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LIFE-TIME OF C_2 AND CN MOLECULES AND SOLID GRAINS IN COMETARY ATMOSPHERES

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From photoelectric observations of intensity distribution in cometary heads systematic changes of colour indexes with the diameter of photometer used were found. This effect may be explained by differences in life-times of molecules and solid particles.

1. INTRODUCTION

Several years ago, on the basis of an analysis of photoelectric observations of comets carried out by different observers, the author drew attention to the pronounced effect of the connection between the colour and the diameter of the diaphragm used (VANÝSEK, 1961). The systematic colour-diameter trend of the diaphragm can be found from observations of the 1958a (Burnham) and 1959k (Burnham) comets carried out by SINTON (1959), (1961). Similar effects can be found for the 1955f (Bakharev—Macfarlane—Krienke) comet by an analysis of the observations made by WALKER (1958). The same holds for the observations of the 1955g (Honda) and 1955e (Mrkos) comets published by M. SCHMIDT and VAN WOERDEN (1957). The first work of this kind at all, in which differences were found in the form of the isophotes in the head of a comet, obtained photographically, can be found in the paper by YOSSE (1953) where, of course, rather broad spectral regions were used in studying 1951 l (Schaumasse) comet.

A similar effect was not ascertainable in comets with a pronounced continuous spectrum such as 1955h (Baade), 1959b (Giacobini-Zinner) and 1963b (Alcock) (VANÝSEK, TREMKO, 1964) or 1961e (Humason) which were distinguished merely by the emission of CO^+. A somewhat different trend in the diaphragm-colour dependence was observed with the 1957h (Arend-Roland) comet, which, as is known, also had a pronounced continuous spectrum.

Similar effects could also be found from photometric scanning made photoelectrically over the head of the comet although with photometric scan, particularly at the edge of the coma, the background is greatly over-estimated (SCHMIDT and VAN WOERDEN 1957).

An explanation of this effect must be sought in the difference between the life-times of CN and C_2 molecules, both parent and dissociated. A large role here is played by the dust component of the coma which, particularly in the inner parts near the comentary nucleus, may greatly influence the intensity distribution in the spectrum. Moreover, the slit spectrograms themselves cannot provide sufficient information since they represent mainly the inner part of the coma and the analysis of spectrograms, obtained by a objective prism, is not entirely satisfactory. Photoelectric measurements have a definite advantage since even at a very small intensity they guarantee an accuracy at least equal to 5 %.

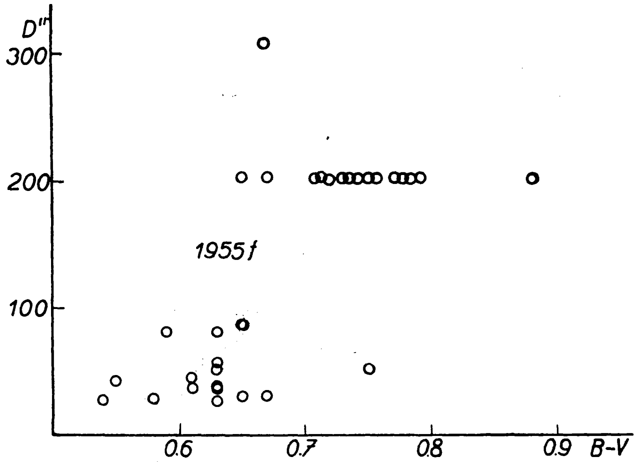

Fig. 1.

2. ANALYSIS OF OBSERVATIONS

The observations mentioned above were available, particularly the very extensive observations of SINTON and WALKER, as well as of O'DELL (1961) concerning the 1955f (Bakharev—Macfarlane—Krienke), 1958a (Burnham), 1959k (Burnham) and 1958b (Giacobini—Zinner) comets. Table 1 gives a list of the principal data of the colour systems used. Figures 1—3 show the dependence of the B—V on the diameter of the diaphragm for the 1955f, 1958a and 1959k comets. The trend is absolutely clear and for the 1959k is particularly pronounced. Figures 1 and 2 are plots of the U—B dependence of the 1955f and 1959k comets from which it is seen that, particularly for 1959k, the dependence does not exist or is not pronounced. It should also be noted that it is just the U and B colour systems which, if they preserve the effective wave-length according to the JOHNSON system, are not suitable for the photometry of comets since the intensity of the CN band, both in U and in B, lies

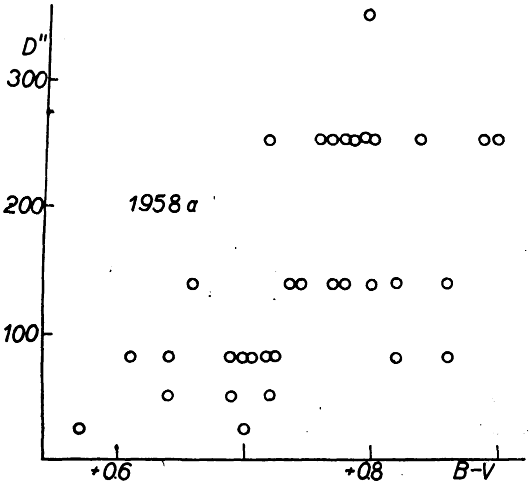

Fig. 2.

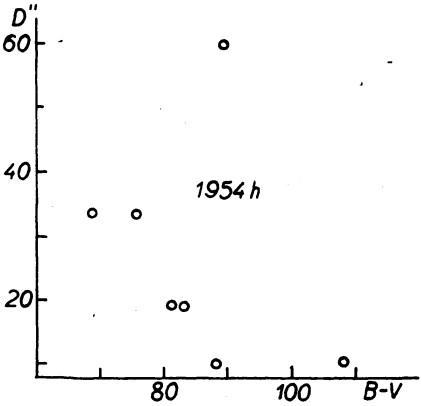

Fig. 4.

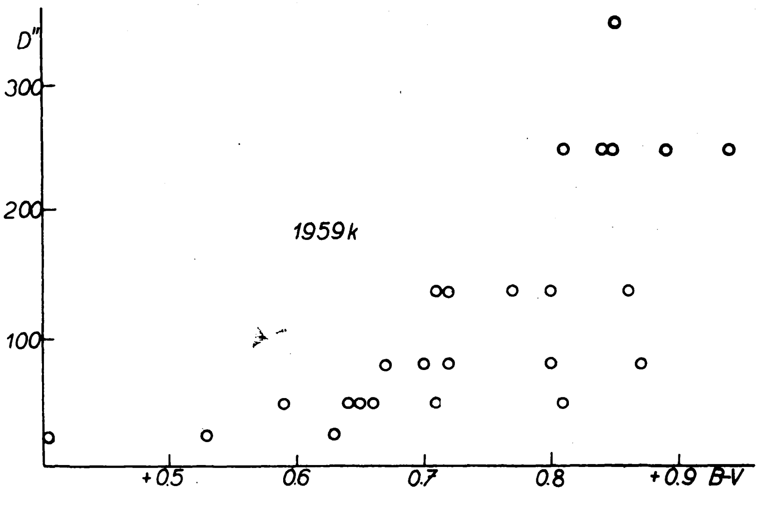

Fig. 3.

in regions where the right or left wing of the curve of the responsibility of the U or B filter has practically the same transmission and differs only in the individual arrangement of the photometer. SINTON'S measurements are important; they are carried out in broader spectral regions but the principal regions of the cometary spectrum are marked out by a suitable combination of filters (see Tab. 2). SINTON, who used filters defining the system denoted B_2 and G, thinks that his measurements could provide some information on the occurrence of a continuum. It should hold, primarily for a spectrum with a continuum,

Table 1.

Comet	Colour of filter system	Observer
1954h Baade	U, B, V	Walker
1955f Bakharev-Macfarlane-Krienke	(U), B, V	Walker
1955e Mrkos	3650 cont	Schmidt and
1955g Honda	3850 CN	van Woerden
1958a Burnham	U, B, V	Sinton
1959k Burnham	U, B, V, B_2, G	Sinton
1959b Giacobini-Zinner	B, V, B_2, G	Sinton
1959k Burnham	4470 cont, 4700 C_2	O'Dell

Table 2

Colour system used by W. M. Sinton (1961)

Colour	λ_{eff} Å	Region of bands
U	3650	Cont + (CN)
B	4100	Cont + C_3 + (CN)
B_2	4050	C_3 + Cont
G	4700	C_2 + Cont
V	5250	C_2 + Cont

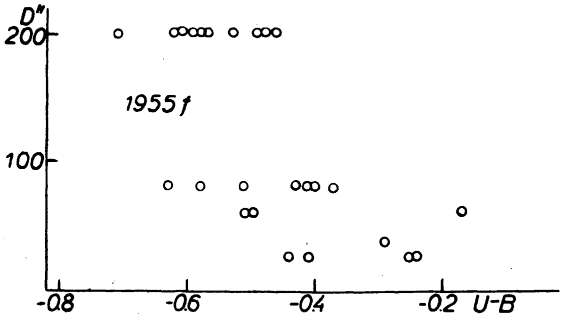

Fig. 5.

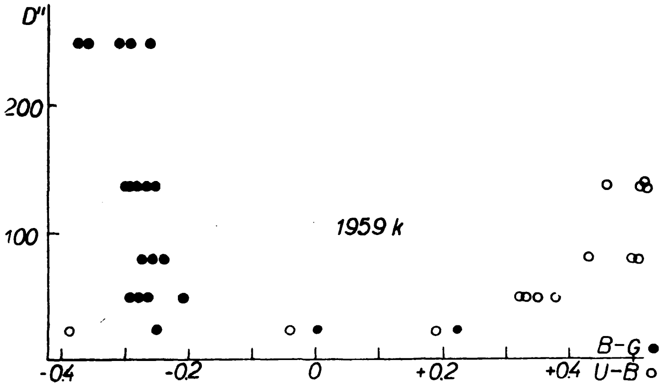

Fig. 6.

that (G—V) — (B_2—G) = 0 if there is intensity equilibrium in both parts of the spectrum, i. e. if the share of the emission is minimum there. The dependence of the value (G—V) and (B_2—G) is plotted in Fig. 9 where the trend of the resultant value is quite apparent. This trend is of course due primarily to the pronounced dependence of the B_2—G colour on the diameter of the diaphragm, as is seen from Fig. 6, 8, since G—V exhibits no dependence.

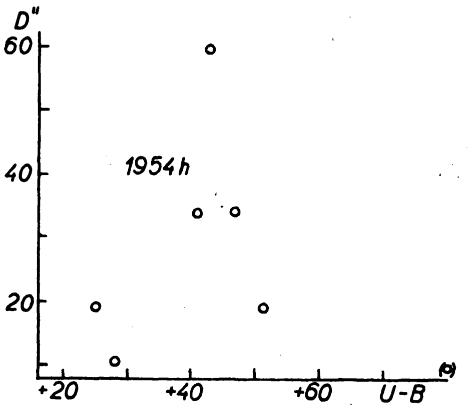

Fig. 7.

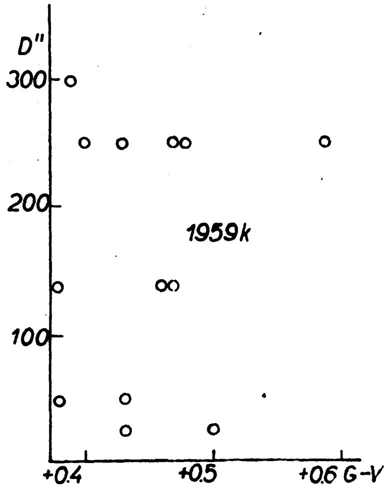

Fig. 8.

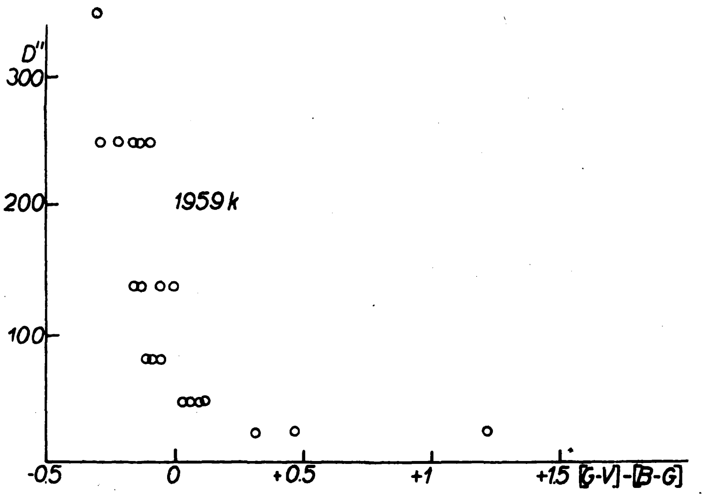

Fig. 9.

It is natural that this dependence should necessarily be apparent in the variation of the brightness decrease in the different colours. The values of the surface brightnesses were studied for 1959k (Burnham) comet on the basis of SINTON's observations in three chosen observational series — from January

30, 1960, April 29, 1960, and May 7, 1960. Table 3 gives the values of the surface brightnesses in magnitudes. Figures 10, 11, 12 show the dependence of logarithm $S_{(\varrho)}$ on logarithm ϱ. The value $S_{(\varrho)}$ is in units chosen so that the intensities

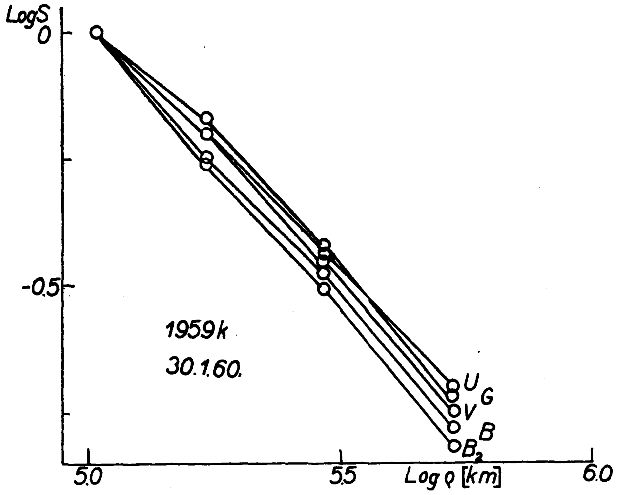

Fig. 10.

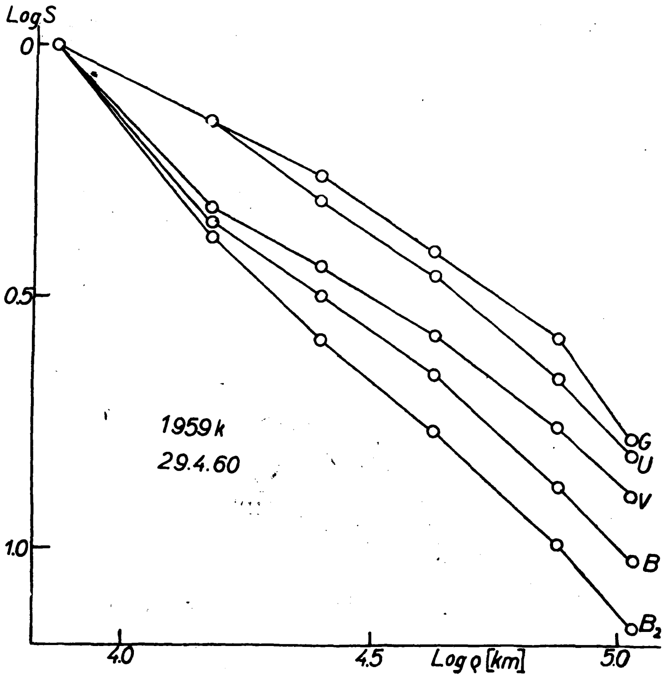

Fig. 11.

are identical in the smallest diaphragms. The trend of this dependence from the two dates, April 29 and May 7, clearly shows the different fall for colours containing primarily molecular emission, which is clearly more gradual than the fall in intensity for colours defining the region of the continuum. For the series of observations from January 30, 1960, these differences are much less pronounced but nevertheless clearly visible. A rapid decrease in the continuum is shown by the measurements of O'DELL (with interference filters) of the same comet from approximately the same period (April 27 and May 1, 1960).

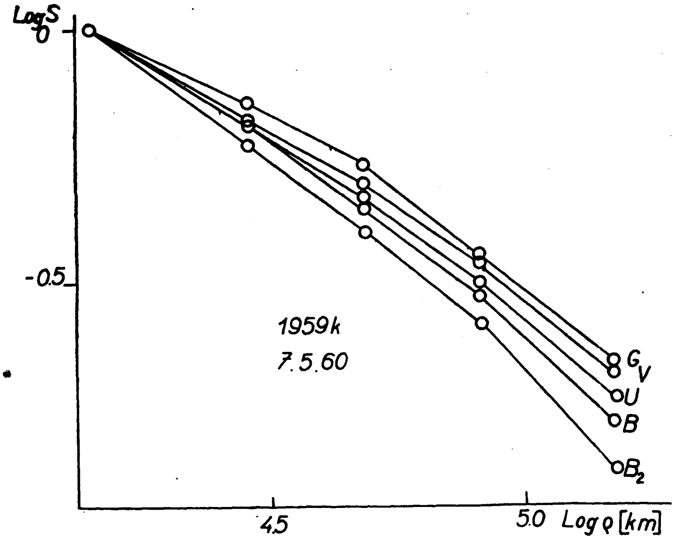

Fig. 12.

O'DELL used the C_2 λ 4700 band for determining the intensity distribution in the coma of the 1959k comet and λ 4470 for the continuum. The dependence of the intensity on the logarithm of the diaphragm diameter and on the distance from the nucleus is shown in Figs. 13 and 14. Using the relation

$$\varkappa = \frac{d \log I_{(\varrho)}}{d \log \varrho} \tag{1}$$

we obtain for $\varkappa$ the values tabulated in Tabs. 4, 5 and log S in Tab. 6 (O'DELL).

It can thus be considered as confirmed that the decrease of intensity of the continuum in this comet is much steeper than the molecular emission. The same can be found from observations, only published graphically, by SCHMIDT and VAN WOERDEN for the 1955g comet. The values of $\varkappa$ obtained from these observations are given in Tab. 7. SCHMIDT and VAN WOERDEN used both interference filters for isolating C_2 and CN and a broadband ultra-violet filter for the continuum 3360—3780. In several comets the continuum is more extended and bound on the CN. This is indicated primarily by the measurements of the Mrkos comet, carried out by the same authors, where the trend of the continuum and of CN is practically the same, as is seen in Tab. 8, while for C_2 they found a far more pronounced decrease. It is obvious that in such a case the colour index

Table 3.

Mean surface brightness for a square second of arc

1959k (Burnham)

Date	log ϱ(km)	d″	V	B	U	G	B_1
January 30, 1960	5.018	49	19.41	20.31	20.15	19.87	20.37
10^5 km = 47″.1	5.238	81.5	19.89	20.84	20.65	20.29	21.01
	5.467	138	20.50	21.50	21.28	20.92	21.65
	5.723	249	21.30	22.26	21.91	21.69	22.42
April 29, 1960	3.866	23.8	15.94	16.47	16.69	16.77	16.38
10^5 km = 323″.4	4.180	49	16.76	17.35	17.08	17.14	17.46
	4.401	81.5	17.06	17.73	17.47	17.43	17.86
	4.630	138	17.41	18.13	17.86	17.79	18.31
	4.886	249	17.86	18.67	18.38	18.26	18.88
	5.034	350	18.21	19.06	18.75	18.60	19.29
May 7, 1960	4.154	23.8	17.57	18.20	17.95	18.07	18.26
10^5 km = 166″.8	4.463	49	18.04	18.68	18.40	18.45	18.83
	4.688	81.5	18.36	19.08	18.81	18.76	19.26
	4.918	138	18.73	19.53	19.23	19.20	19.72
	5.174	248	19.29	20.18	19.81	19.72	20.44

Table 4

Values of $\varkappa$

1959k (Burnham)

Date	log ϱ (km)	V	B	U	G	B
January 30, 1960	5.11	0.873	0.964	0.910	0.873	1.163
	5.35	0.926	0.979	1.310	0.961	0.979
	5.50	1.375	1.343	0.797	1.329	1.329
April 29, 1960	3.90	1.185	1.134	0.510	0.484	2.280
	4.30	0.362	0.688	0.706	0.525	0.724
	4.75	0.472	0.558	0.542	0.488	0.647
	4.94	0.828	0.969	0.938	0.860	1.016
	5.10	0.919	1.027	0.973	0.892	1.081
May 7, 1960	4.30	0.622	0.635	0.596	0.504	0.751
	4.57	0.533	0.712	0.729	0.516	0.764
	4.80	0.539	0.643	0.591	0.661	0.661
	5.04	1.000	1.140	1.032	0.938	1.250

Table 6

Mean surface brightness for a square second of arc
1959k (Burnham)

Date	log D (km)	log S_{C_2} erg sec^{-1}	log S_{Cont} erg sec^{-1} Å^{-1}
April 27.4, 1960	5.045	12.795	9.183
	4.848	13.003	9.493
	4.498	13.144	9.680
	4.330	13.144	9.108
May 1.2, 1960	5.134	12.451	8.086
	4.934	12.757	9.046
	4.464	12.947	9.401
	4.418	13.193	9.741
May 14.1, 1960	5.068	13.867	11.176
	4.840	14.104	11.261

Table 7

Mean value of $\varkappa$. Comet 1955g (Honda)

log ϱ*)	Cont (336—378 mμ)	CN (382—393 mμ)	C (465—478 mμ)
—0.5	1.15	0.50	0.45
—0.25	1.15	0.70	1.00
0.00	1.15	1.05	1.05
+0.25	1.15	1.05	1.05
+0.50	1.15	1.05	1.05

*) Mean value log ϱ in minutes of arc.

Table 8

Mean value of $\varkappa$. Comet 1955e (Mrkos)
June 25, 1955

log ϱ*)	Cont (336—378 mμ)		*CN* (382—393 mμ)		C_2(465—478 mμ)	
	rings	scanning	rings	scanning	rings	scanning
—0.50	0.38	0.38	0.45	0.45	0.70	0.70
+0.50	1.25	1.60	1.30	1.30	1.70	1.70
+1.00	0.80	2.50	1.30	2.25	1.70	2.60

*) log ϱ in minutes of arc.

would have to decrease with increasing diaphragm, i. e. the trend would be the opposite of that in the preceding three cases. A similar effect is found to a certain extent with the Baade comet (with a pronounced continuous spectrum without the presence of an emission band) by analyzing the observations of **Walker** from December 16, 1955, where the decrease in colour index with increasing diaphragm was particularly pronounced. It can be deduced that this decrease is connected with the occurrence of C_2 emission in the visual region of the photometric system, i. e. the bands $\lambda = 4737$, 5165 and 5635 Å, which occurred only directly around the cometary nucleus. A similar effect is also found with the 1957h (Arend-Roland) comet. And, finally, **Sinton**'s measurements of the 1959b (Giacobini—Zinner) from November 5, 1959 again exhibit a decrease in the colour index with increasing diaphragm (see Tab. 9).

Table 9

Mean surface brightness for a square second of arc
1959b (Giacobini-Zinner)

Date	log D	V	B	G	B_2
October 23, 1960	1.691	17.353	18.083	17.763	18.163
	2.397	19.643	20.243	19.993	20.273
	2.142	18.738	19.398	19.128	19.348
	1.376	16.858	17.388	17.248	17.348
	1.913	18.023	18.693	18.383	18.733
November 5, 1960	1.913	17.943	18.473	18.203	18.483
	2.397	19.333	19.793	19.663	19.743
	2.142	18.528	19.088	18.878	19.058
	1.913	17.883	18.473	18.263	18.403

Table 10

Mean value of $\varkappa$. Comet 1959k
(Giacobini—Zinner)
October 23, 1960

log ϱ	$\varkappa_V$	$\varkappa_B$	$\varkappa_G$	$\varkappa_{B2}$
1.5	0.80	0.80	0.93	1.08
1.8	1.10	1.10	1.10	1.08
2.0	1.25	1.12	1.15	1.08
2.5	1.50	1.20	1.25	1.20
$\bar{\varkappa}$	1.20	1.1	1.1	1.1

As regards the U—B measurements, we always find negative U—B values for comets with pronounced molecular emission and these can be ascribed primarily to CN emission. Of course, the uncertainty in the boundary sensitivities of the U and B regions make more definite conclusions impossible. The dependences between the diaphragm diameter and the U—B colour, as has already been stated, are also not pronounced. For comets with a continuous spectrum the U—B values are mostly positive.

Table 11

Mean surface brightness for a square second of arc 1955f
(Bakharov—Macfarlane—Krienke)

Date	$\log \varrho$	V	B	U
July 28, 1955	1.137	18.51	19.09	18.97
	1.712	19.03	19.66	19.49
	1.905	19.27	19.92	19.52
	2.306	19.86	20.60	20.10
July 31, 1955	1.137	18.27	18.82	18.57
	1.712	18.88	19.49	18.99
	1.905	18.99	19.68	19.05
	2.306	19.95	20.71	20.15

3. INTERPRETATION OF EFFECT OF DEPENDENCE OF COLOUR ON DISTANCE FROM NUCLEUS

The above-mentioned effects can be primarily ascribed to the different life-times of the CN and C_2 molecules and thus to the different brightness decrease at different distance from the nucleus. Another fact is, of course, the different intensity distribution of the continuum, i. e. of the dust particles in the atmosphere of the comet compared with the gas component. It is thus possible to estimate the relative differences in life-times of the two gas components. The different distribution of the dust component could be explained by the much more pronounced mechanical effect on the solid particles in the sense of Wallace's and Miller's models (1956) or by the limited life-time of solid particles which sublimate during motion in the coma. The sublimation of ice particles would support Whipple's "ice conglomerate model" (1950, 1951).

Haser's model (1957) can be used to determine the life-time of molecules; this is based on the assumption that the density $D_{(r)}$ of particles at a distance r from the nucleus is given by the relation

$$D_{(r)} = Cr^{-2} \left[\exp(-v_0\beta_0) - \exp(-v_1\beta_1)\right] \tag{2}$$

where β_0 and β_0 are generally dependent on the life-time τ_0 of the molecules and of the parent molecules τ_0, respectively and their mean velocities v_0 and v_1

$$\beta_i = \frac{1}{v_i \tau_i} \tag{3}$$

Table 12

$S_1(\varrho)$

$\log \beta_0\varrho$	$\beta_1/\beta_0 = 2$	5	10	15	25	30	50	∞
0.699	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0.000	0.231	0.325	0.328	0.328	0.328	0.328	0.328	0.328
—0.097	0.337	0.520	0.533	0.533	0.533	0.533	0.533	0.533
—0.222	0.507	0.880	0.930	0.931	0.932	0.932	0.932	0.932
—0.398	0.798	1.620	1.838	1.860	1.863	1.863	1.863	1.863
—0.699	1.393	3.477	4.633	4.965	5.102	5.113	5.119	5.119
—1.000	2.049	5.849	9.003	10.524	11.742	11.978	12.252	12.286
—1.398	2.813	9.343	16.305	20.963	26.728	28.563	32.507	34.935
—1.699	3.640	12.080	22.325	30.070	41.325	45.565	57.095	73.510

Table 13

Values of $S_\Sigma(\varrho) = \frac{1}{\beta_0\varrho} k + S(\varrho)$

	$\left(\frac{\beta_1}{\beta_0}\right)_2 = 5$				$\left(\frac{\beta_1}{\beta_0}\right)_2 = 10$			
$\log \beta_0\varrho$	k = 5.0	1.0	0.5	0.1	5.0	1.0	0.5	0.1
0.699	1.001	0.2007	0.1007	0.0207	1.001	0.2007	0.1007	0.0207
0.000	5.325	1.325	0.8249	0.4249	5.328	1.328	0.8283	0.4283
—0.097	6.770	1.770	1.145	0.6450	6.783	1.783	1.158	0.6575
—0.222	9.214	2.547	1.714	1.047	9.263	2.596	1.763	1.096
—0.398	14.12	4.120	2.870	1.870	14.34	4.338	3.088	2.088
—0.699	28.48	8.477	5.977	3.977	29.63	9.633	7.133	5.133
—1.000	55.85	15.85	11.85	6.849	59.00	19.00	14.00	10.00
—1.398	134.3	34.34	21.84	11.84	141.3	41.31	28.81	18.81
—1.699	262.1	62.08	37.08	17.08	272.3	72.33	47.33	27.33

Let us put

$$\sigma_i = \beta_i \varrho$$

where ϱ is the projected distance from the nucleus expressed in km; then for the surface brightness $S(\varrho)$ in dimentionless quantities we obtain (Osterbrock, O'Dell 1963), Vanýsek, Tremko (1964))

$$S_{(\varrho)} = \frac{1}{\sigma_0} [B(\sigma_0) - B(\sigma_1)] \tag{4}$$

where $B(\sigma_0)$ and $B(\sigma_1)$ are integrals containing the Bessel function of zero order. The values of $S_{(\varrho)}$ are given in Tab. 12 for different values of β_1/β_0.

Table 14

Values of $S_\Sigma(\varrho) = S_1(\varrho)\,k + S_2(\varrho)$

	$\left(\frac{\beta_1}{\beta_0}\right)_1 = \infty;\ \left(\frac{\beta_1}{\beta_0}\right)_2 = 5$				$\left(\frac{\beta_1}{\beta_0}\right)_1 = \infty;\ \left(\frac{\beta_1}{\beta_0}\right)_2 = 10$			
$\log \beta_0\varrho$	k = 5.0	1.0	0.5	0.1	5.0	1.0	0.5	0.1
0.699	0.0042	0.0014	0.0010	0.0008	0.0042	0.0014	0.0010	0.0008
0.000	1.966	0.6532	0.4891	0.3577	1.970	0.6566	0.4925	0.3611
—0.097	3.183	1.053	0.7863	0.5733	3.196	1.065	0.7988	0.5858
—0.222	5.538	1.812	1.346	0.9734	5.587	1.861	1.395	1.023
—0.398	10.94	3.483	2.552	1.807	11.15	3.701	2.769	2.024
—0.699	29.07	8.596	6.036	3.989	30.23	9.752	7.192	5.145
—1.000	67.28	18.14	11.99	7.078	70.43	21.29	15.15	10.23
—1.398	191.0	44.28	26.81	12.86	191.0	51.24	33.77	19.80
—1.699	379.6	85.59	48.84	19.43	389.9	95.84	59.08	29.68

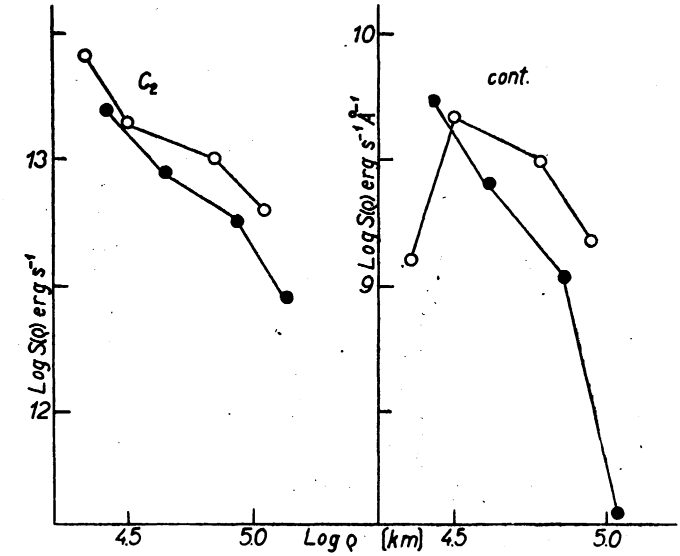

Fig. 13.

In general, however, the course of the values $S(\varrho)$ will not fully satisfy the above relation if the continuum is not completely distinguished from the molecular bands in the measurements. Let us assume spherical symmetry and an infinitely long life-time of the dust particles; we then get for the resultant brightness $S_{\Sigma(\varrho)}$ the relation

$$S_{\Sigma(\varrho)} = \frac{1}{\sigma_0}\left[B(\sigma_0) + B(\sigma_1) + k\right] \tag{5}$$

where k is the ratio of the surface brightnesses of the dust and gaseous components. The plot of $S_{\Sigma(\varrho)}$ for different values of k is seen in the graphs Nos. 15, 16.

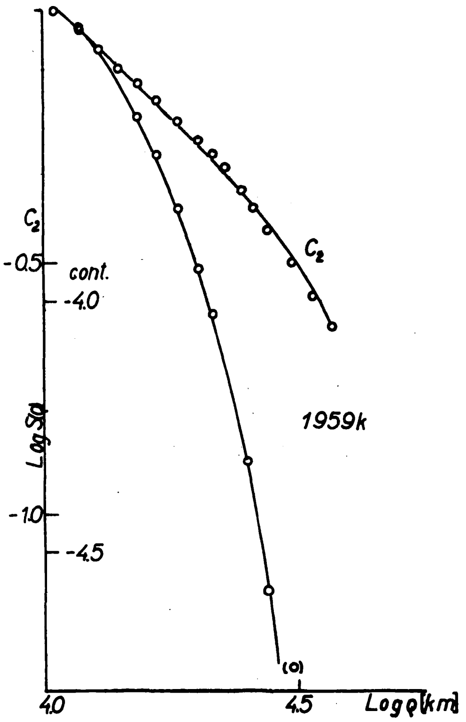

Fig. 14.

The most probable values of β_1/β_0 were taken to be 10 and 5. Higher values of β_1/β_0 for this combination do not substantially change the trend of the original curves for values of $1/\beta_0\varrho$.

If we assume sublimation of the solid particles, we can use the following relation for $S_{\Sigma(\varrho)}$ in the first approximation

$$S_{\Sigma(\varrho)} = S_1(\varrho)k + S_2(\varrho)_2 \tag{6}$$

where $S_1(\varrho)$ is calculated from relation (4) for the case when $\beta_1 \ll \beta_0$ ie: $\beta_1/\beta_0 \doteq \infty$ the definition of k is the same as in the preceding case. The plot of these values is seen in Fig. 15.

The values of $S_\Sigma(\varrho)$ are then used to derive the theoretical course of the colour index in the coma.

Let us assume that

a) the spectral region B is predominantly the region of the continuum and the region V the region of C_2 emission;

b) the life-time of the C_2 molecules is sufficiently long and the ration $\beta_1/\beta_0 = 10$.

For the differences in B—V colour we obtain the relation

$$\Delta_\varrho^{B-V} = \frac{\delta\, S_\Sigma(\varrho)_B}{\delta\, S_\Sigma(\varrho)_V} \tag{7}$$

or in a given interval of ϱ_1 to ϱ_2

$$(B-V)_1 - (B-V)_2 = 2.5 \log \Delta_\varrho^{B-V} \tag{8}$$

Table 15

Some results of computation of increase of B—V near the nucleus

$S_{\Sigma(\varrho)}$	interval of log ϱ	$k_B = 1;\ k_V = 0.5$	$k_B = 5.0;\ k_V = 0.1$	$k_B = 1;\ k_V = 0.1$
$(\beta_1/\beta_0)_1 = \infty$ $(\beta/_1\beta_0)_2 = 5$	—1; —0.4	+0.12	+0.75	+0.30
$(\beta_1/\beta_0)_1 = \infty$ $(\beta_1/\beta_0)_2 = 10$	—1; —0.4	+0.15	+0.35	+0.15

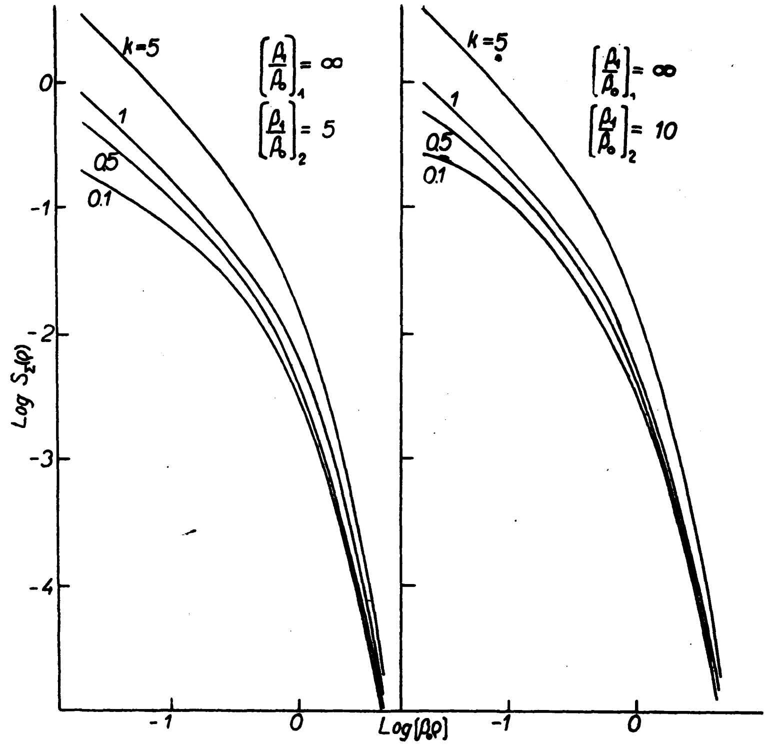
k=5
1
0.5
0.1
$\left[\frac{\beta_1}{\beta_0}\right]_1 = \infty$
$\left[\frac{\beta_1}{\beta_0}\right]_2 = 5$
$\left[\frac{\beta_1}{\beta_0}\right]_2 = 10$
0
-1
-2
-3
-4
Log $S_\Sigma(\rho)$
-1
0
Log$[\beta_0\rho]$
-1
0

Fig. 15.

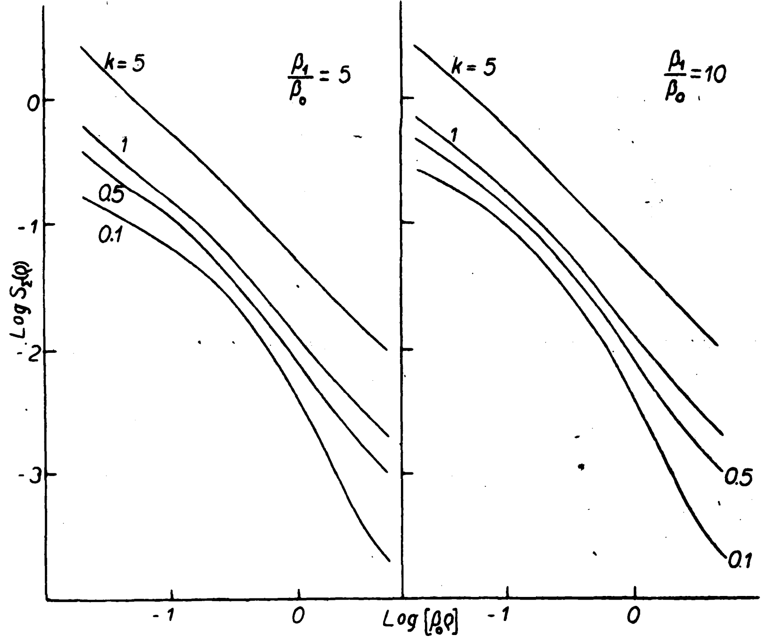
k= 5
1
0.5
0.1
$\frac{\beta_1}{\beta_0} = 5$
k= 5
1
0.5
0.1
$\frac{\beta_1}{\beta_0} = 10$
0
-1
-2
-3
Log $S_\Sigma(\rho)$
-1
0
Log$[\beta_0\rho]$
-1
0

Fig. 16.

The maximal difference of increased B—V in a interval log ϱ for selected cases near the nucleus are given in Table 15, and agree with the observed increase of colour indexes. When computing here mentioned examples it was supposed $k_B > k_V$.

Table 16

The total amount and mean density of solid grains in 1959k

Date	M (grams)	$\log N$ cm^{-3}
27 April	3.10^{11}	—3.2
1 May	4.10^{11}	—3.1

Table 17

Assumed life-time if $v \approx 1$ km/sec

Particles	β_1/β_0	hours
C_2	3—10	$\sim$10
CN	30	50 $\sim$ 200
ice grains $d = 10^{-3}$ cm		10 $\sim$ 100

From O'Dell's measurements for the 1959k comet it is possible to estimate the total amount of dust particles by Vanýsek's method (1958), but this time on the assumption of high albedo ≈ 0.9. The total amount M and the density of the solid particles are gien in Tab. 16.

The outburst from May 14 meant a certain sudden ejection of solid particles into the coma having a total mass of about 10^9 grams which, of course, can substantially change the B—V dependence on the radius of the coma.

4. CONCLUSIONS

The observed dependence of the colour index on the distance from the centre of the comet was found for some comets. It is due primarily to the effective radius of the dust and gas coma and the fundamentally different life-times of the particles and molecules. The differences between the life-times of CN and C_2 molecules are clearly seen particularly for the 1955e comet.

Under normal circumstances the dust (ice) region in the coma is much smaller than the gaseous and it is distinguished by a pronounced decrease in brightness towards the edge of coma. This phenomenon can be explained by the sublimation of the ice grains.

With solid particles the life-time can be expressed by the time required to sublimate the total mass of ice grains which should be about 10 hours. The remainder of the solid particles (condensation nuclei) is not photometrically significant.

The dielectric character of the particles — ice grains — was clear from earlier papers (Vanýsek (1960), Liller (1961)). The colour difference $(B—V)_{\text{Sun}} — (B—V)_{\text{Comet}}$ observed for the 1954h (Baade) and 1959b (Schwassmann—Wachmann) comets points to large dimensions. Ice grains, which get far into the coma, obviously have such dimensions in the near comets that selective dispersion does not occur and the colour index of such comets is identical with that of the Sun. An example of this is the Giacobini—Zinner comet, as is clear from the observations of Sinton (1961).

The total amount of molecules in the comet atmosphere is multiply higher than is assumed from the density of the CN and C_2 molecules. This excess of H_2O and radicals would certainly make possible the chemical reaction assumed by Biermann and Trefftz (1964) leading to the ionization of Ca^+ and possibly to the occurrence of OI.

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O ŽIVOTNÍ DOBĚ MOLEKUL CN, C_2 A PRACHOVÝCH ČÁSTIC V KOMETÁRNÍCH ATMOSFÉRÁCH

(Souhrn)

Z fotoelektrických pozorování rozdělení jasnosti v hlavách komet byly zjištěny systematické změny barevného indexu s průměrem použité clony fotometru. Tento efekt je vysvětlen rozdílnou životní dobou molekul a pevných částic.

ПРОДОЛЖИТЕЛЬНОСТЬ ЖИЗНИ МОЛЕКУЛ И ПЫЛИНОК В ГОЛОВАХ КОМЕТ

(Резюме)

Из фотоэлектрических наблюдений распределения яркости в головах комет было обнаружено систематическое изменение света с диафрагмой фотометра. Было сделано предположение, что эффект зависимости свет-диафрагма может быть описан как эффект продолжительности жизни молекул и твердых пылинок.