CERN/TC/NBC 65-2
11.1.1965

TECHNICAL NOTE CONCERNING B.N.H.B.C. PICTURES TAKEN IN OCTOBER AND NOVEMBER, 1964

P. Fleury - P. Shephard - R. Vanderhaghen

When we have projected B.N.H.B.C. pictures on the scanning tables, we have observed on some of them a strong unstability in the fiducial crosses configuration. This effect, probably due to unsufficient holding of the film in the camera box, seems to affect mostly camera No. 2.

On 10 films at our disposal, we made a rather extensive study in order to determine :

1) the order of magnitude of the effect when it exists
2) the occurrence or non-occurrence of smaller unstabilities for those films which seem good on the scanning table
3) the criteria that could easily separate good and bad film (possibly good and bad frames) on the scanning table.

The 10 films are not consecutive - they cover a range of about 40 films.

MEASUREMENTS

For each film, we measured on IEP 11 frames at the beginning and 11 frames at the end of the roll corresponding to camera No. 2. On each frame 8 crosses were measured, and each frame was measured 3 times consecutively.

We have calculated :

- 18 distances $D_{i=1,\ 18}$
- 12 ratios of distances $DD_{i=1,\ 12}$.

See Figure 1 for the configuration of the 8 crosses measured and the definition of distances and ratios.

These three measurements were made without moving the films in the IEP press-films. Thus, we are allowed to average the three measurements of each cross coordinate. From there on we calculate length and ratios. We also compute the variance σ_x and σ_y from these sets of three measurements and thus obtain for each film the average IEP error on x and y, independently.

RESULTS - ANALYSIS

For each ratio we have computed the expected width under the assumption that there is no effect other than IEP errors.

In Table I we indicate for each ratio the width of its distribution divided by the expected width, for each film. From this table we can see that there are six "good films" for which all values of the reduced width σ/σ expected are not very different from 1.; five films are "bad". The film 96_A is subdivided into 96_{A_1} which is "bad", and 96_{A_2} which is "good". The division corresponds to an interruption of the picture taking (withdrawal of the cameras). Films 93 and 98, classified as "bad", also have good parts. We did not separate these parts since the change of condition does not correspond to any manipulation known by us.

"GOOD FILMS"

Even for the good films, there seems to be a small unstability effect : $\langle \sigma/\sigma_{\text{expected}} \rangle \simeq 1.65$ instead of 1. The amplitude estimate of this effect is 0.5 IEP errors (i.e. about 1.5 IEP units). A cross check was obtained when we computed the reduced width $\sigma/\sigma_{\text{expected}}$ from one set of cross measurements (instead of the three sets) and compared them with the previous values. We believe that this small effect, even if it is confirmed, could be safely neglected.

Another observation concerning the "good films" is that all ratios have a similar reduced width, including DD_4 and DD_5. All computed ratios, other than these two, are invariant under variations of magnifications along x and y, independently; for instance, they must be invariant under a linear stretching of the film. The fact that DD_4 and DD_5 widths are as narrow as the other ones implies that any shift of magnification affects equally the x and y directions. We shall come back to that point when discussing the selection criteria.

"BAD FILMS"

On Figure 2, we have plotted the histogram of the ratio DD_9 for all films. It can be seen that the "bad films" contain a few good frames; we also observe that good and bad frames are well separated.

CRITERIA

On Figure 3, the histogram of the length D_3 is plotted. We first observe that the narrow peak corresponding to good frames is in fact much larger than IEP errors. This is related to a variation of the magnification. (We have already noticed the stability of the ratios DD_4 and DD_5 which are both ratios of a length along y over a length along x. This is related to a correlation between the variation of these lengths. We have observed that pictures with larger length are the ones first measured in the series of 11 frames. We also noticed that a given set of 11 frames measured twice with a few days' interval, gave a detectable variation of magnification. We very likely observe an effect due to the variation of IEP temperature. The amplitude of this effect is $1^{\circ}/_{\circ\circ}$. This temperature variation must be rather slow, since it is not apparent during the measurement of a given frame.) Secondly, we observe that the bad frames are well separated from the good ones. In other words, the rough measurement of this length furnishes us with criteria for the selection of good and bad frames. In fact, other lengths are not as good criteria as this one.

To demonstrate more clearly the validity of this criteria, we give in Figure 4 the scattered diagram of D_3 versus DD_9.

CONCLUSION

1) Out of 10 films on camera No. 2, 5 films show obvious unstabilities in the crosses configuration, which forbids, in our opinion, any event measurements on bad frames.

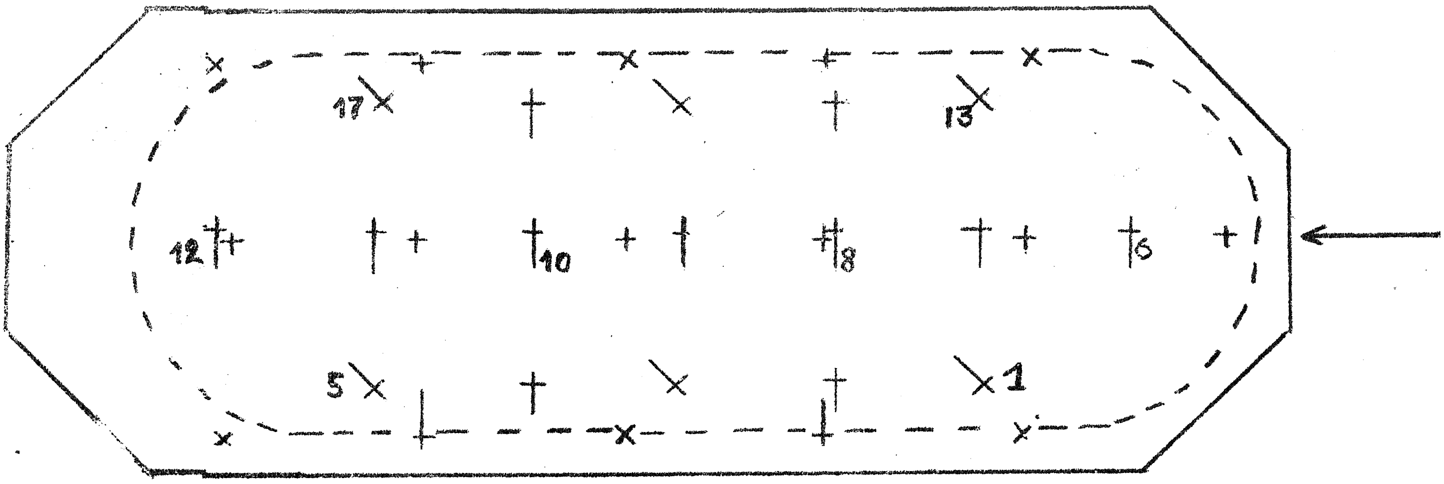
2) For the 5 other films the unstability, if any, is inside measurement errors or at most of the same order of magnitude.

3) The length D_3 affords us with a good criteria to select good and bad frames.

Besides, no large effect has been observed for the other cameras (Nos. 1 and 3). No systematic study has as yet been done. However, the only film already studied for the cameras Nos. 1 and 3 leaves this question quite open: camera No. 1 is good, and camera No. 3 gives broad width (somewhat less than the bad films of view No. 2, but the absence of structure in the ratio histogram leaves little hope for a simple selection criteria).

CAMERA 2

Fig 1



measured fiducial marks

length

ratios

length D	between cross	and
1	12	10
2	8	10
3	6	8
4	6	12
5	5	17
6	1	13
7	1	17
8	5	13
9	12	17
10	12	5
11	10	17
12	10	3
13	8	13
14	8	1
15	6	13
16	5	1
17	17	13
18	8	7

ratios	length	over-length	$\widetilde{\text{value}}$
1	2	1	1.
2	3	1	1.
3	4	1	3.
4	5	1	1.
5	6	1	1.
6	6	5	1.
7	7	5	1.
8	9	10	1.
9	13	14	1.
10	11	12	1.
11	15	16	1.
12	17	18	1.

TABLE 1

vue 2

reduced width of the ratios σ^2 observed / σ^2 expected

Film	#	ie perrors #	σ_x	σ_y	$\frac{\sigma_x+\sigma_y}{2}$	reduced width of the ratios # 1	2	3	4	5	6	7	8	9	10	11	12	average
Good films	96A$_2$	2	2.78	2.94	2.86	0.87	1,13	0.95	1.06	1.13	0.71	1.14	1.51	1.54	0.93	1.82	0.82	1.17
	99A	4	1.42	1.36	1.39	1.85	1.80	1.95	1.21	1.27	1.55	2.16	1.98	1.10	1.66	1.84	2.34	1.76
	104A	2	2.18	2.34	2,26	1.89	1,16	1.74	1.47	2.28	1.67	1.63	1.46	1.77	1.87	1.31	1.48	1.66
	105A	2	2.54	2.76	2.65	2,36	1.73	2.28	2.32	1.78	1.85	1.04	0.97	1.55	1.50	1,27	1.18	1.71
	108A	2	2.58	2.88	2.75	1.13	1,65	1.51	1,37	0.98	1.19	1.18	1.19	1,27	1.43	2.13	1.17	1.38
	110B	2	2.47	2.72	2.59	1.47	1.36	1.38	1.28	1.49	1.41	1.10	1.63	1.24	1.58	1.58	1.54	1.43
average						1,59	1,47	1,63	1.45	1.47	1.39	1.37	1.45	1.41	1.49	1.65	1.42	1.51
film of the 80cm chamber	1254	4	1.32	1.07	1.19	1.59	1.24	1,57	1.38	1,24	1.29	1.72	0.79	1.02	1.65	1.21	1,05	1.33
Bad films	90B	4	1.65	1.40	1.47	13.62	39.90	28.30	33.15	25.0	12.60	40.60	22.5	37.5	7,21	2,51	38.7	28.24
	93A	4	1.74	1.07	1.40	21,9	22.2	25.0	19.2	20.6	2,53	19,7	8,9	18.2	6.56	2.56	14.6	16.98
	96A$_1$	2	2.28	2.24	2.26	4.67	5.78	6.03	4.9	4.32	1.75	3.4	5,12	3,94	3,85	2.52	5.08	4.46
	98A	4	1.67	1.41	1.54	26.3	54,2	49.6	23,1	35,3	14.6	39.9	25.3	42.2	10.8	3,06	45.8	34.54
	101B	2	3.44	3.78	3.61	6.28	8,64	8.62	10.58	12.20	3,91	21.6	16.7	25.6	8.9	1.9	35.9	16.43
average						14.5	26.1	23.5	18.19	19,4	7,08	25.04	15.9	25.4	7.46	2.51	28.0	18.13

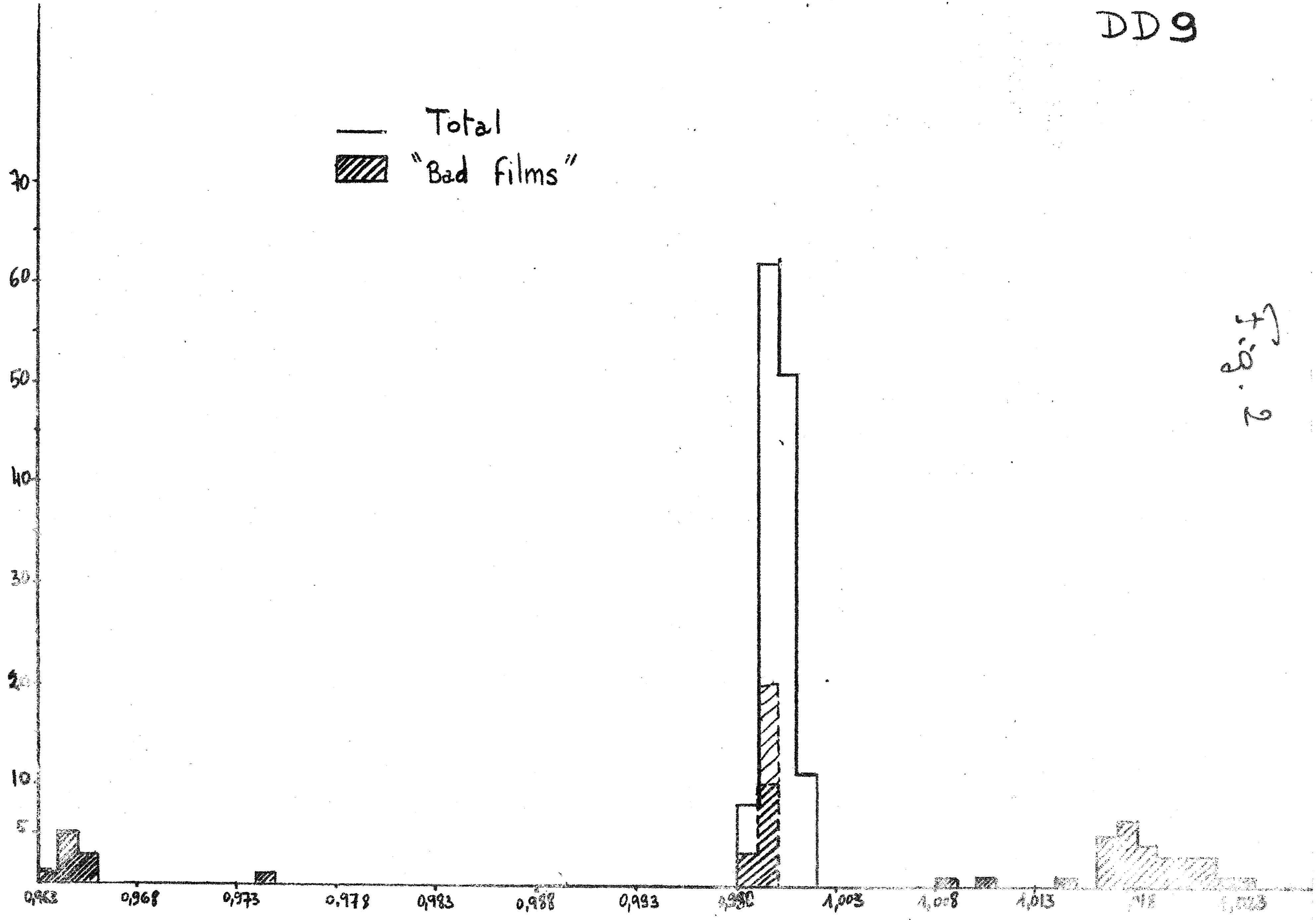
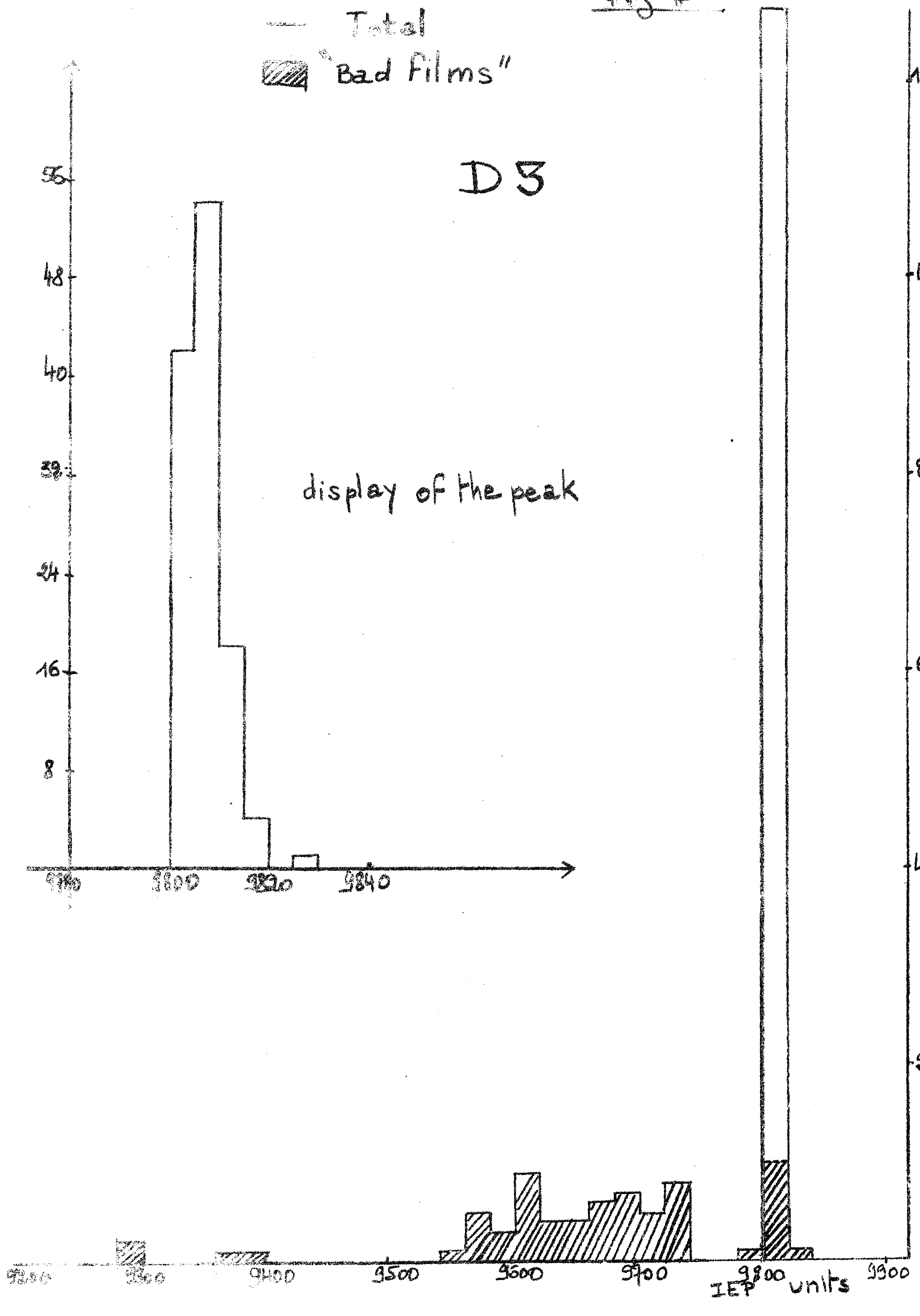
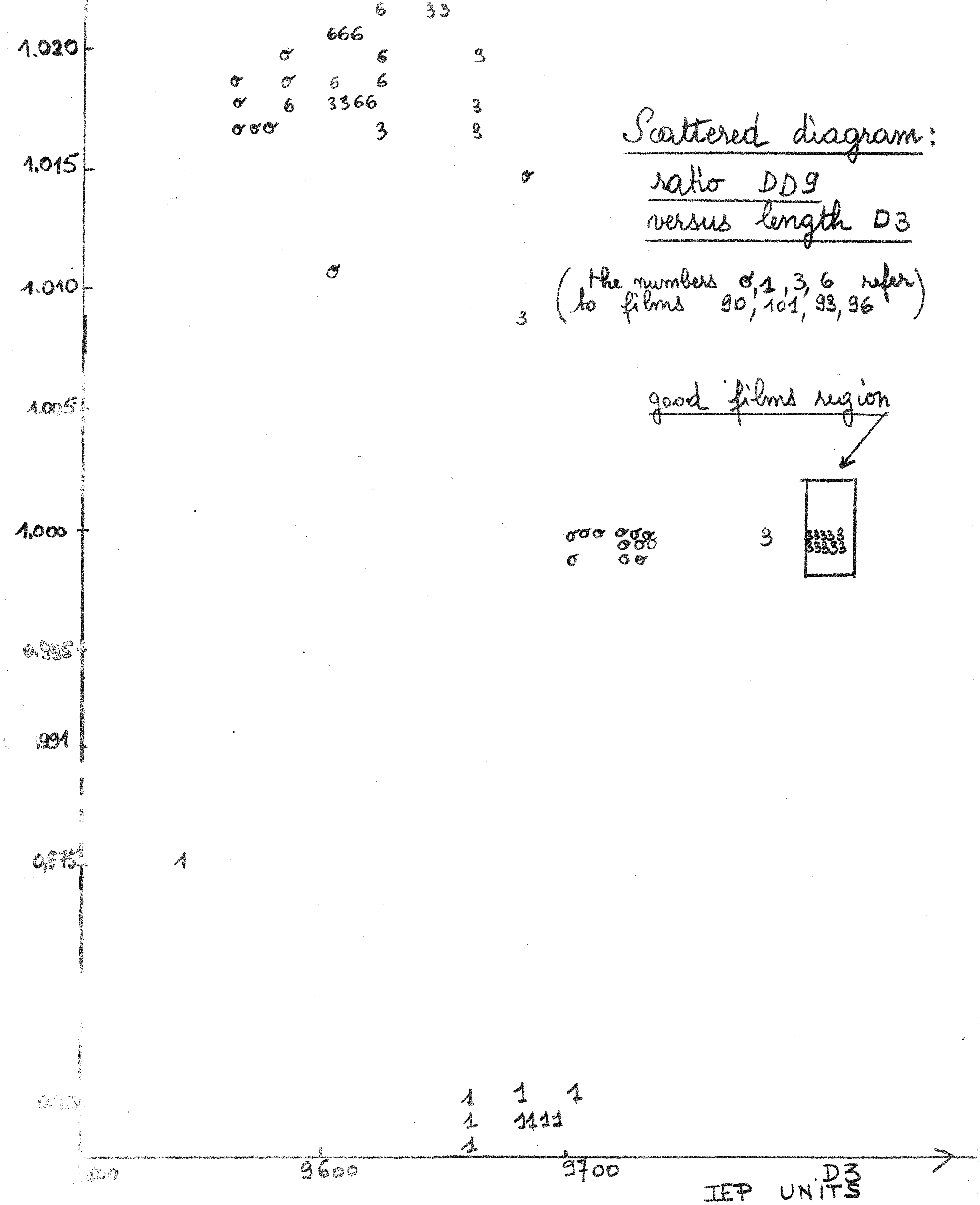

DD9
Total
"Bad films"
70
60
50
40
30
10
5
0,963
0,968
0,973
0,978
0,983
0,988
0,993
1,003
1,013
Fig. 2

Fig 3



Total
"Bad films"
D3
display of the peak
56
48
40
32
24
16
8
9780
9800
9820
9840
120
100
80
60
40
20
9200
9300
9400
9500
9600
9700
9800
9900
IEP units

Fig 4


DD9
1.020
1.015
1.010
1.000
9600
9700
D3
IEP UNITS
Scattered diagram:
ratio DD9
versus length D3
(the numbers σ, 1, 3, 6 refer to films 90, 101, 93, 96)
good films region