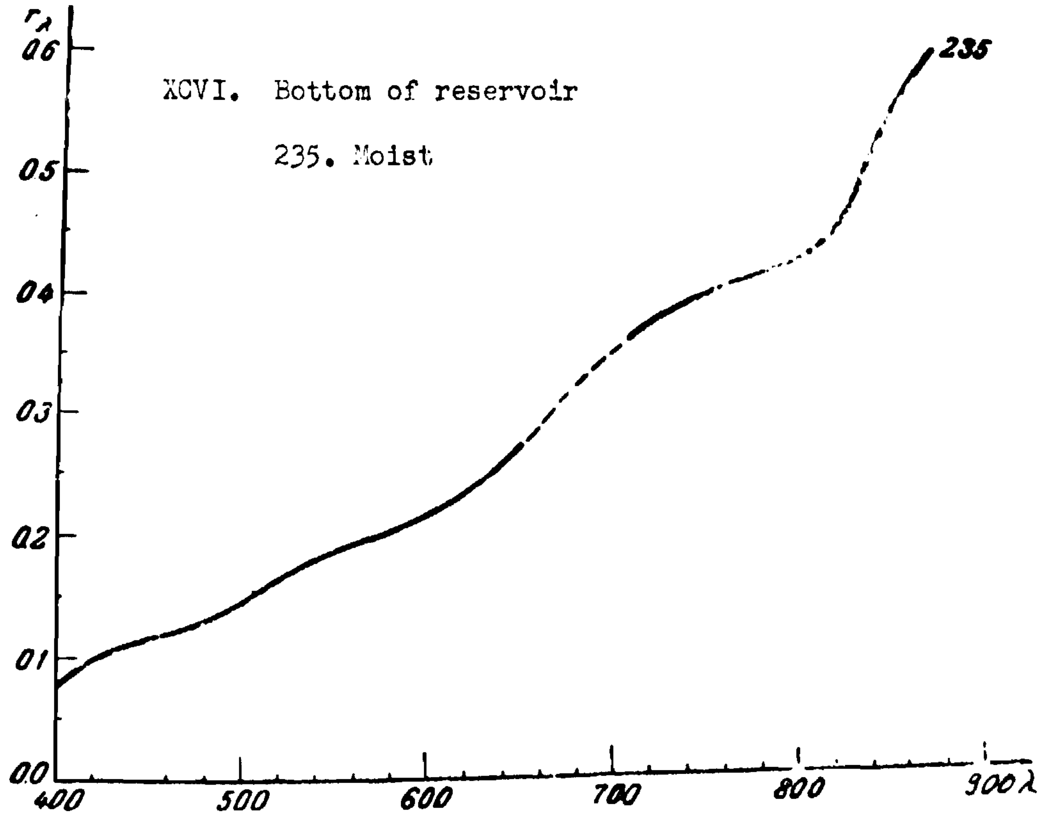
XCIV. Boulders

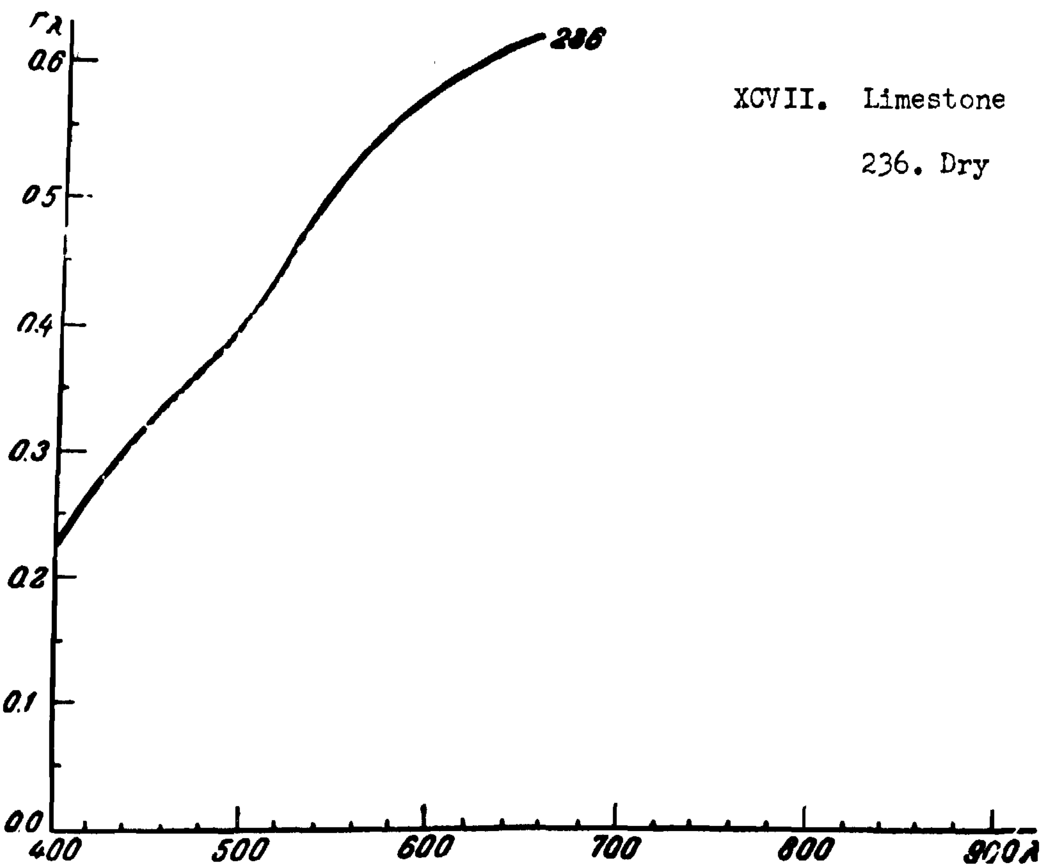
232. Dry; 233. Wet

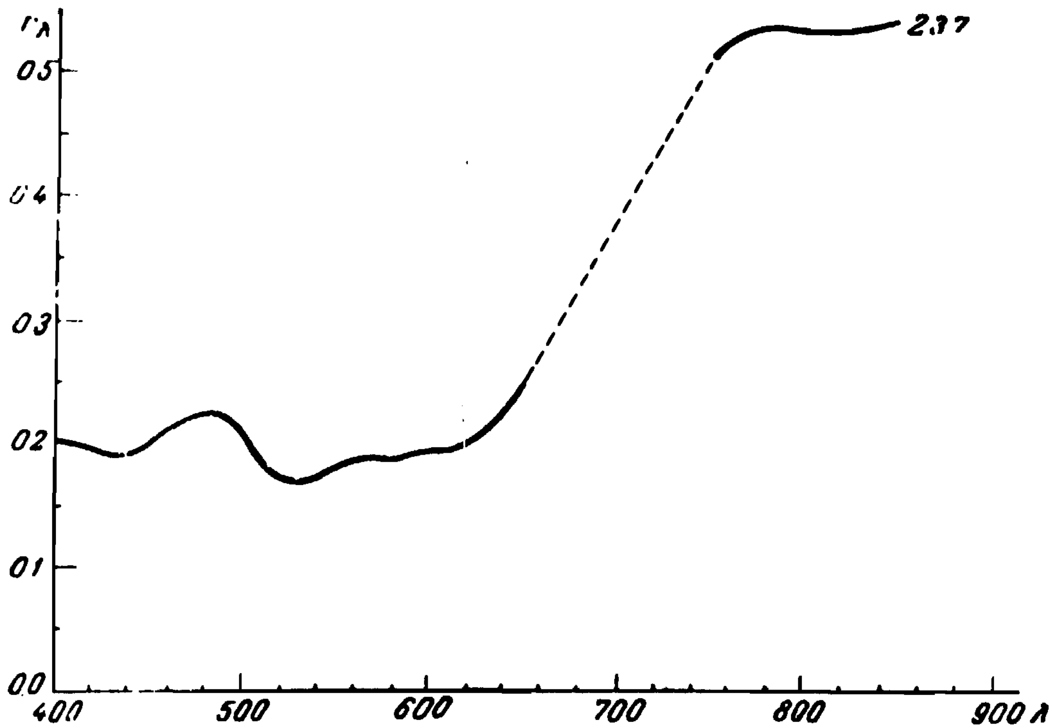


XCV. Clay

234. Dry

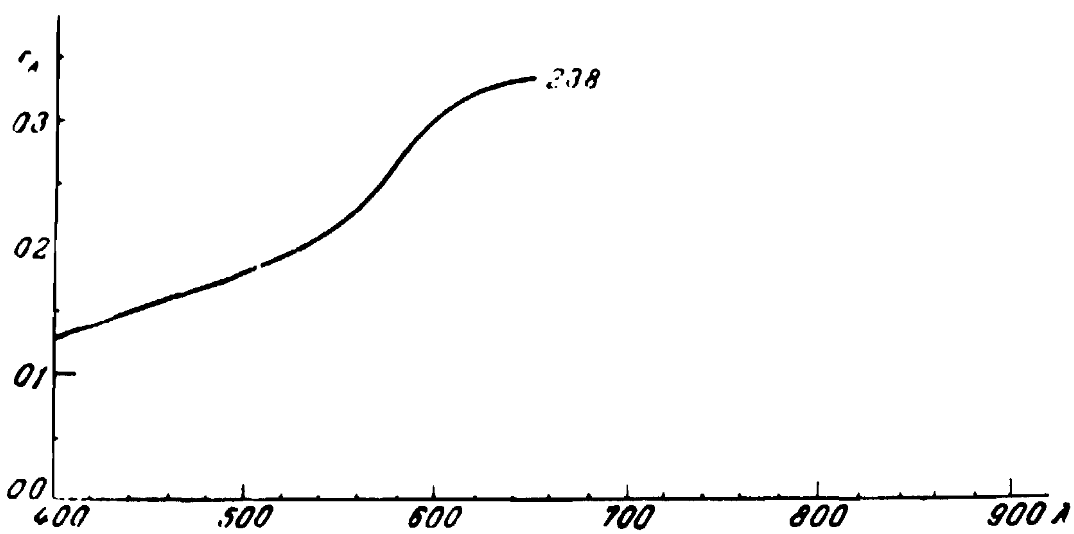

XCVI. Bottom of reservoir
235. Moist
235
r_λ
0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900 λ


XCVII. Limestone
236. Dry
236
r_λ
0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
500
600
700
800
900 λ

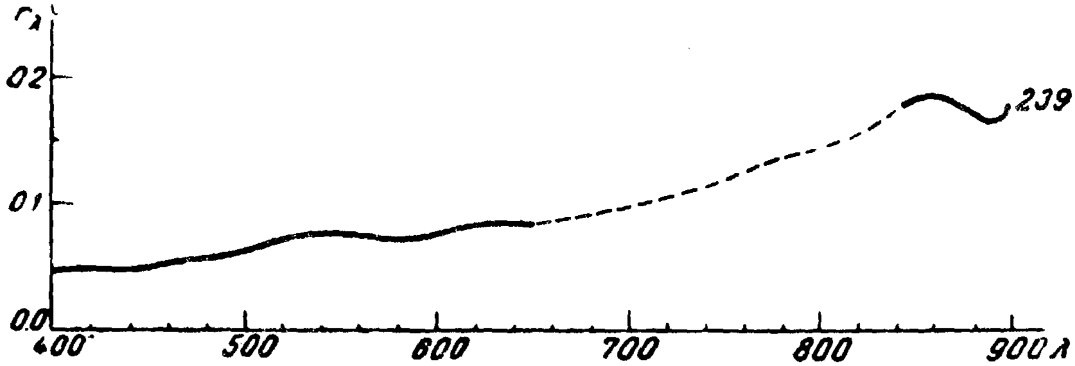


XCVIII. Silt at bottom of canal

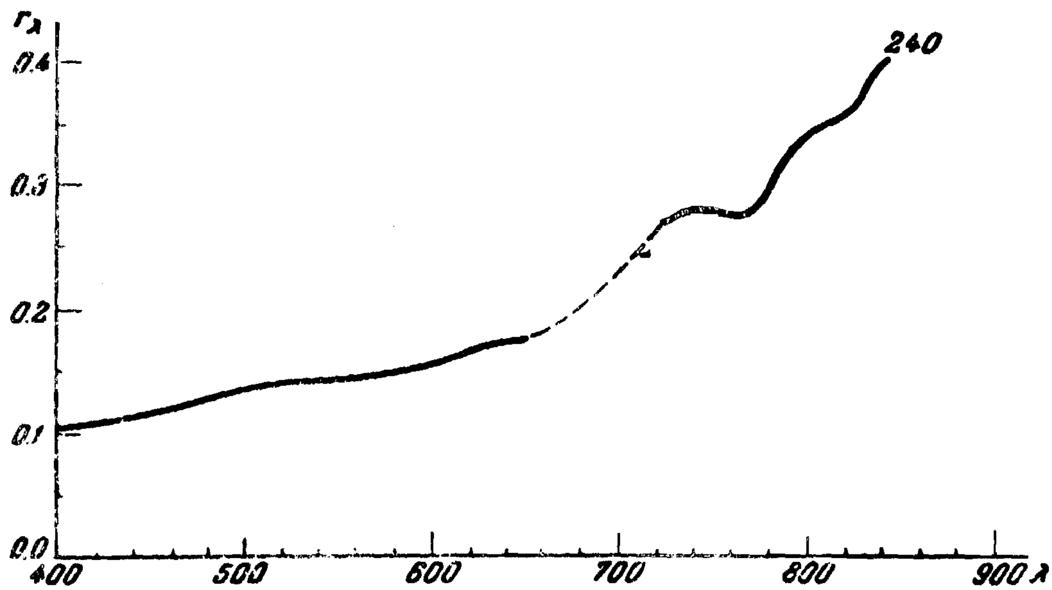
237. Dry



XCIX. Conglomerates with small impressions.
238. Dry.

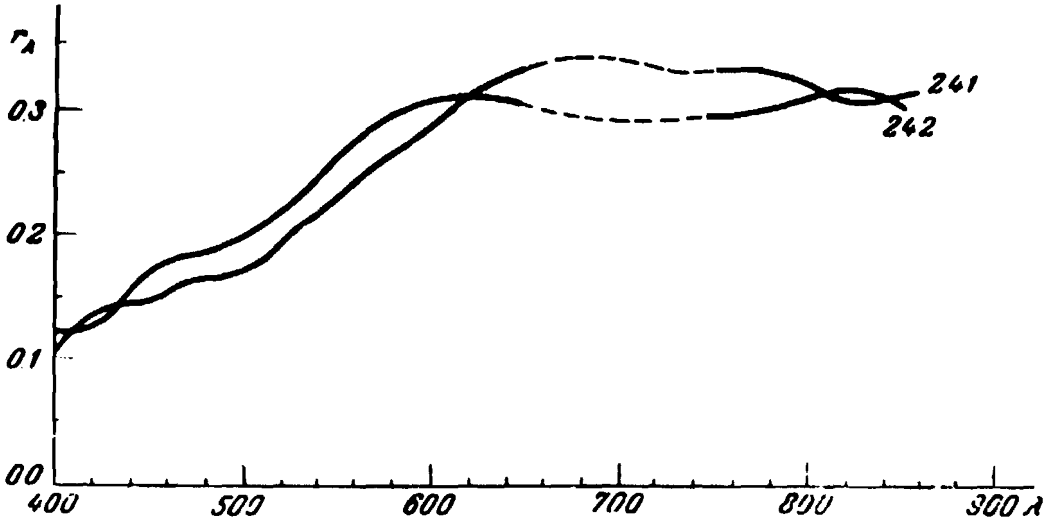


C. Hillock, turf
239. Bare and dry



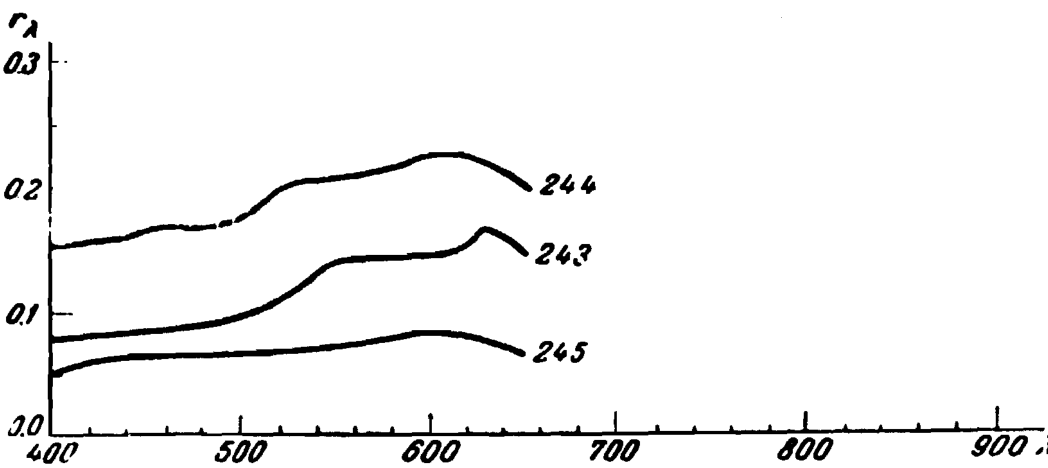
CI. Edge of river bank

240. Bare, dry



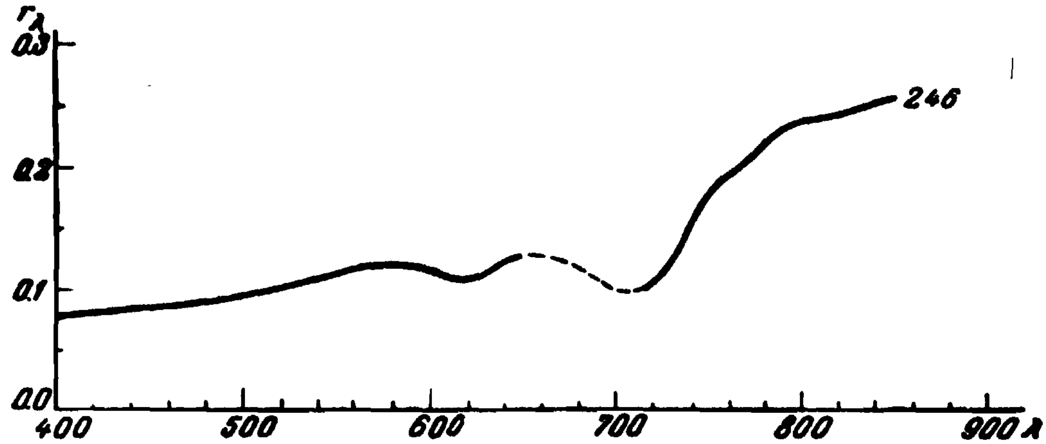
CII. Wind-eroded area

241. Compact clay; 242. Individual sample



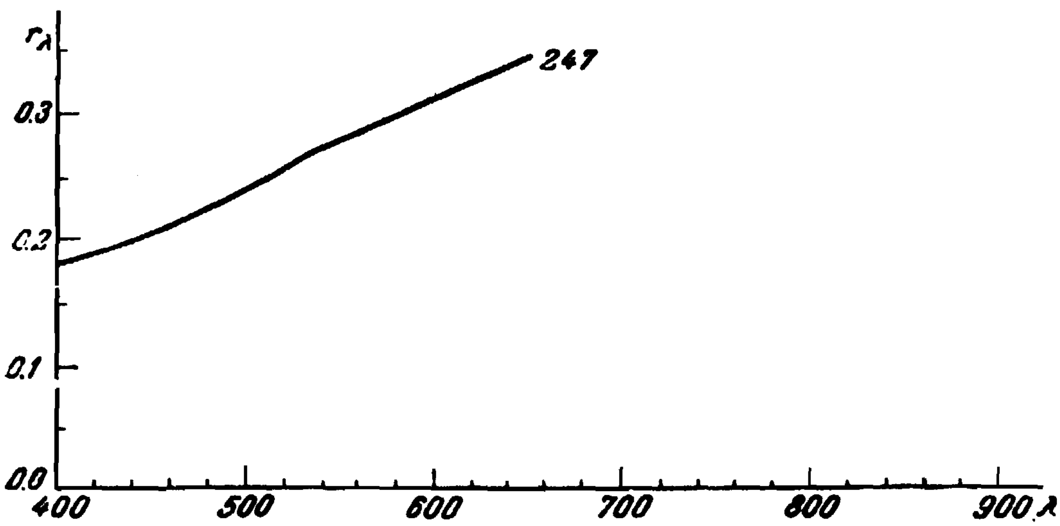
CIII. Talus

243. In mountain region; 244. Tundra;
245. Tundra, partially in shade



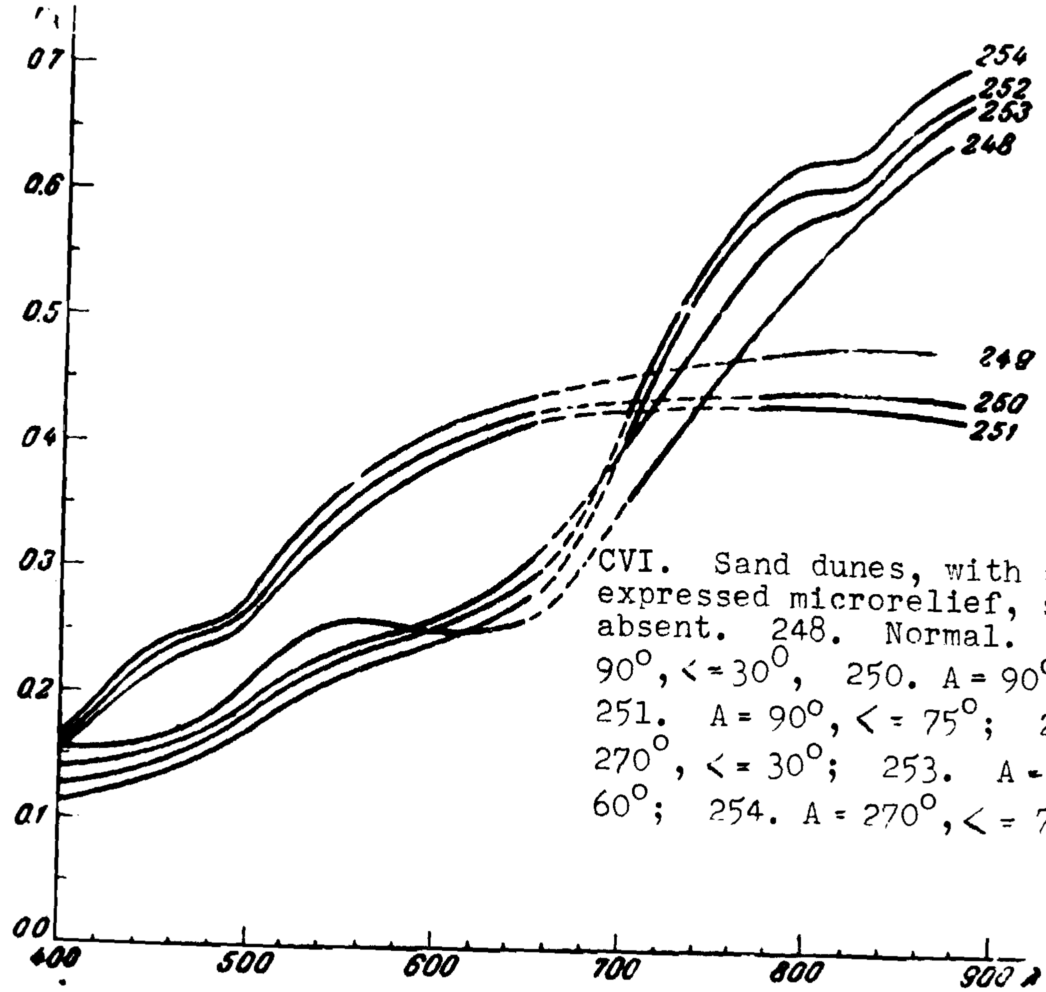
CIV. Shallows

246. Moist

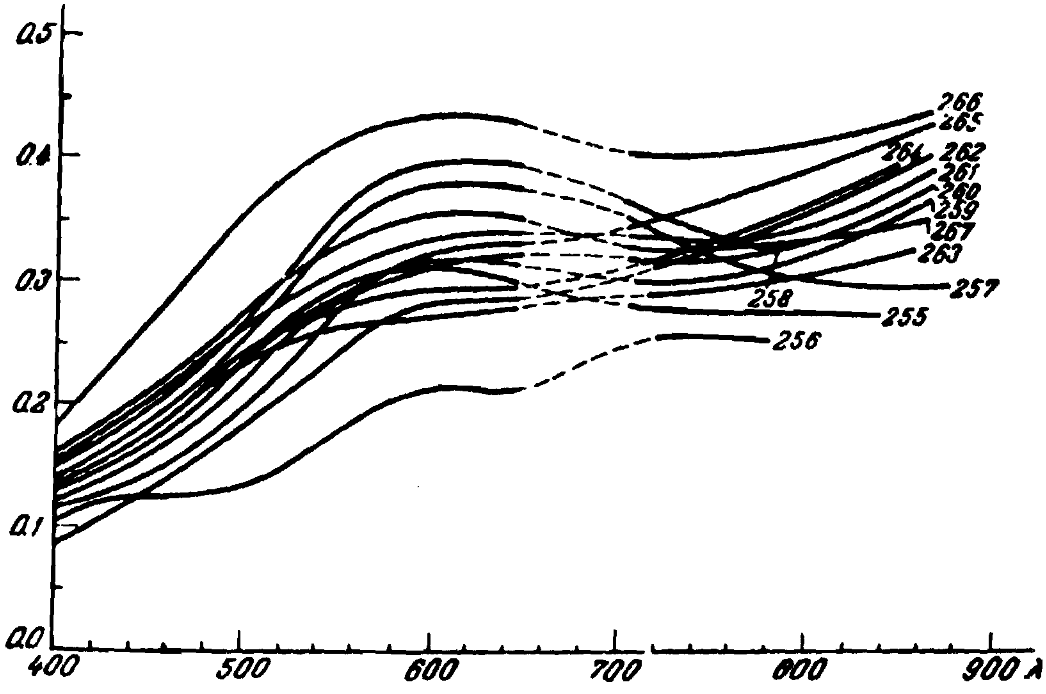


CV. Sand

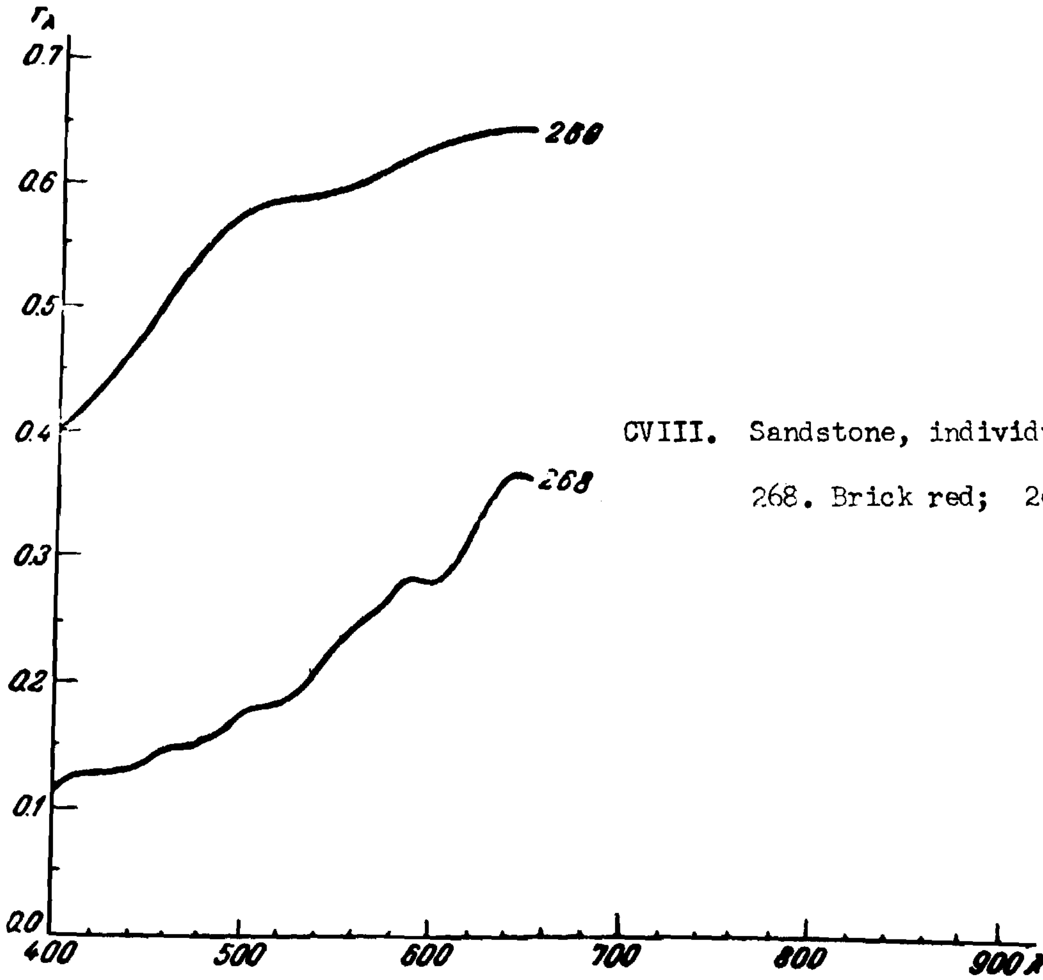
247. Dry



CVI. Sand dunes, with sharply expressed microrelief, shadows absent. 248. Normal. 249. A = 90°, < = 30°, 250. A = 90°, < = 60°; 251. A = 90°, < = 75°; 252. A = 270°, < = 30°; 253. A = 270°, < = 60°; 254. A = 270°, < = 75°.

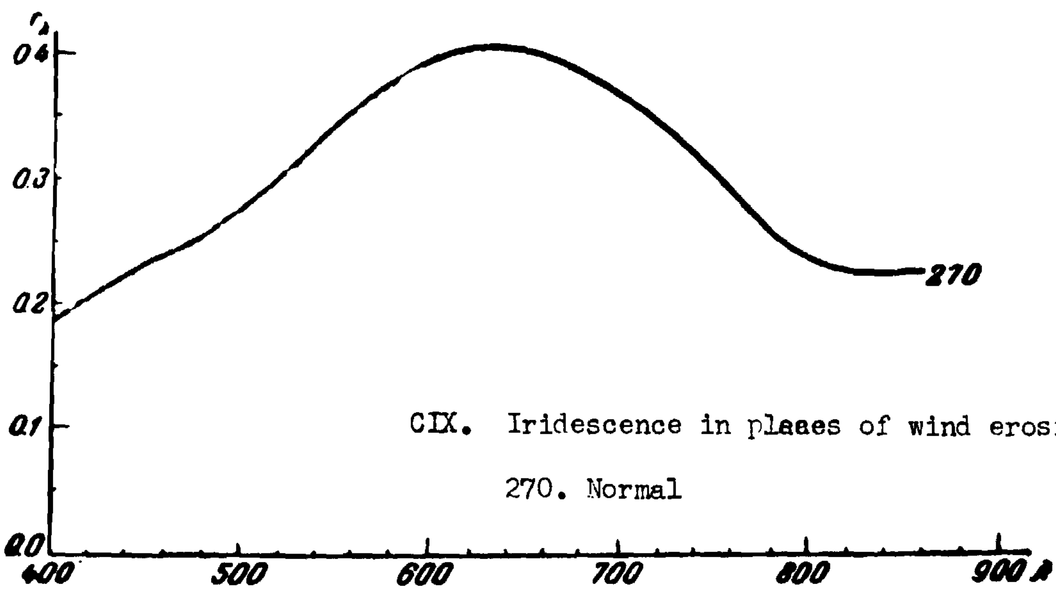


CVII. Sand dunes, shadows at right-angles to ridges (ridges in azimuth of 90°.
255. Normal. 256. A = 0°, < = 30°; 257. A = 0°, < = 60°; 258. A = 0°, < = 75°; 259. A = 90°, < = 30°; 260. A = 90°, < = 60°; 261. A = 90°, < = 75°; 262. A = 180°, < = 30°; 263. A = 180°, < = 60°; 264. A = 180°, < = 75°; 265. A = 270°, < = 30°; 266. A = 270°, < = 60°; 267. A = 270°,



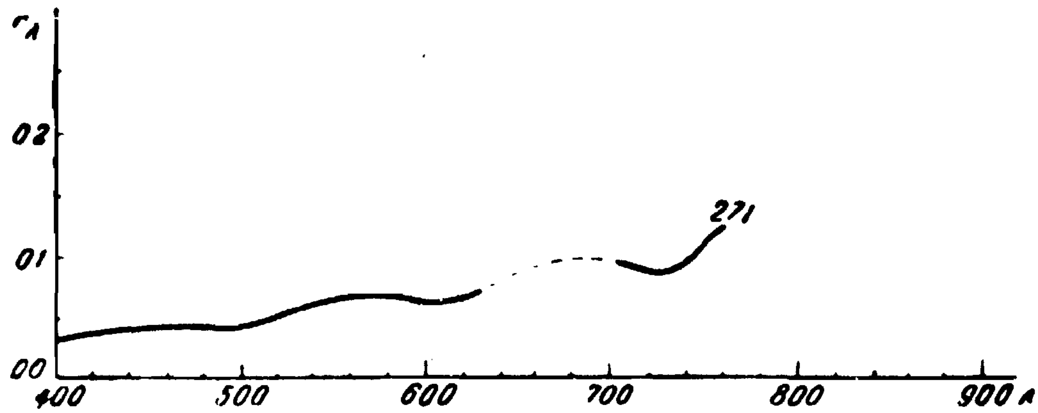
CVIII. Sandstone, individual sample

268. Brick red; 269. Light grey



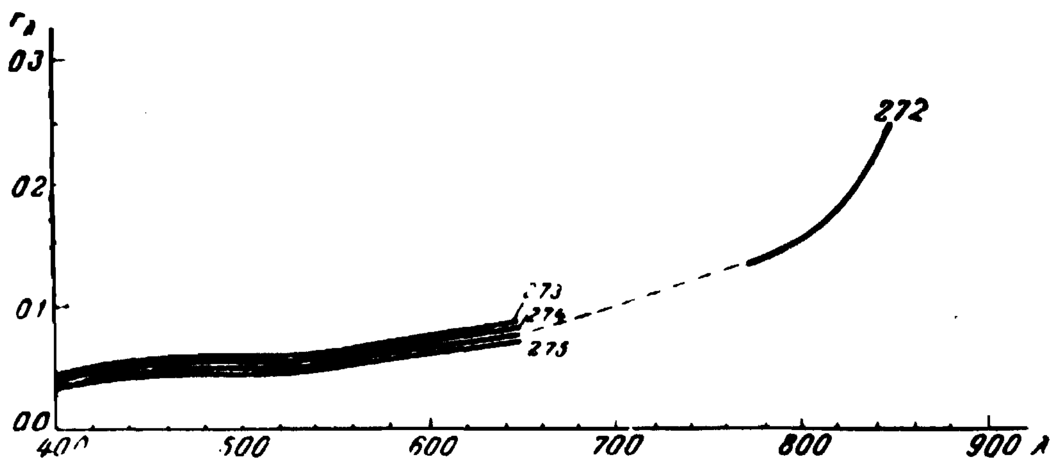
CIX. Iridescence in plaaes of wind erosion

270. Normal

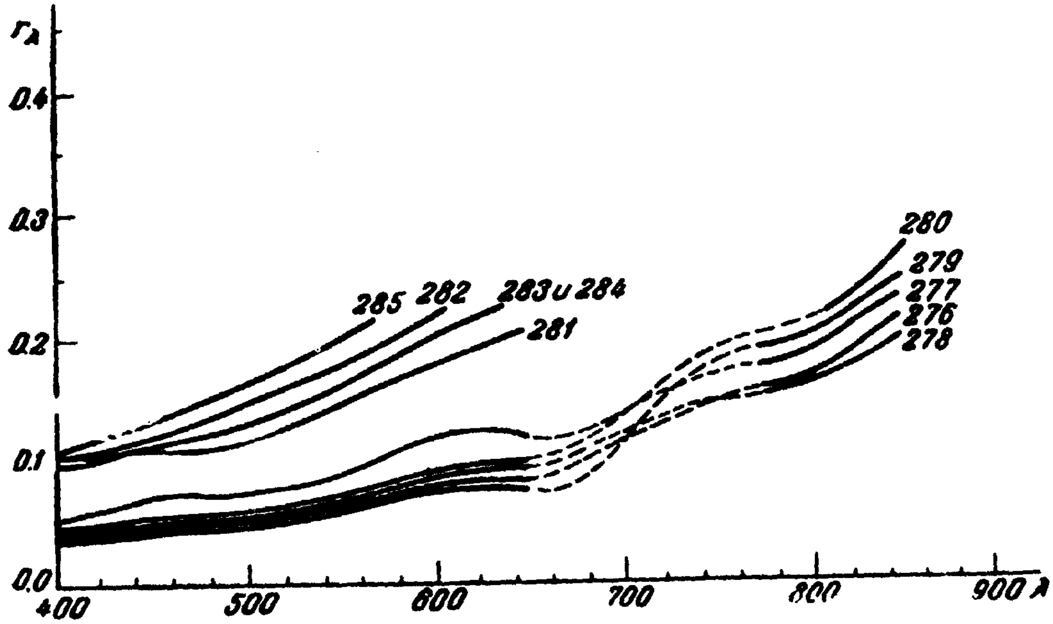


CX. Soil, boggy

271. Very moist

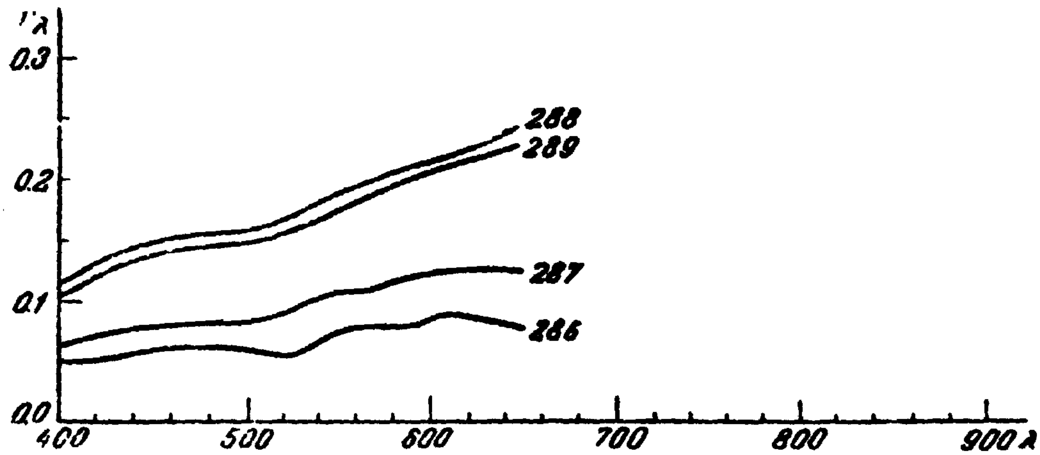


CXI. Soil, podsol, moist.
272. normal; 273. A = 0°, < = 15°; 274. A = 0°, < = 30°; 275. A = 0°, < = 60°.

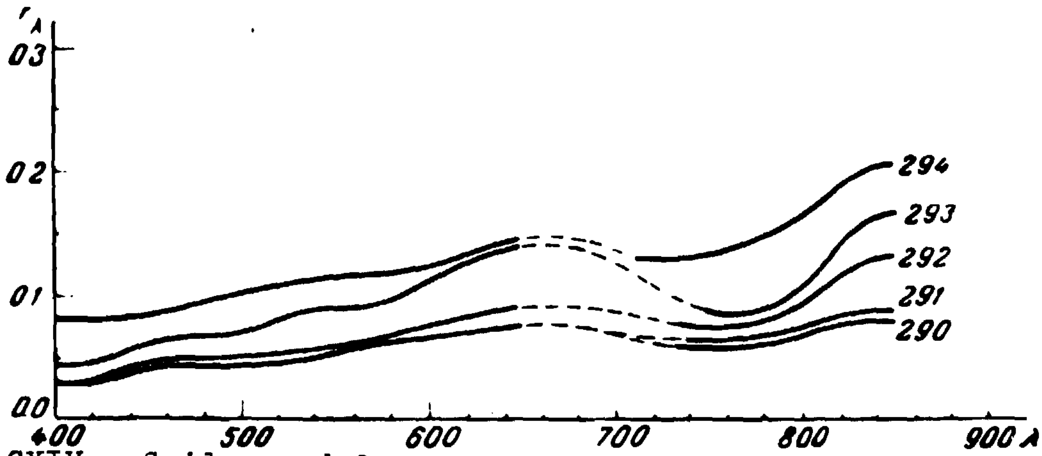


CXII. Soil, podsol, moist.

276 — A = 90°, ∠ = 15°; 277 — A = 90°, ∠ = 30°; 278 — A = 90°, ∠ = 45°; 279 — A = 90°, ∠ = 60°; 280 — A = 90°, ∠ = 75°; 281 — A = 270°, ∠ = 15°; 282 — A = 270°, ∠ = 30°; 283 — A = 270°, ∠ = 45°; 284 — A = 270°, ∠ = 60°; 285 — A = 270°, ∠ = 75°.

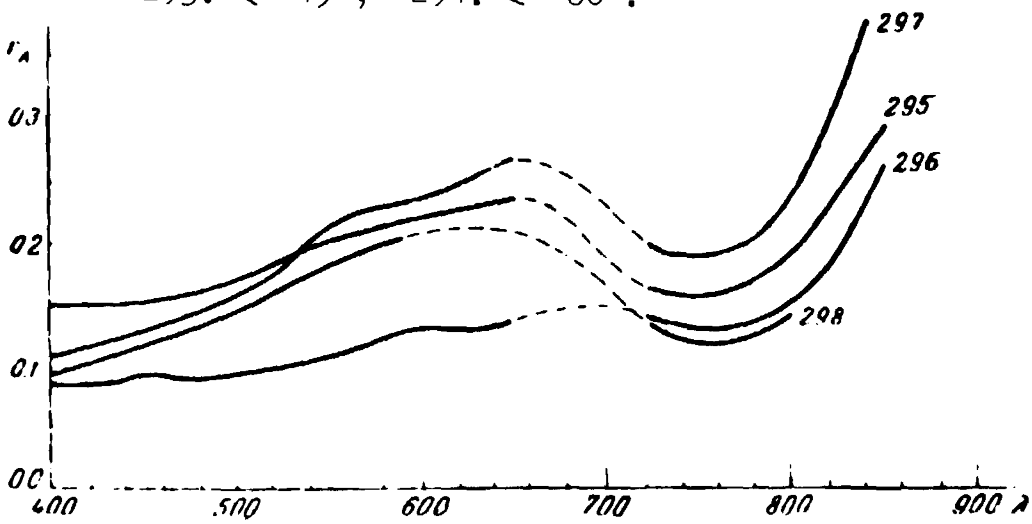


CXIII. Soil, podsol.
Wet: 286. < = 45°. Dry: 287. A = 0°, < = 45°;
288. A = 90°, < = 45°; 289. A = 180°, < = 45°.



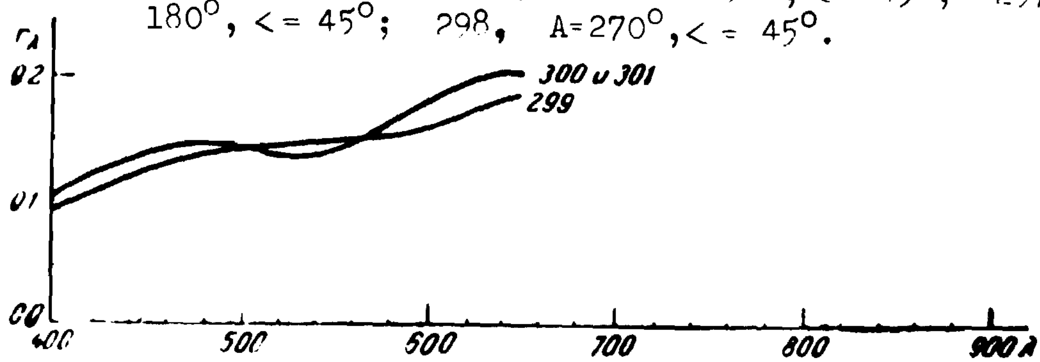
CXIV. Soil, sand loam, moist.

290. Normal; cloudy sky: 291. < = 15°; 292. < = 30°; 293. < = 45°; 294. < = 60°.



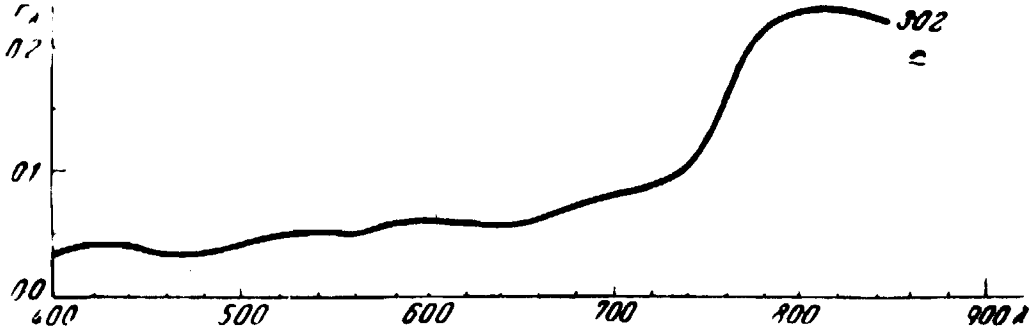
CXV. Soil, sand loam, moist

295. A = 0°, < = 45°; 296. A = 90°, < = 45°; 297. A = 180°, < = 45°; 298, A = 270°, < = 45°.

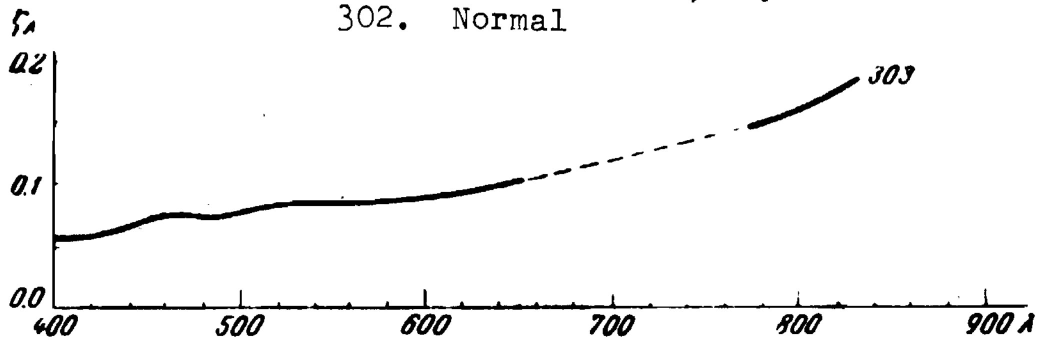


CXVI. Soil, sand loam, dry.

299. Normal; 300. A = 0°, < = 45°; 301. A = 90°, < = 15°.

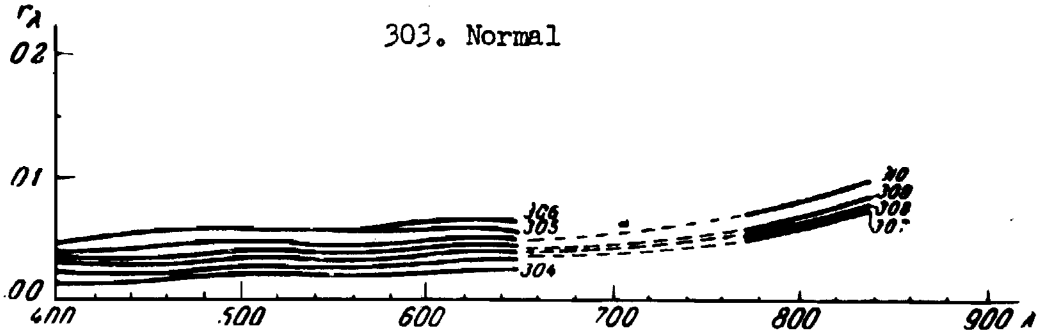


CXVII. Soil, grey, podsol, dry.
302. Normal

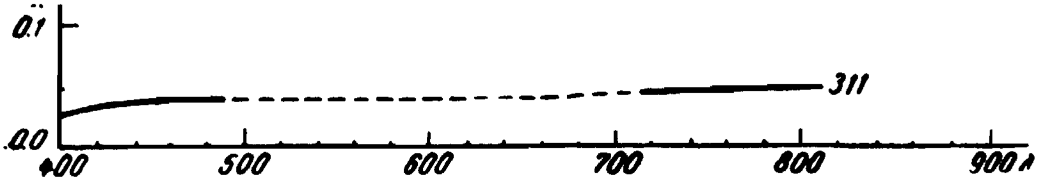


CXVIII. Soil, black earth, leached (moist)

303. Normal

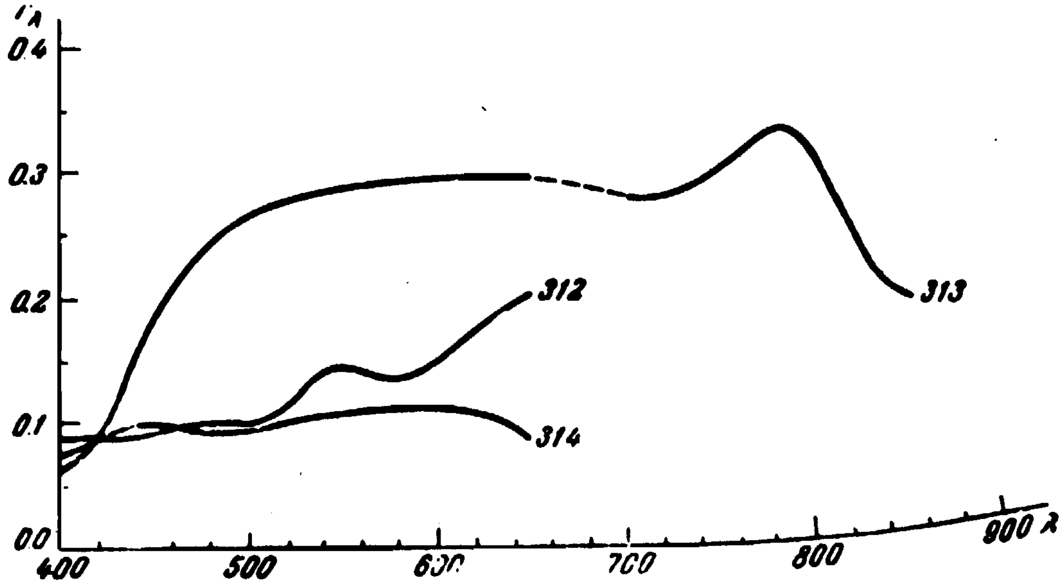


CXIX. Soil, rich black earth.
Wet: 304. Normal; 305. A = 0°, < = 45°; 306. A = 180°, < = 45°;
Dry: 307. Normal; 308. A = 0°, < = 45°; 309. A = 90°, < = 45°;
310. A = 180°, < = 45°.



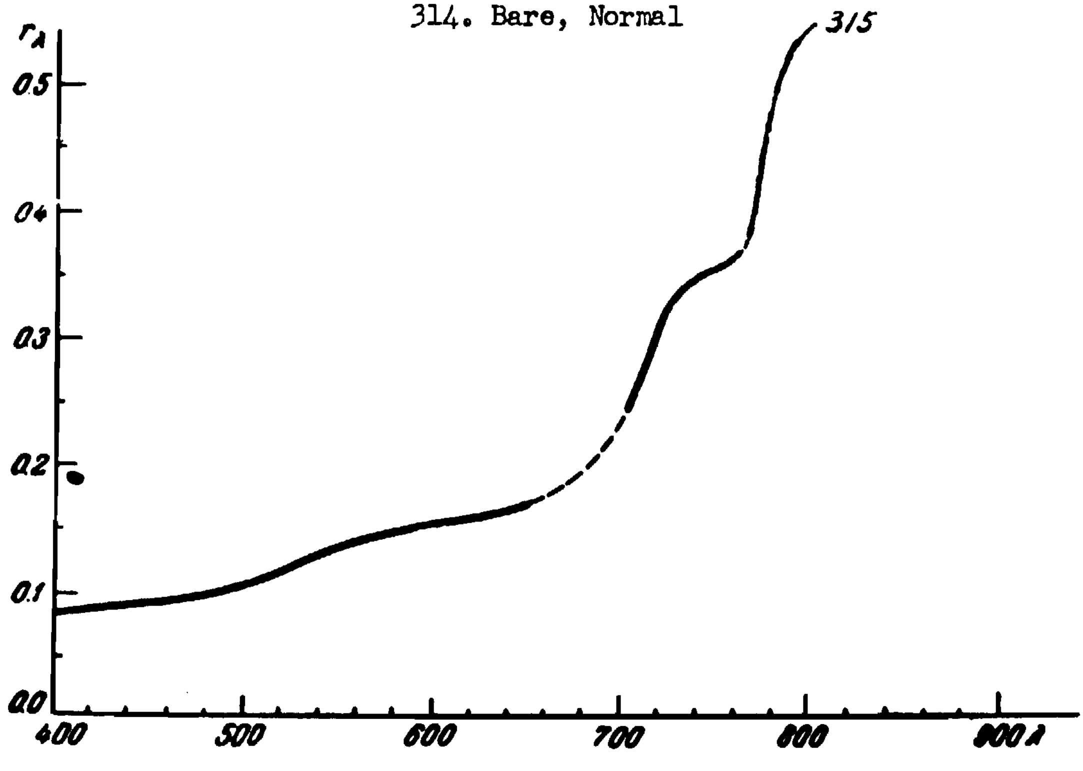
CXX. Soil, clay loam, moist

311. From the air, alt. = 300 m.



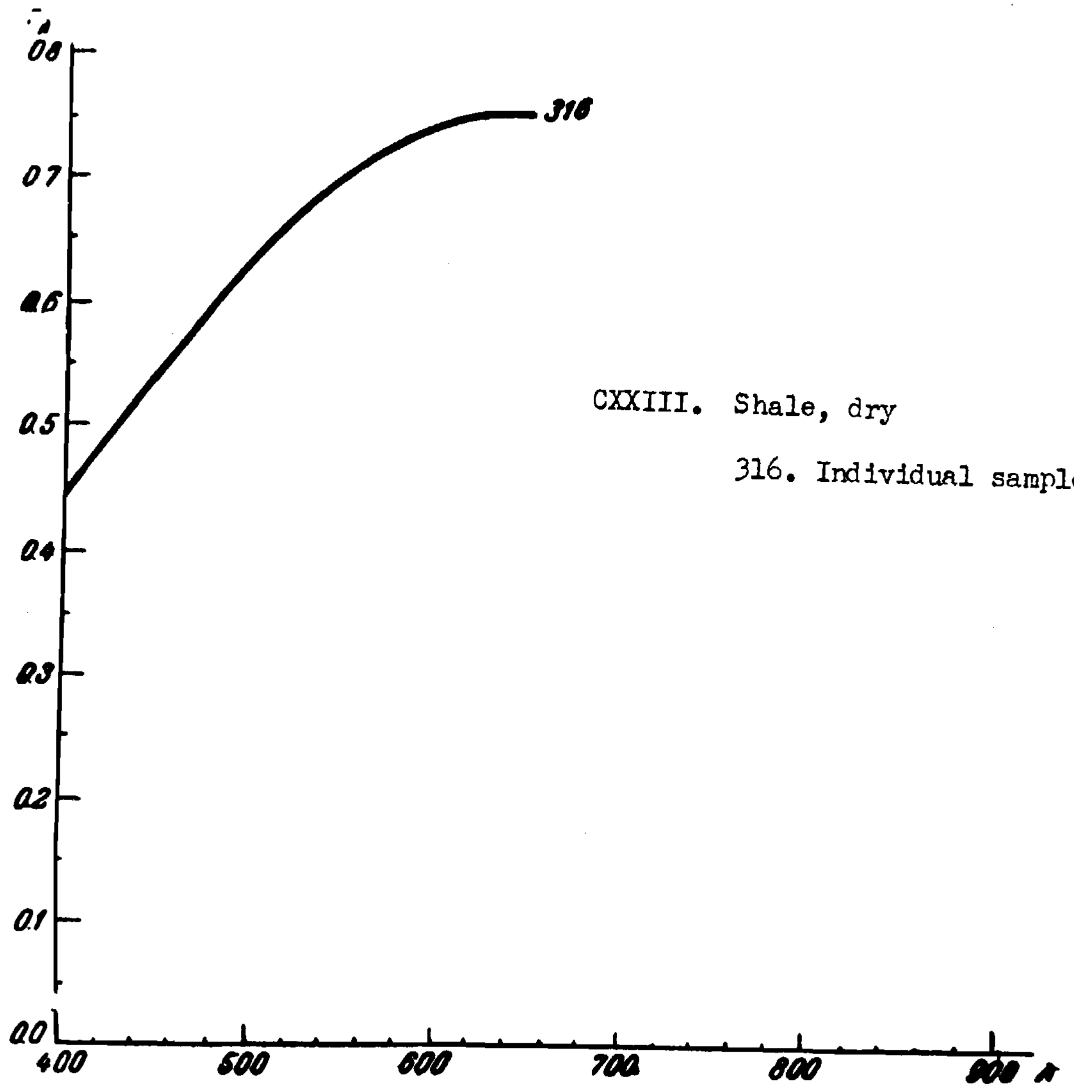
CXXI. Cliffs

312. Bare, A = 110°; 313. At mountain top, Normal; 314. Bare, Normal



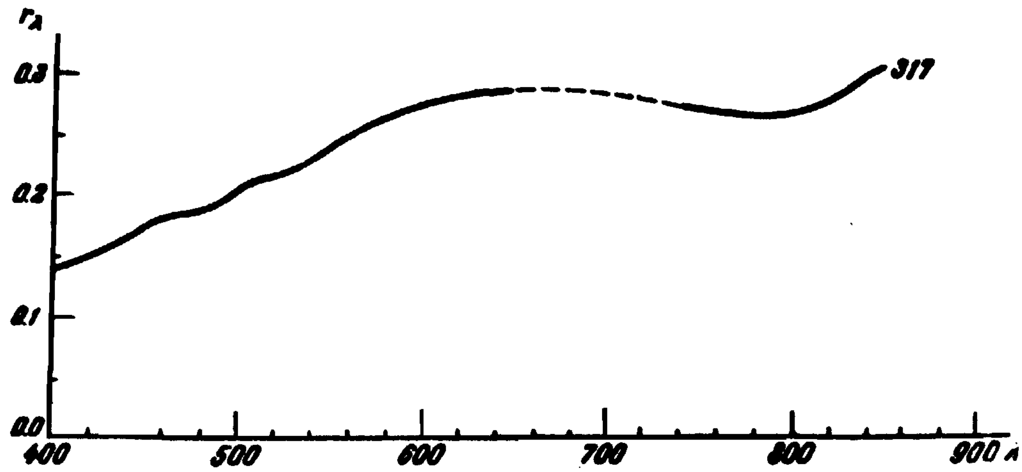
CXXII. Hillside

315. Bare



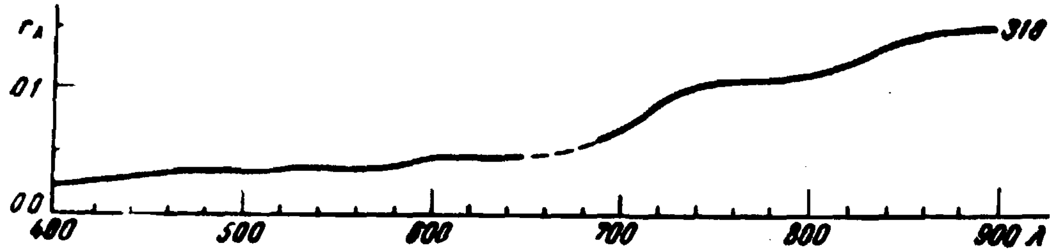
CXXIII. Shale, dry

316. Individual sample



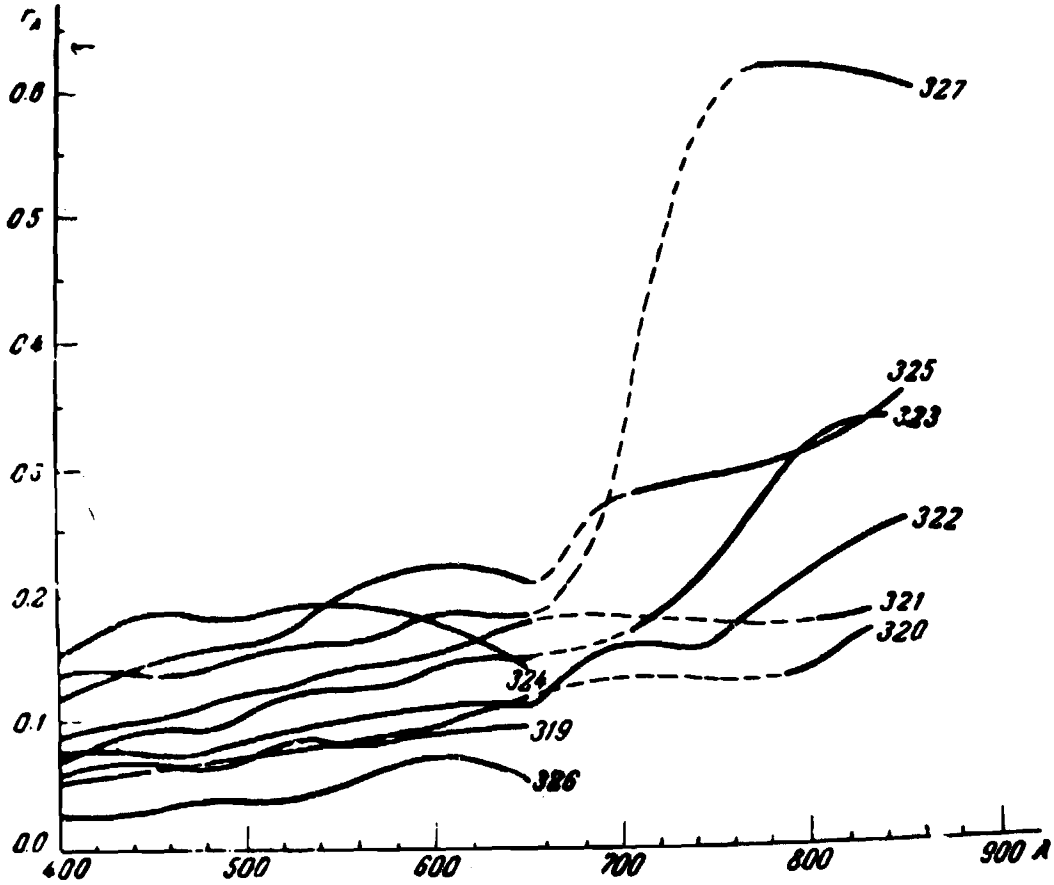
CXXIV. Salt marshes.

317. A = 90°, < = 45°



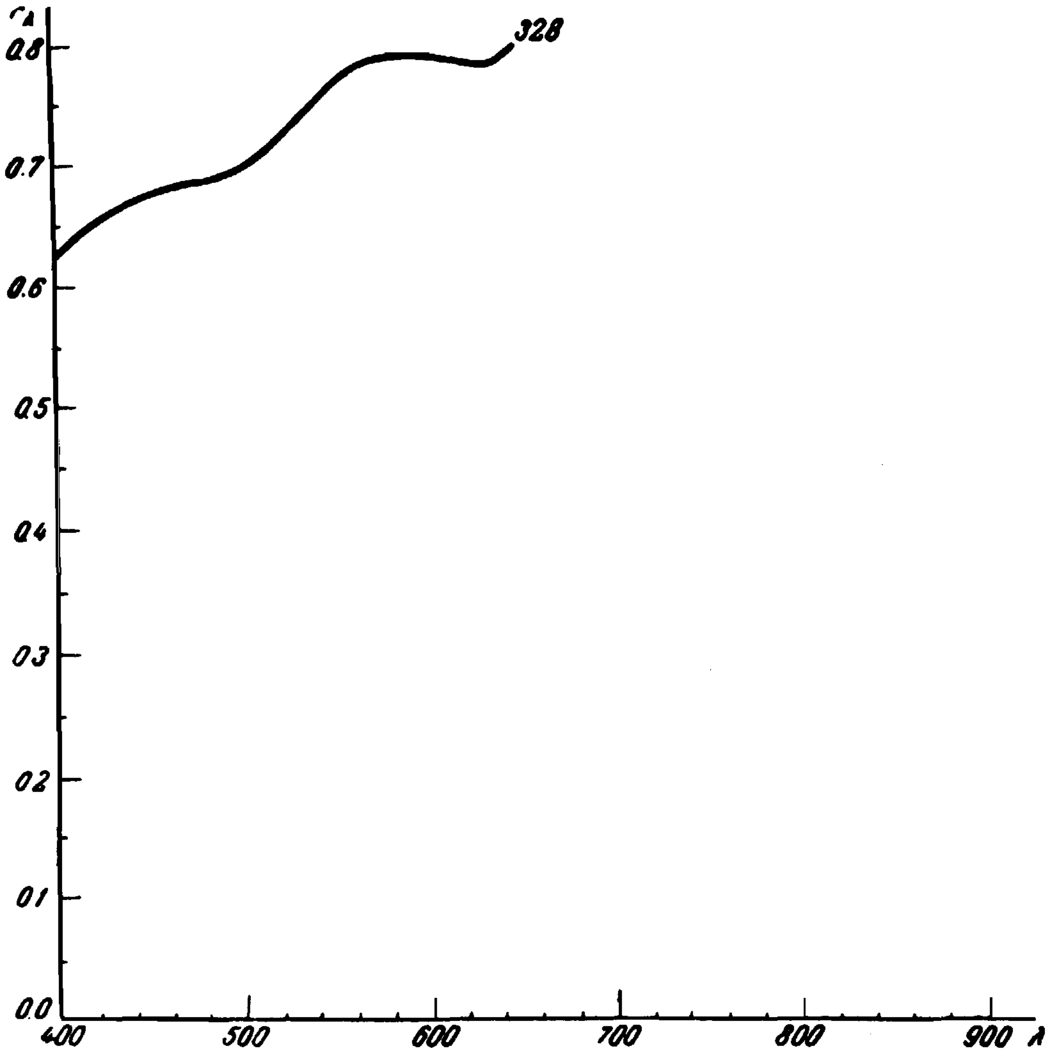
CXXV. Turf, bare

318. Normal



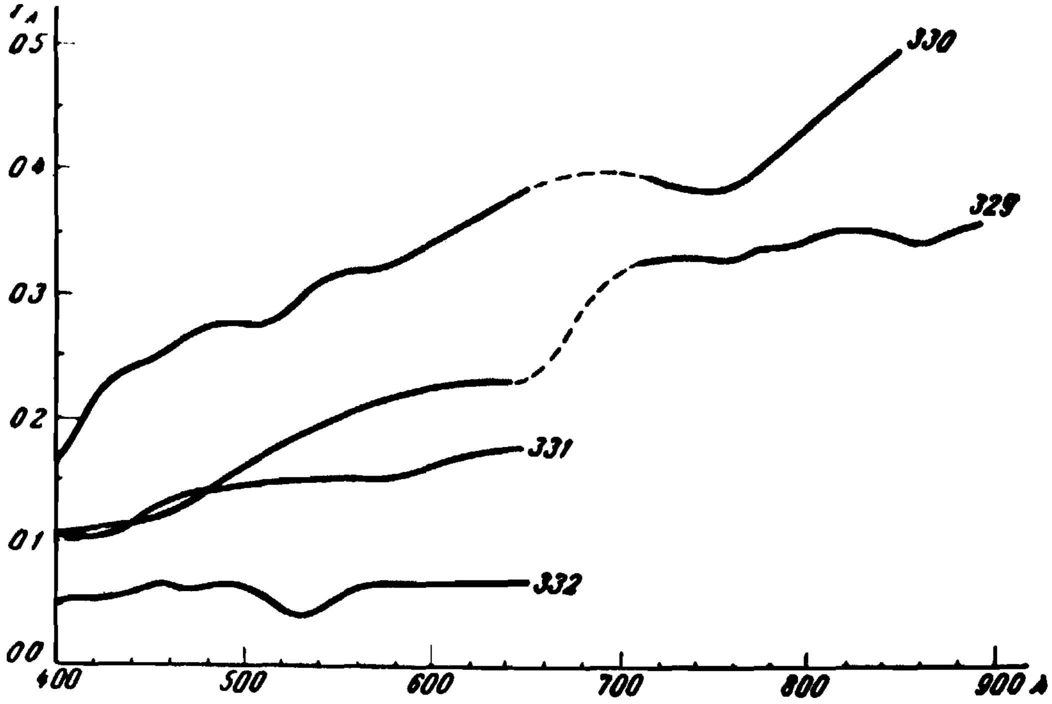
CXXVI. Roads, earth

319. Dry, heavily trampled, black earth, normal; 320. Dry, trampled, cloudy sky, sand loam, normal; 321. Dry, trampled, sand loam, $\angle = 30°$; 322. Dry, trampled, grey desert soil, normal; 323. Dry, trampled, leached black earth, normal; 324. Dry, lightly trampled, chestnut brown soil, normal; 325. Dry, trampled, podsol, normal; 326. Wet, muddy, podsol, A = 90°; $\angle = 45°$; 327. Dry, covered with a layer of loess, normal



CXXVII. Road, winter

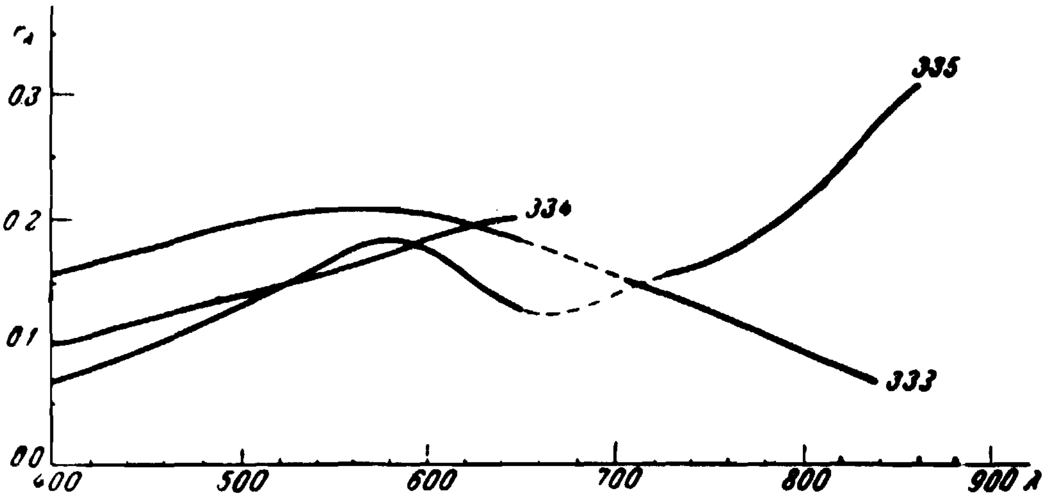
328. Wet, yellowish after rain



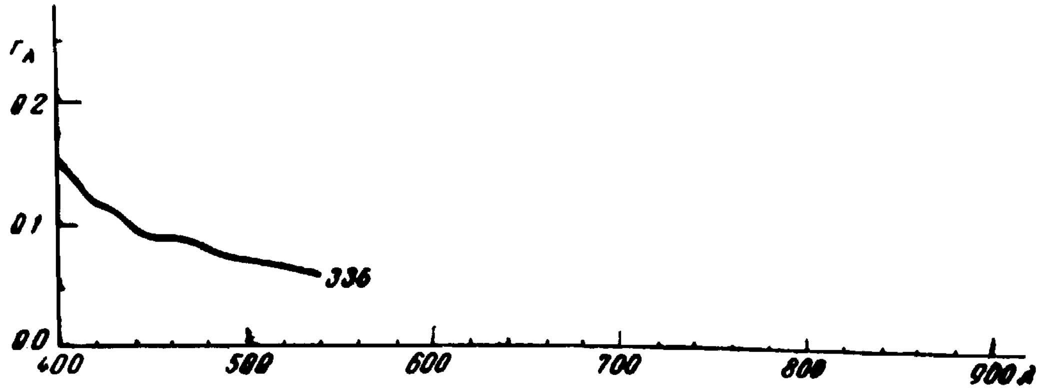
CXXVIII. Roads, cobblestone

329. Dry, normal, in tundra; 330. Dry, normal, in n.f.b.;

331. Dry, A = 90°; <= 45°, in n.f.b.; 332. Wet, A = 90°; <= 45°, in n.f.b.

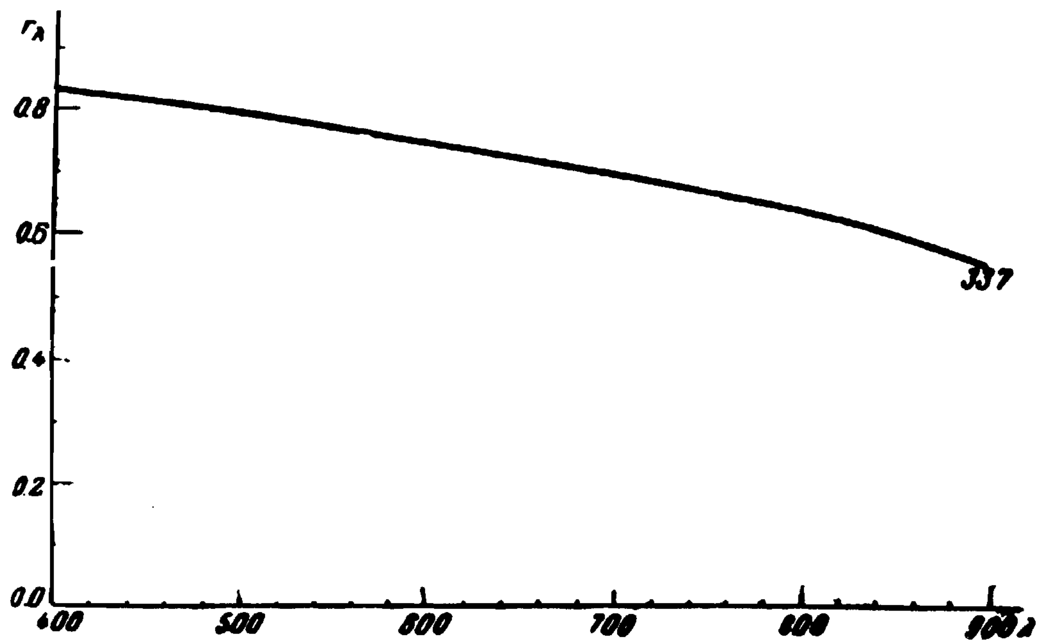


CXXIX. Water. 333. In the River Kuban, muddy, almost plumb. 334. In mountain river Dzhemagat, normal. 335. In reservoir, very muddy, chocolate color, normal.



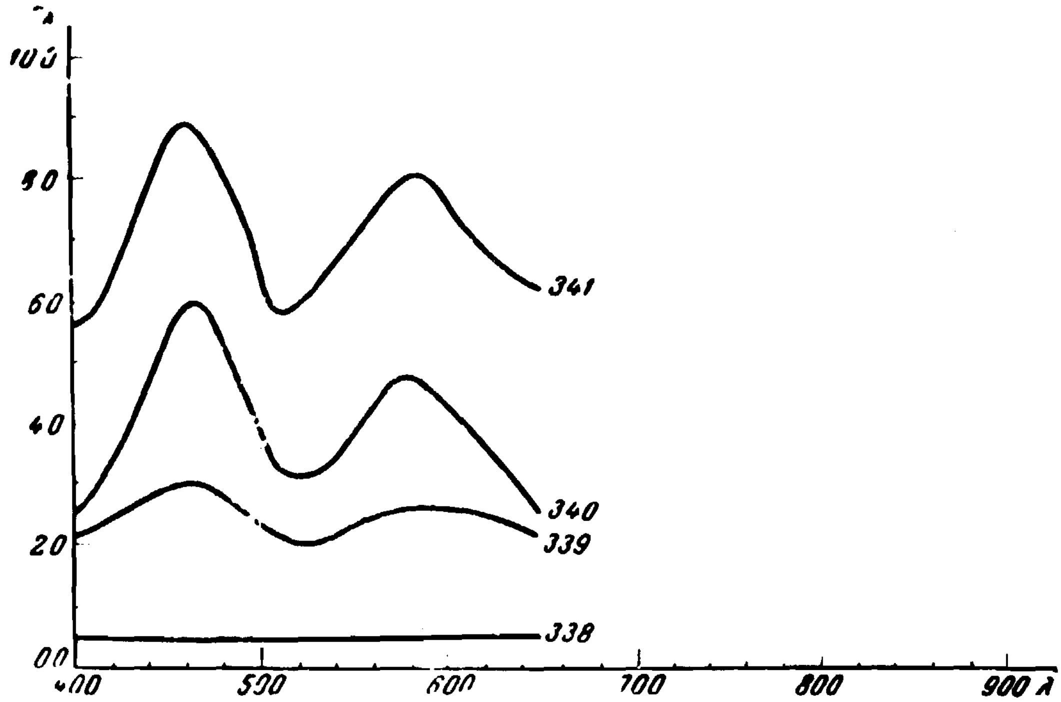
CXXX. Pond, clear

336. With reflection of blue sky



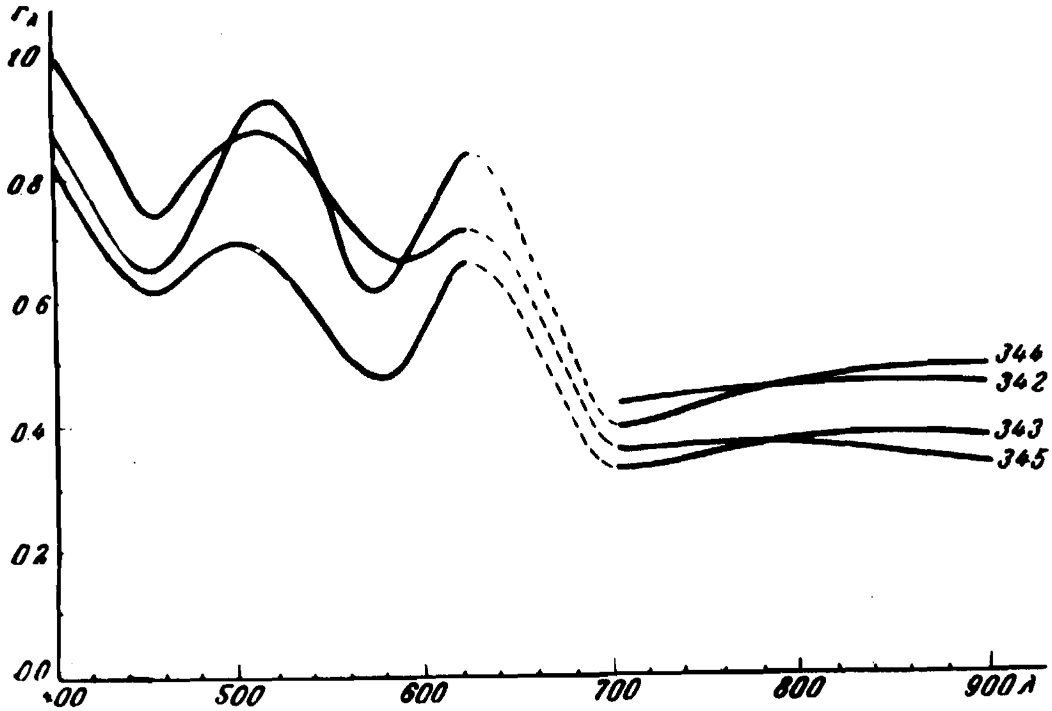
CXXXI. Snow, fresh

337. Normal



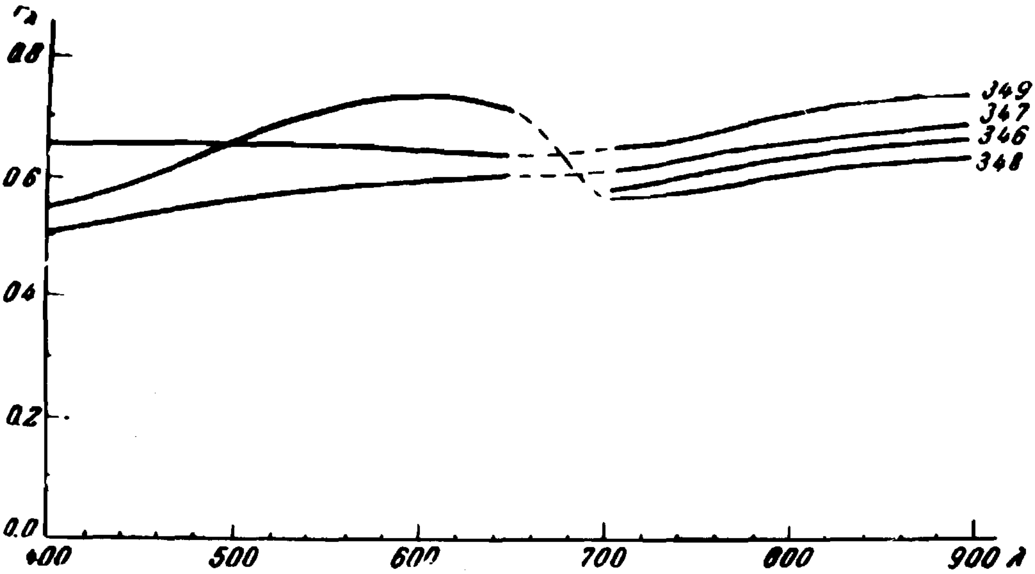
CXXXII. Snow, dry, with crust

338 A = 0°, ∠ = 20°; 339 - A = 0°, ∠ = 40°; 340 - A = 0°, ∠ = 60°;
341 - A = 0°, ∠ = 80°.



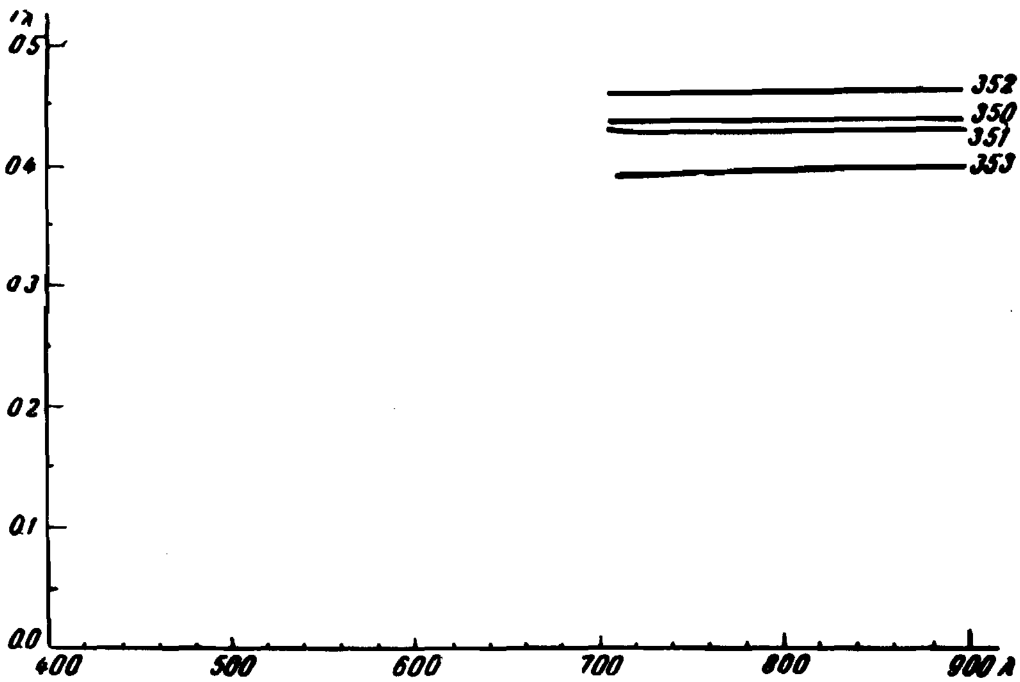
CXXXIII. Snow, dry, with crust

342 - A = 90°, ∠ = 20°; 343 — A = 90°, ∠ = 40°; 344 A = 90°, ∠ = 60°;
345 - A = 90°, ∠ = 80°.



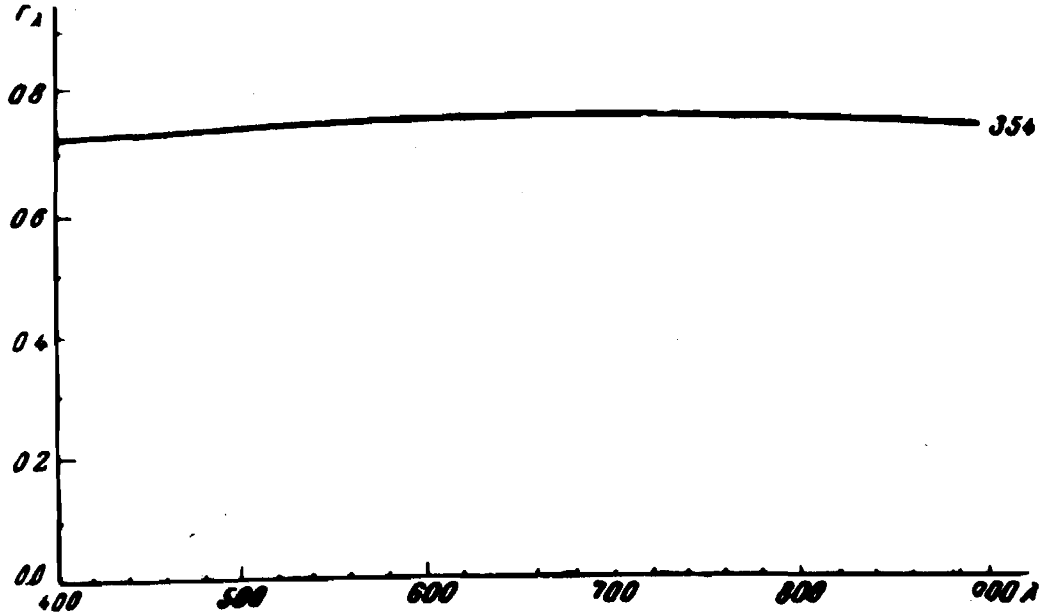
CXXXIV. Snow, dry, with crust

346 – A = 180°, ∠ = 20°; 347 — A = 180°, ∠ = 40°; 348 — A = 180°, ∠ = 60°;
349 — A = 180°, ∠ = 80°.



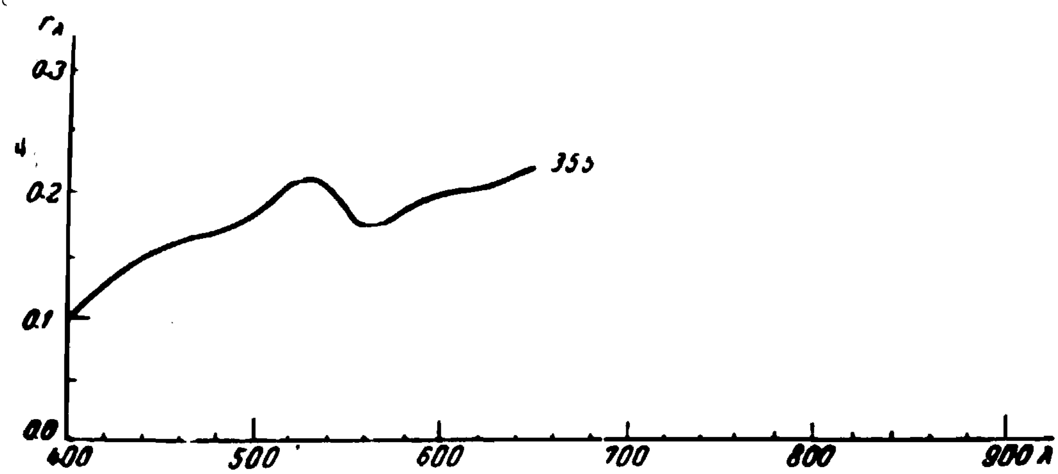
CXXXV. Snow, dry, with crust

350 — A = 270°, ∠ = 20°; 351 — A = 270°, ∠ = 40°; 352 — A = 270°, ∠ = 60°;
353 — A = 270°, ∠ = 80°.



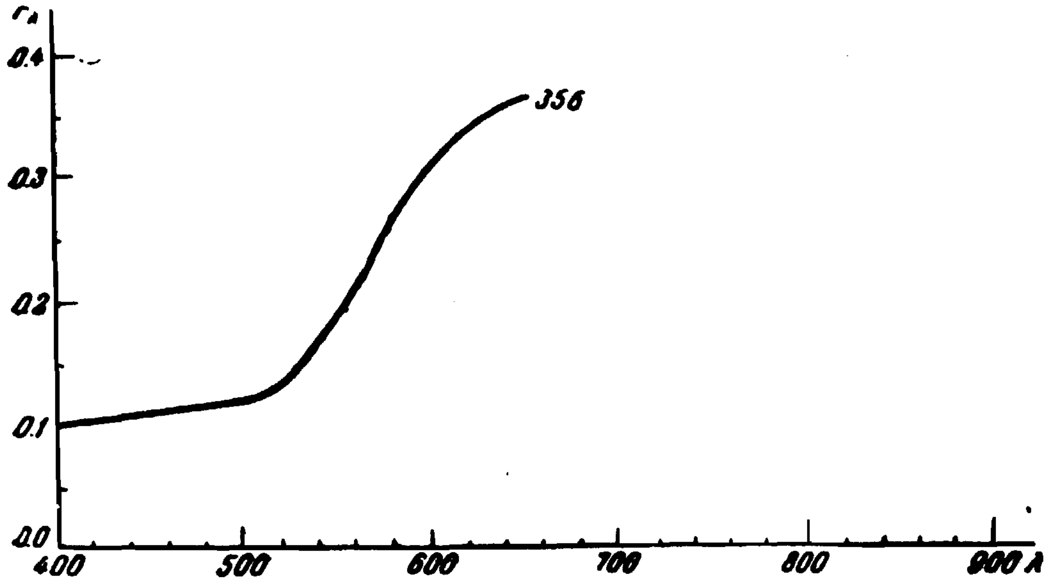
CXXXVI. Snow, covered with film of ice

354 – ∠ = 45°.



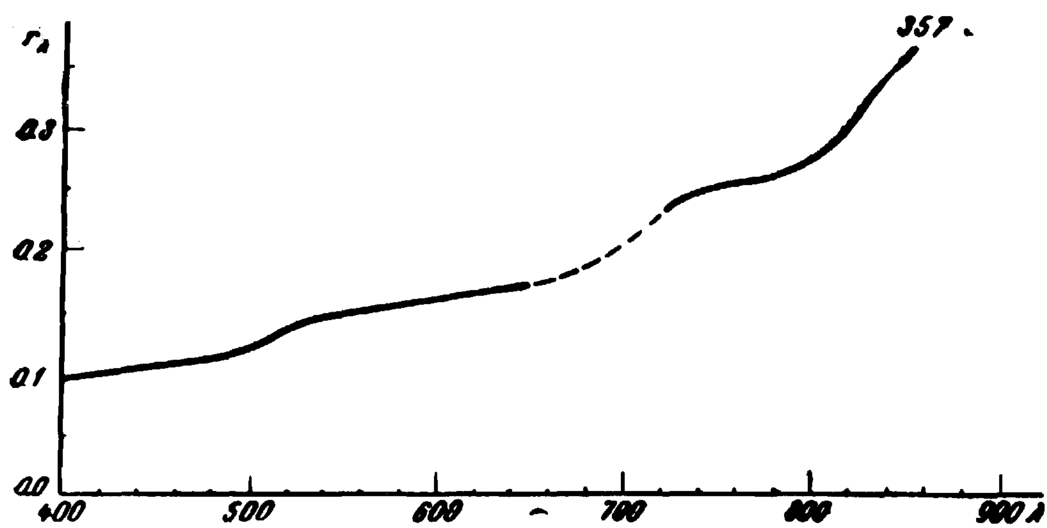
CXXXVII. Cobblestone

355. Dry



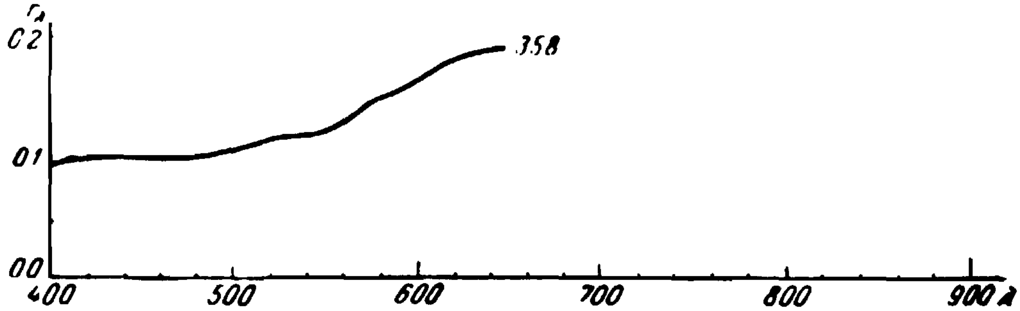
CXXXVIII. Brick

356. New, red



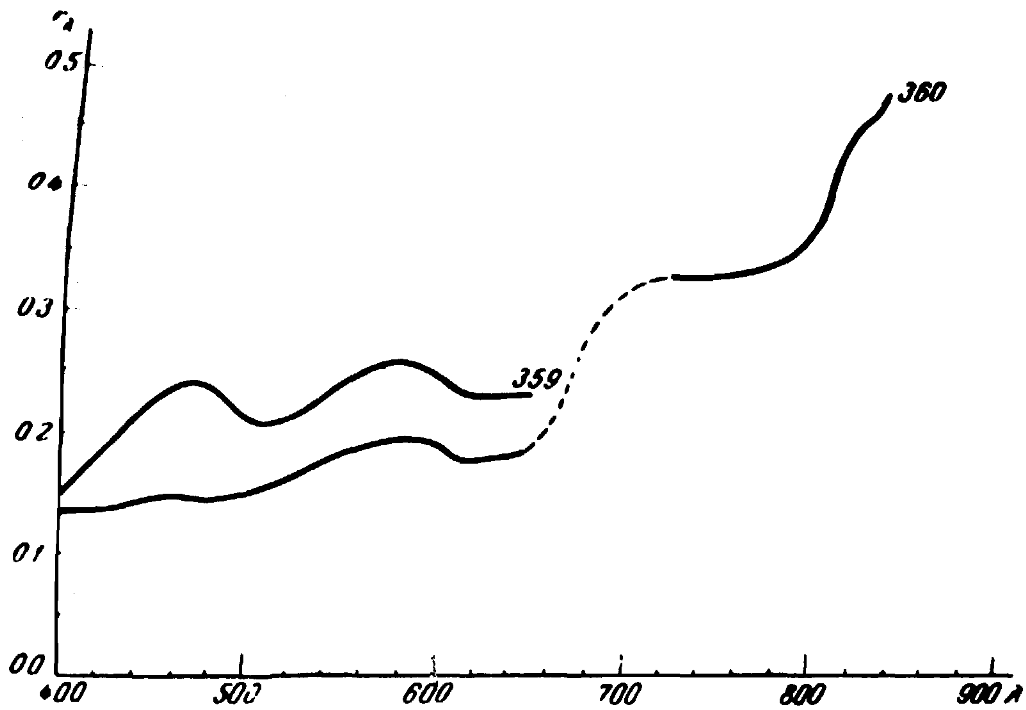
CXXXIX. Roof, shingled

357. Old



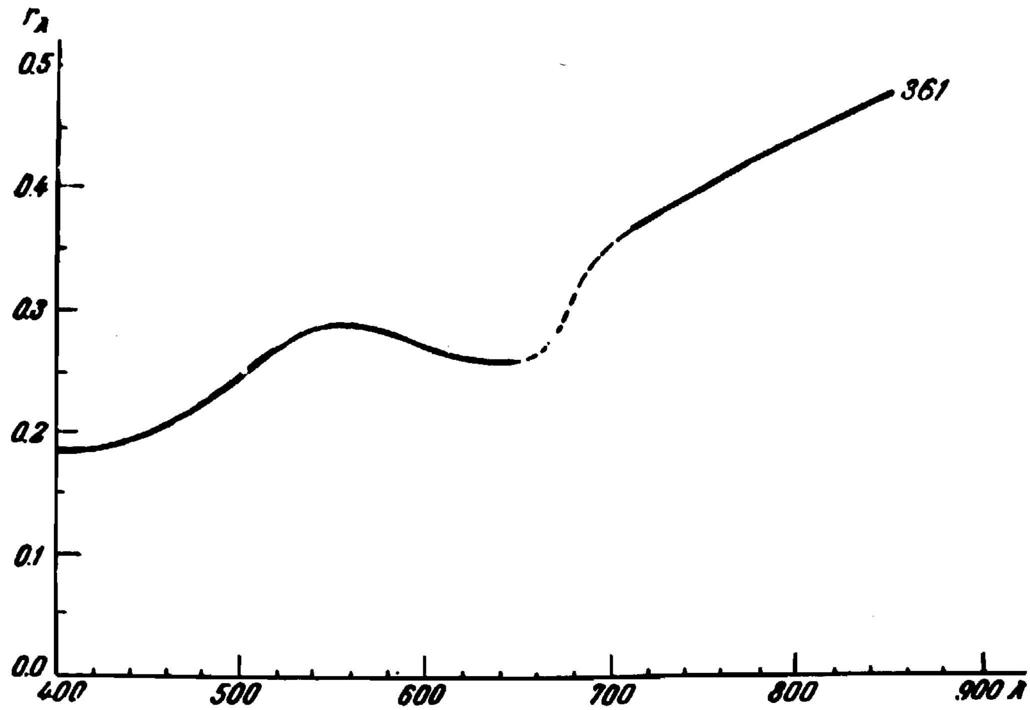
CXL. Roof, iron

358. Painted red



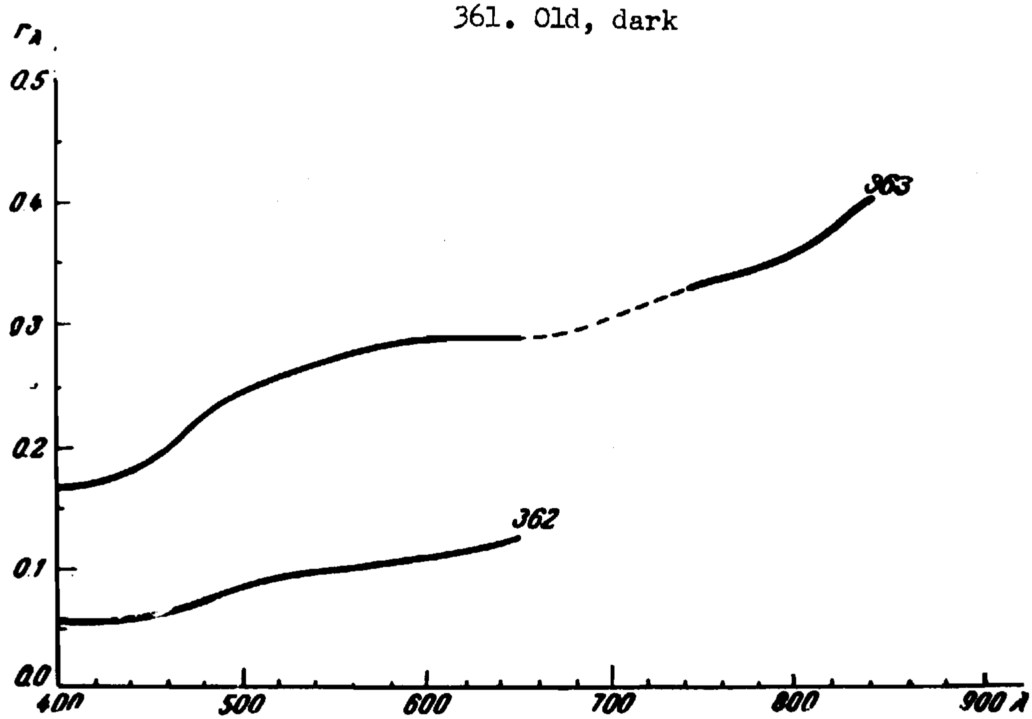
CXLI. Roof, straw

359. Fresh; 360. Old



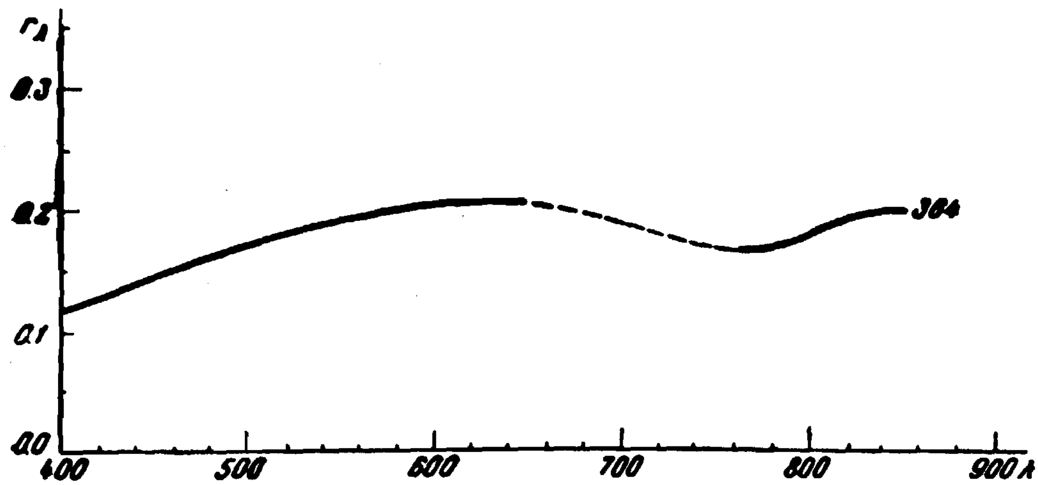
CXLII. Bridge, wooden

361. Old, dark



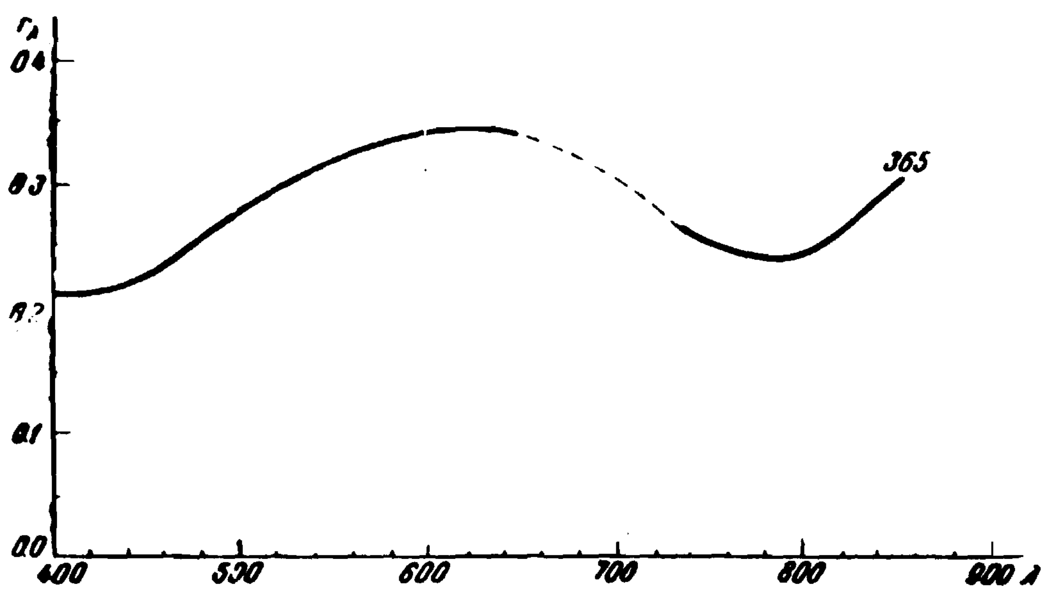
CXLIII. Street, cobblestone

362. Wet; 363. Dry



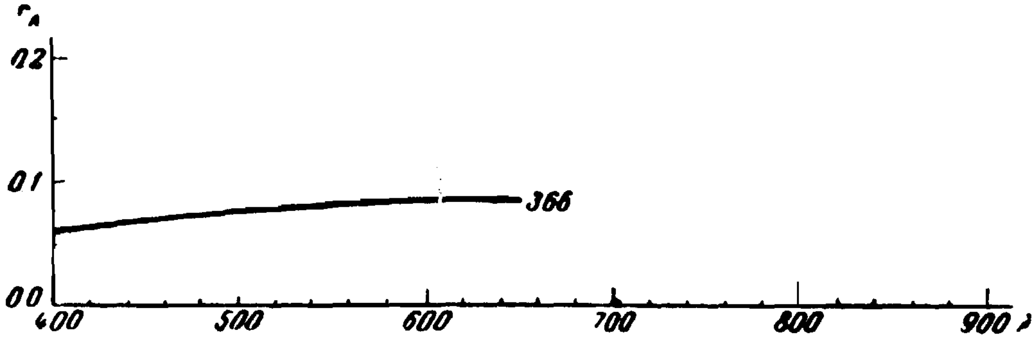
CXLIV. Street, wood-block

364. Dry



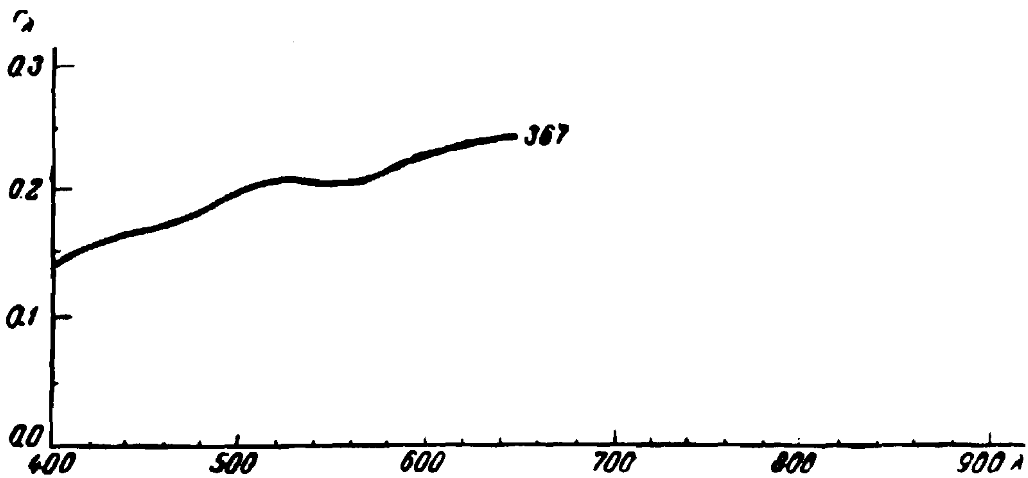
CXLV. Quay, granite

365. Dry



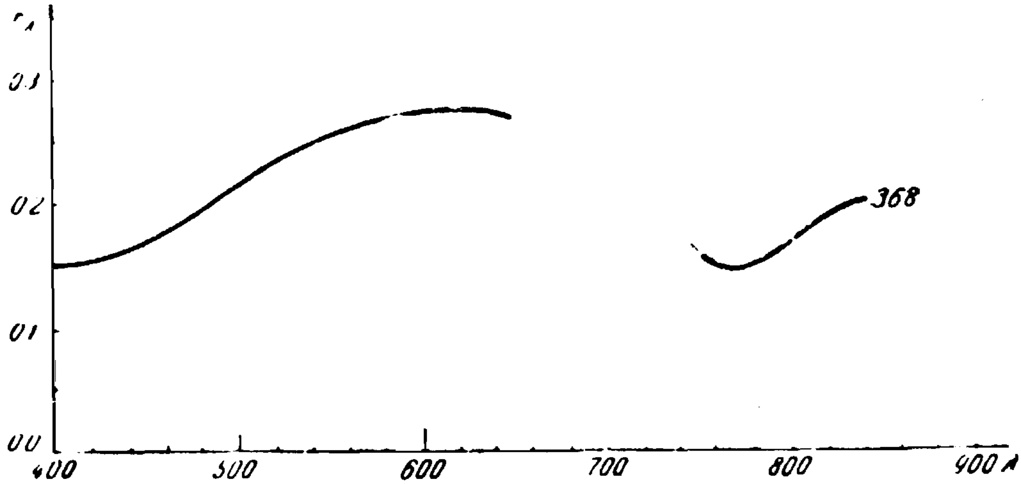
CXLVI. Square, asphalt

366. Dry



CXLVII. Wall of house, log

367. Darkened

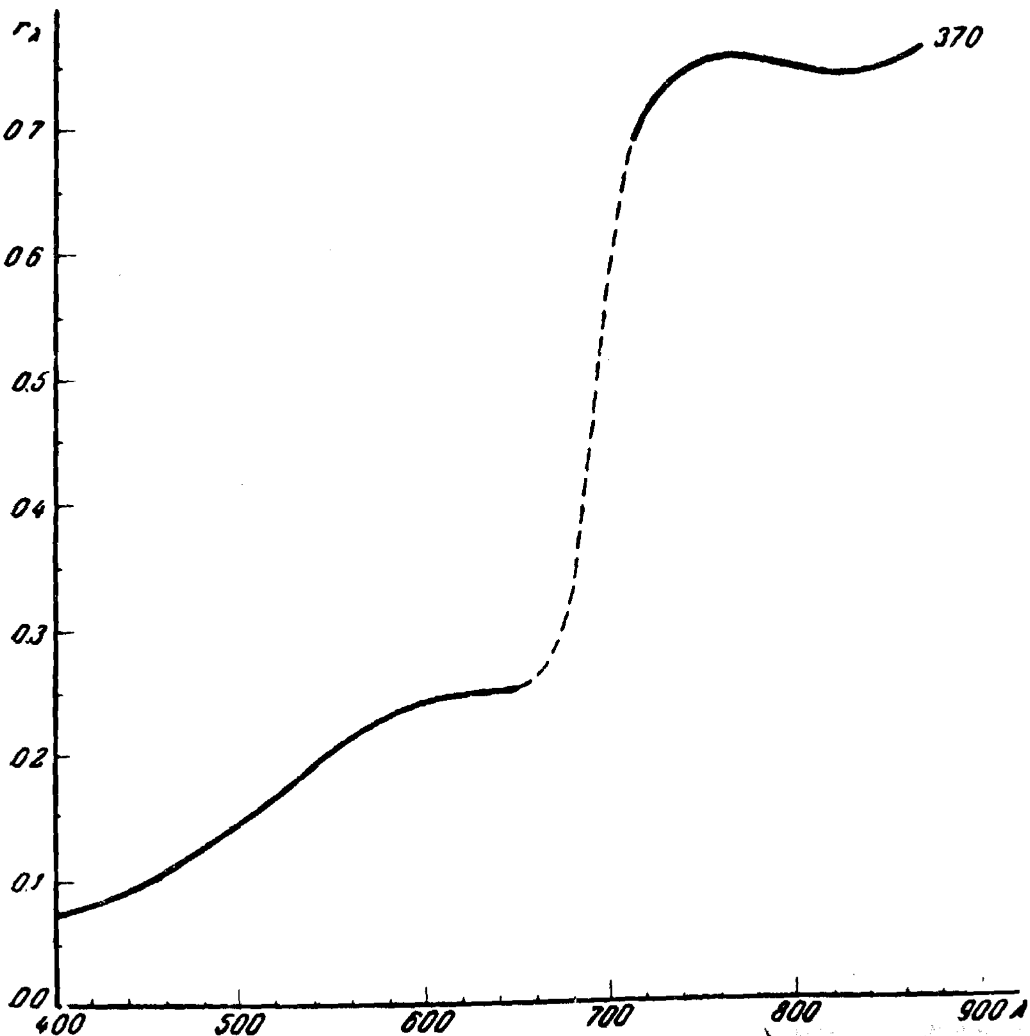


CXLVIII. Sidewalk, asphalt

368. Dry

CXLIX. Sidewalk, flagstone

369. Dry



CL. Roof tile, red

370. New