

Discrimination between star-like defects on photographic plates and possible γ -ray burst optical counterparts

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Abstract. The depth structure of stellar images as well as of definite plate faults in photographic emulsions is investigated by microscopy using transmitted and reflected light. This method reveals characteristic properties of stellar images and, thus, allows a clear distinction between real stellar images and star-like plate defects. The only limitation is for very faint objects which have a brightness near the plate limit.

The method is applied to all candidate objects of γ -ray burst optical counterparts found on plates in the Sonneberg Observatory. Most of them are shown to be plate defects; the remaining cases are unsolved. Thus, there is up to now no definitive candidate for a γ -ray burst optical counterpart on Sonneberg archival plates.

Key words: γ -ray bursts – optical counterparts – plate defects – photography – microscopy

1. Introduction

During more than a hundred years of astronomical stellar photography the recognition of plate faults has been regarded to pose no problem. Since all known stellar astronomical objects were thought to be continuously radiating (though often with varying luminosity) a second exposure taken several hours or days later could easily allow to verify the nature of any doubtful object. This situation has changed only recently with the discovery of objects with short variability or even outbursts with durations of seconds only. The outstanding example are the γ -ray bursts which last in general only several seconds, without any repetition detected up to now.

If the γ -ray sources also emit optical radiation one can expect to find optical flashes on archival astronomical plates. However, it has been proved to be very difficult to distinguish star-like plate defects from real flash images. Especially, the reality of archival flashes in or near γ -ray burst error boxes (Schaefer, 1981; Schaefer et al., 1983; Greiner and Flohrer, 1985; Hudec et al., 1987; Greiner et al., 1987a; Moskalenko et al., 1989) has been controversial (Zytkow, 1988).

In contrast to these images a number of other plate defects are known and their causes have been investigated: 1. There are many cosmetic defects (dust spots, shadows from dust on the filter, scratches, halo images due to small deposits on the back of the plate, false stars due to particles adhering to the emulsion) which mainly arise during copying (Robertson and Tritton, 1988). 2. Also known for several years are aging blemishes (e.g. Krause, 1985), either due to damage of the emulsion during processing, contamination of the processing solutions or deterioration and unknown causes during storage. 3. Several mechanisms have been proposed to account for the formation of microspots which have characteristic reddish to brownish-orange colour. They develop only after several years of storage (Good and Gourlay, 1984) and are relatively easy to detect because of their periodic concentric ring structure (Brandt, 1984). 4. More difficult to recognize are black spots, sometimes called pepper spots, known to be metallic silver specks formed as a result of a defect in the silver halide emulsion manufacture (Krause, 1985).

All these defects have distinct properties and, therefore, can be recognized by thorough plate inspection. In contrast, the many published candidate optical counterparts of γ -ray bursts (GRB) have been shown to exhibit complete similarity with stellar images (shape, density profile). Therefore, in those cases it is not clear at all whether we have a real flash image or a plate defect.

Examining archival plates with the need to decide on the nature of archival “new” images one is confronted with two worrisome facts (examples will be given in Sect. 4): First, there is ample evidence that the occurrence of very bright star-like plate faults is not an exceptional case. However, because of their brightness (sometimes up to 5–6 mag above the plate background) one is tempted to reject the possibility that such objects are defects. In the past, during searches for “normal” variable stars before knowing of GRBs, it was however common practice to reject unconfirmed “bright objects” on the plates. Second, any quotation of the “exact” probability of occurrence for a given object is very unsatisfactory because it contains no information on the object itself. In the case of possible optical counterparts of γ -ray bursts this holds for the vicinity of “new” optical images and error boxes (inside or outside the $3\sigma, 4\sigma, \dots$ levels) as well as for the positional coincidence of two or more star-like objects on plates exposed at different times.

These problems motivated us to investigate in detail definite plate faults and stellar images microscopically using reflected

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light. We found distinct differences and characteristic properties (Sect. 3) which, in turn, allow to assess the reality of archival star-like images. This has been done for all published candidate objects for GRB optical counterparts found on plates of Sonneberg Observatory (Sect. 4).

2. Method

This paper is based on the following two aspects:

1. The plates are examined using reflected light. All previous investigations of flash images (microscopy, photometric density profiles, equidensitometry) used transmitted light.

2. In order to investigate the in-depth extension (into the photographic emulsion) of stellar images and defects, respectively, the plate emulsions are examined also from the back-side, i.e. through the glass.

An incident-light camera microscope NEOPHOT 32 of Jenoptik Jena GmbH (Weiland et al., 1985), with a special transmitted-light equipment has been used. This inverted type microscope has several advantages for our purposes:

- no limitation for the size of plates
- high resolving power and small depth of focus, using planapochromatic objectives $25\times/0.60$ and $50\times/0.90$ for incident light observation
- variable tube lenses $0.8\times\dots 2.0\times$ for easy change of magnification
- simple switching between reflected and transmitted light, which facilitates the identification of the objects on the plates
- high pressure Xenon bulb, necessary because of the low reflectivity of photographic emulsions.

Examining plates from the back necessitates appropriate devices. Particularly, the objectives of the microscope have to be corrected for observing through a glass plate of definite thickness and should have a long working distance.

The special requirement of greatly varying thickness of archival plates is very well met by the long distance planachromat LDN 40/0.60 ∞ /1.2-A (Riesenberg, 1987) of Jenoptik Jena GmbH. This objective can be adjusted for any glass thickness between 0.5 mm and 1.6 mm.

The investigation uses image scales between 50:1 and 800:1 for both transmitted light (mainly to identify the object) and reflected light (from either side of the plate). When observing reflected light from above the emulsion, one sees only the gelatine surface. In contrast, looking by reflected light from below, i.e. through the glass, and varying the focus will allow to see grains in different depths of the emulsion (provided the density of the grains is not too high).

3. Structure of stellar images and defects

A wide range of images, photographic emulsions and plates has been studied to allow some generalization of the investigation. A total of 38 plates have been examined including various emulsions (Kranseder Kranz Ultra, Agfa Astro, Agfa Astro Spezial, ORWO ZU 21 and ZU 1, ORWOP 1, Kodak 103a-O), plates of different age (1 to 50 yr), plates with different exposure times (1 s up to 60 min) and plates with/without anti-halation backing.

More than 200 images have been investigated (real stellar images as well as definite plate defects and candidate objects). In what follows, we describe the general features of these images.

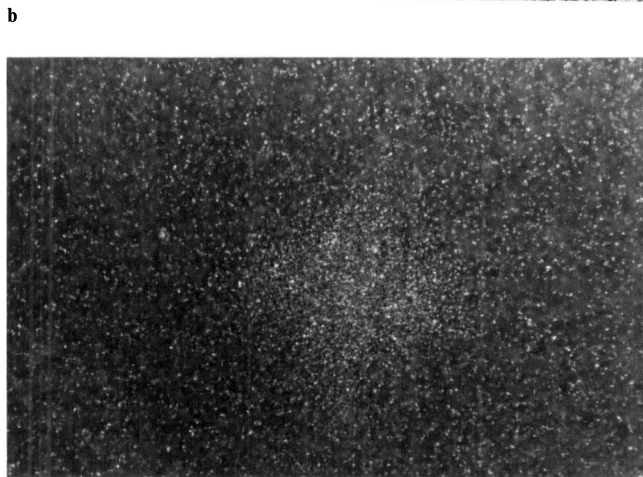
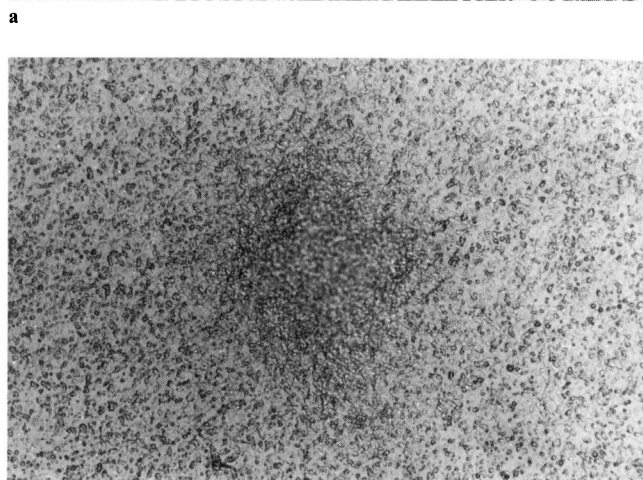
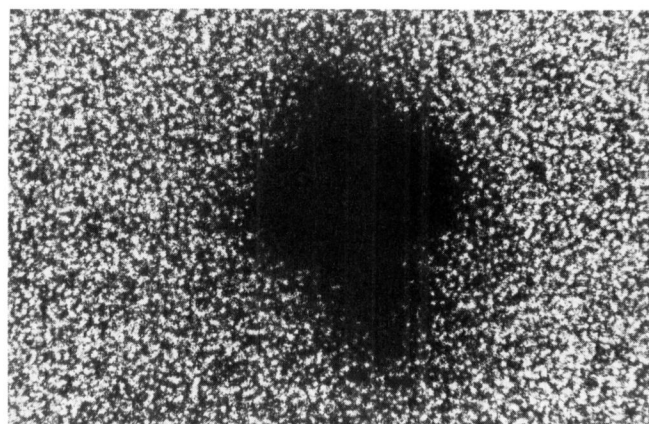


Fig. 1a–c. Typical stellar image, slightly distorted by the camera objective, as seen in a microscope. The star has 9th mag and the plate limit is 14 mag. The images cover $540\mu\text{m} \times 360\mu\text{m}$. **a** Usual view in transmitted light. **b** View in reflected light from above the surface of the emulsion. The top of the silver mountain ($4\mu\text{m}$ above the gelatine) is already out of focus. **c** View in reflected light through the glass plate with the focus at the glass/emulsion boundary. The form and the diameter of the stellar image are the same on the emulsion surface and at the glass/emulsion boundary

3.1. Stellar images

It is well known that the exposed regions of an emulsion form silver mountains above the gelatine surface (e.g. Lau and Krug, 1957). The height can reach 1–4 μm depending on the kind of processing solutions (developer, fixer) used.

The comparison of different microscopic views of stellar images, i.e. by transmitted and by reflected light from above the emulsion as well as through the glass plate shows that the image diameters at the emulsion surface and at the emulsion/glass boundary are equal (Fig. 1 shows a typical stellar image). Thus stellar images extend, in general, through the 10–25 μm thick emulsion down to the supporting material (glass plate, plastic film) with constant radius. Only the faintest stellar images do not reach the support. Thus, all but these images are geometrically right cylinders with radius/height ratios between about 100:1 and 1:1.

This is in contrast to the results of the study by Zytkow (1988) in which a decreasing radius for deeper regions in the emulsion was reported for typical stellar images. From our examination it follows that such a behaviour may be valid only for the images of the very faintest stars having diameters smaller than the depth of the emulsion. However, the diameter of these faintest images (which do not reach the support) is difficult to determine due to the graininess of the emulsion as well as grains related to the fog. Unfortunately, no details of the method and material of Zytkow's investigation are known to us. Thus, the reason for this discrepancy cannot be clarified further.

Concerning the faintest stars (< 1–3 mag above background depending on emulsion sensitivity or/and insufficient developing) it is sometimes difficult to recognize even a real stellar image using reflected light. In comparison to "normal" stellar images (which extend down to the support) these fainter images often correspond to a smaller mountain which in some cases cannot be seen at all. At the worst, the stellar image will not be visible by reflected light, neither from above the gelatine nor through the glass.

In view of the supposed duration of only a few seconds of optical flashes from γ -ray burst sources, special attention was paid also to images on shortly exposed plates. We have investigated a series of plates with exposure times of 1 s, 4 s, 16 s, 60 s, and 40 min. The comparison of these images revealed no differences in their properties which might depend on the exposure time.

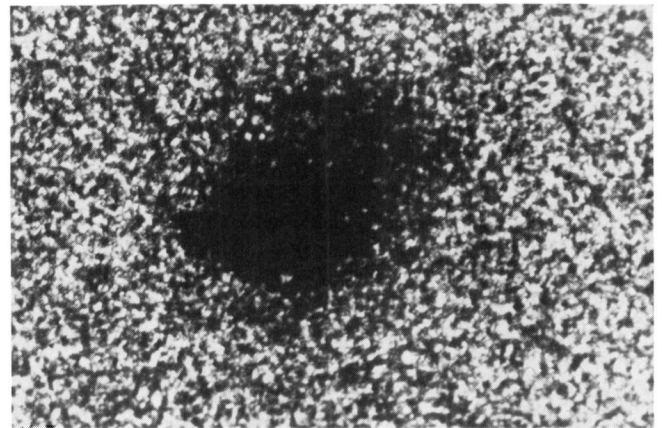
3.2. Star-like plate defects

Some details on plate fault statistics, i.e. frequency of defects, their distribution on plates and their variety of forms have already been reported (Greiner et al., 1987a) using plates which had been exposed in the laboratory without any star. The same plates have now been investigated microscopically with reflected light including however only defects apparently rather similar to stellar images.

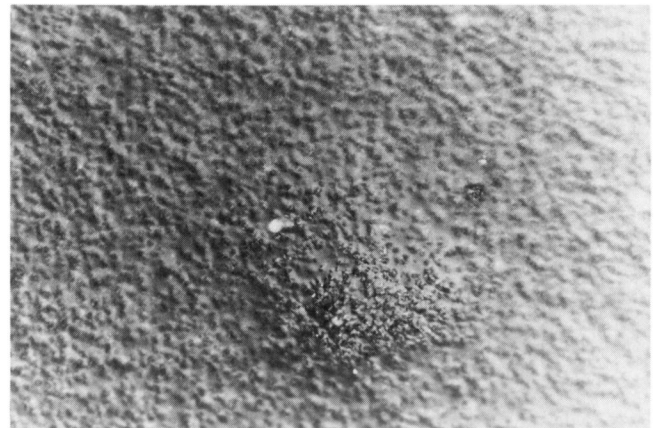
Studying these definite plate faults reveals the following possibilities:

i) Distortions on either side of the emulsion. Figure 2 shows a fault looking like two stellar images of different magnitudes which slightly overlap. However, only one mountain (instead of two) is visible on the emulsion surface with another little defect northwest of it, whereas the image at the glass/emulsion boundary shows a ring-like structure.

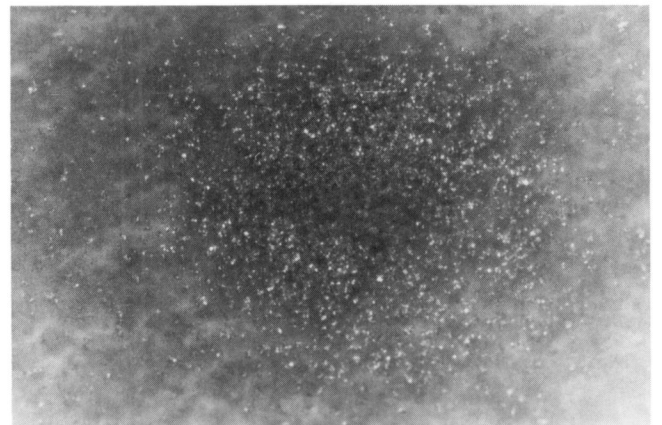
ii) Distortions on the surface of the emulsion. Figure 3 shows another nearly point-like defect. Examining the emulsion surface by reflected light reveals a large relief structure which extends up



a



b

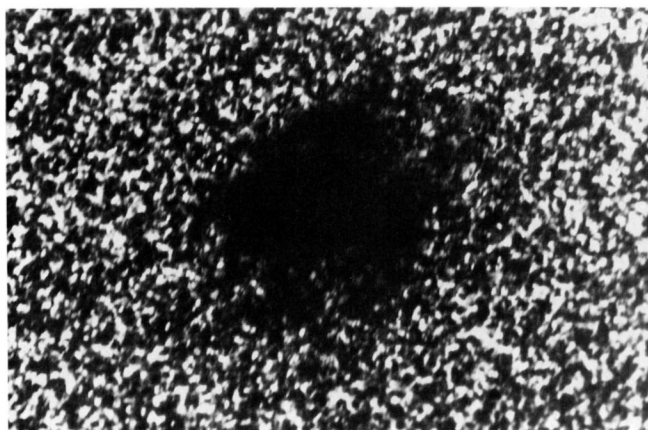


c

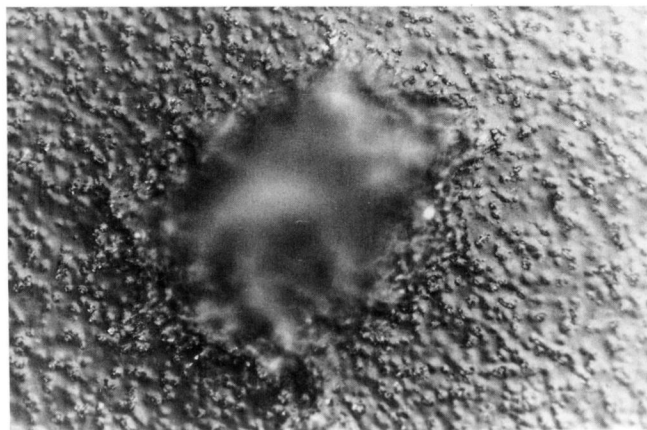
Fig. 2a–c. Plate fault which shows distortions of its image on either side of the emulsion. **a** In transmitted light it looks like two adjoining stellar images. **b** In reflected light from above the surface a distorted silver mountain is seen at the location of the lower part of the image in **a**. **c** A ring-shaped silver structure is visible by reflected light through the glass which is completely different in form and size from those shown in **a** and **b**. The field dimensions are 270 μm \times 175 μm

to 13 μm above the emulsion surface. At the glass/emulsion boundary this defect looks like a normal stellar image (also in transmitted light).

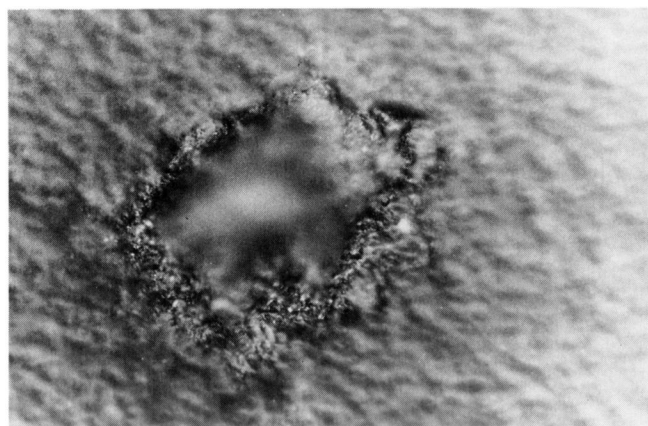
iii) Distortions at the glass/emulsion boundary. Compared with ii) there is also the possibility of distortions only at the



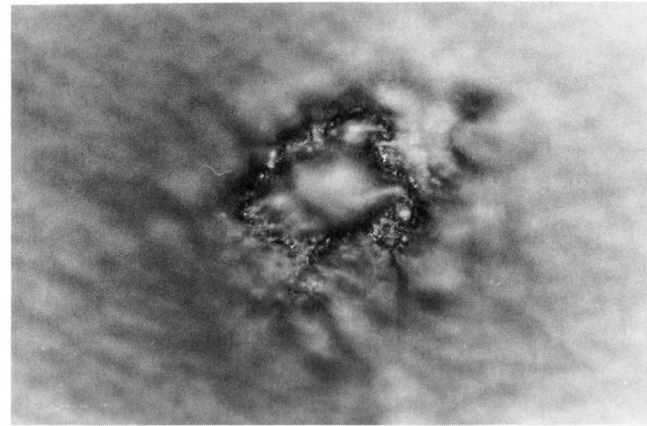
a



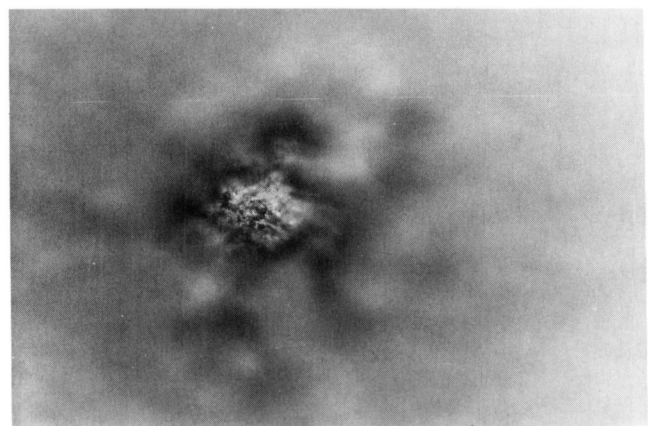
b



c



d



e

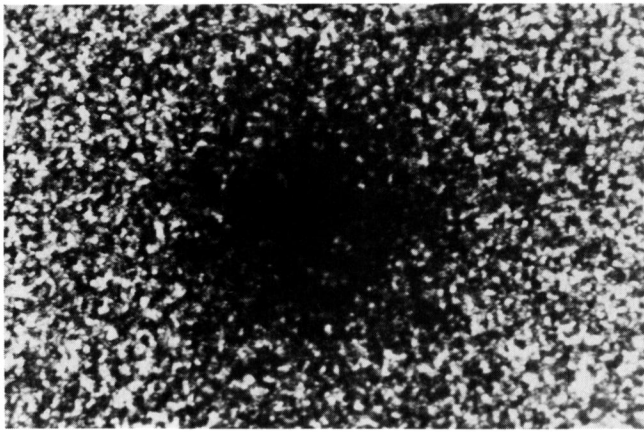
Fig. 3a–e. Plate fault with the distortion on the emulsion surface. **a** In transmitted light the image is star-like. **b** In reflected light with the focus on the surface of the emulsion a huge blurred structure appears. **c** Focus is $4\ \mu\text{m}$ above the emulsion surface. **d** Focus is $8\ \mu\text{m}$ above the emulsion surface. **e** Focus is $12\ \mu\text{m}$ above the emulsion surface. The images **b–e** show the circumference in various heights of a bizarre defect structure rising up to $13\ \mu\text{m}$ above the surface of the gelatine. The field dimensions are $215\ \mu\text{m} \times 145\ \mu\text{m}$

glass/emulsion boundary (Fig. 4), whereas the surface of the emulsion looks normal. Figure 5 shows a very faint fault of the same type having a little bright spot instead of an extended bright area at the glass/emulsion boundary.

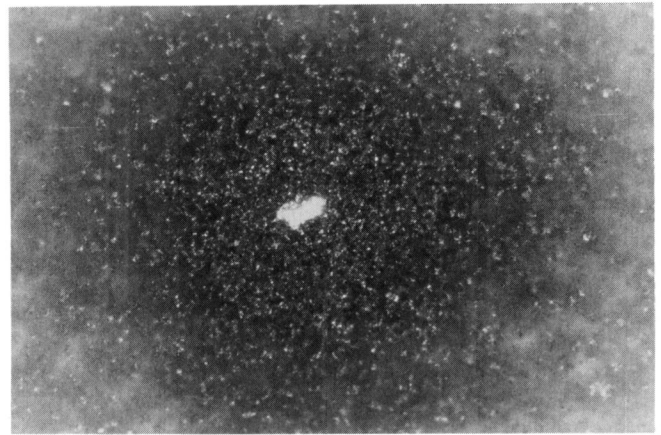
iv) Distortions within the emulsion. These are faults without any sign of compact structures at the emulsion boundaries. (Additionally, there are distortions belonging to this group which are not detectable in transmitted or reflected light.) The example in Fig. 6 is invisible in reflected light from above the surface of the emulsion. It is only in reflected light through the glass that the clustering of silver grains becomes noticeable.

Obviously, there exist several reasons for the formation of star-like plate faults, e.g. silver structures due to the reduction of the silver halides with decreasing completeness at increasing distance without light irradiation. These include contaminations during manufacture of the plates (such as chemically active centers on the glass or in the gelatine as well as metallic impurities in the emulsion), during developing and fixing (e.g. oxydation products of the developer) and radioactive dust particles or any electron emitter (due to the detector properties of photographic emulsions). In the case of chemically formed silver centers it is known that they differ from those formed photolytically. Whereas the latter ones grow under exposure conditions, chemically formed centers are often destroyed (Spencer et al., 1983; Hamilton, 1988). The question is, however, whether these different formation processes (including also the others just mentioned above) can be distinguished after development of the plate.

Depending on the kind of formation, the size of the active centers or impurities and the emulsion state during the formation

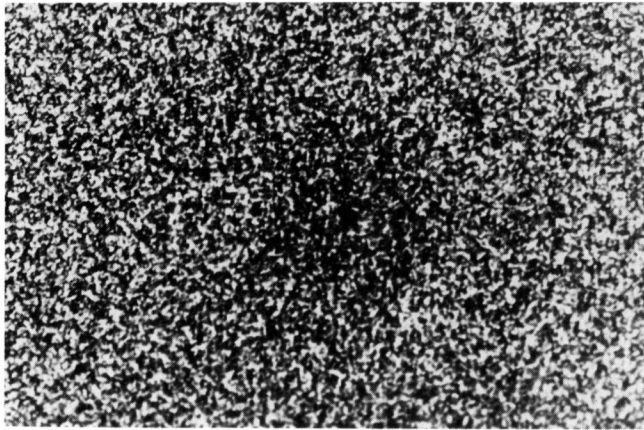


a

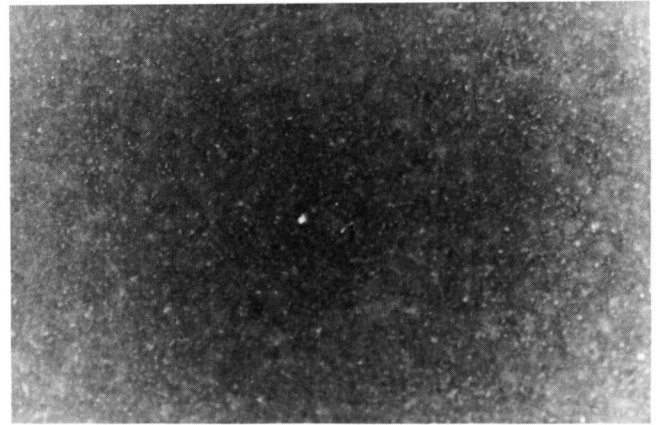


b

Fig. 4a and b. Plate fault with the distortion at the glass/emulsion boundary. **a** In transmitted light the object is completely star-like. **b** In reflected light through the glass a bright irregular spot demonstrates the defect nature. The field dimensions are $270\ \mu\text{m} \times 175\ \mu\text{m}$

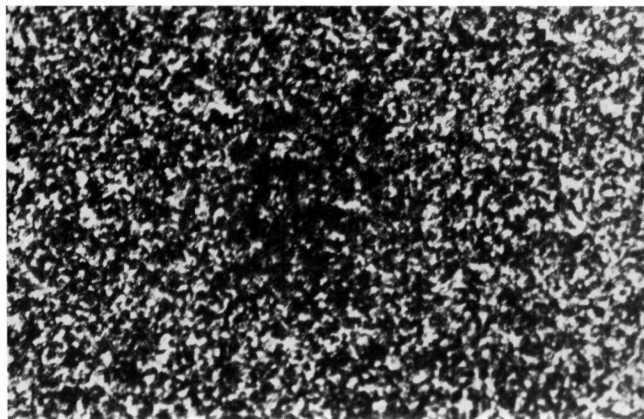


a

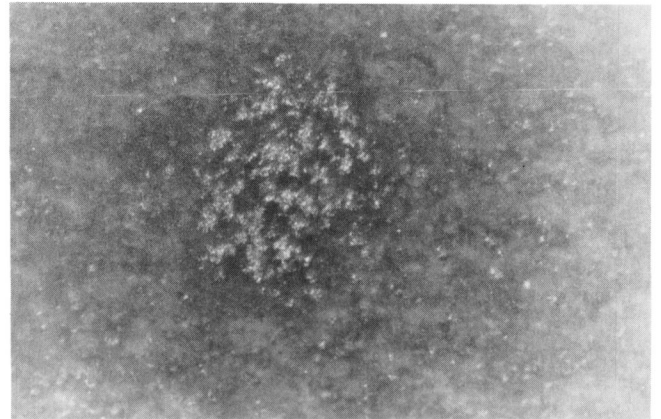


b

Fig. 5a and b. Faint plate fault of the same type as in Fig. 4 but with another appearance. Again a bright spot appears. The field dimensions are $435\ \mu\text{m} \times 290\ \mu\text{m}$

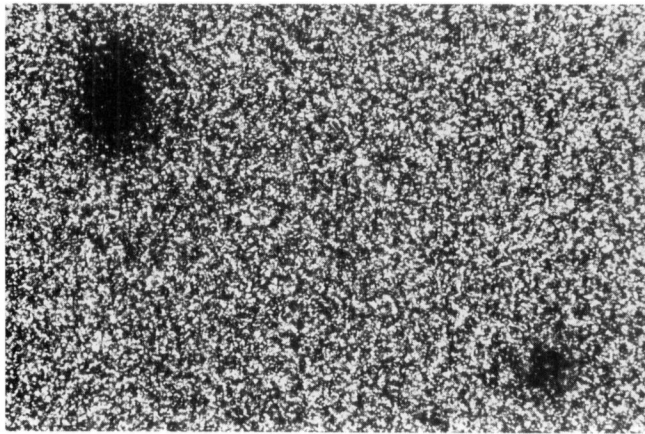


a

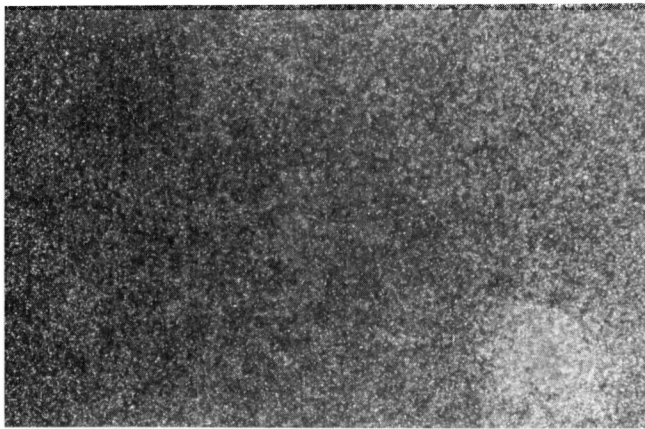


b

Fig. 6a and b. Plate fault within the emulsion. It is invisible in reflected light from above the surface and does not reach the glass/emulsion boundary. **a** In transmitted light a faint and diffuse object is visible. **b** Here, the emulsion is transparent enough to see in reflected light through the glass the grain clustering about $7\ \mu\text{m}$ above the glass/emulsion boundary. The field dimensions are $270\ \mu\text{m} \times 175\ \mu\text{m}$

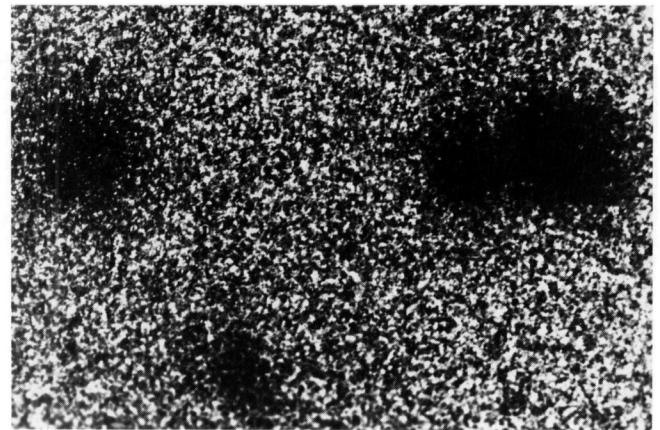


a



b

Fig. 7a and b. Object (below right) on plate Te_2 7679, previously thought to be a candidate optical counterpart for GBS 1703 + 01. The brighter object above left is a stellar image slightly elongated due to a guidance error. **a** In transmitted light the object is star-like where the lack of elongation would have been attributed to a possible flash nature. **b** In reflected light through the glass the real stellar image is invisible, i.e. does not reach the glass/emulsion boundary. The same is expected for the fainter object if it is real. However, a bright grainy area appears having a diameter greater than that which is visible in transmitted light. Therefore, the object is a plate fault at the glass/emulsion boundary. The field dimensions are $530 \mu\text{m} \times 350 \mu\text{m}$



a



b

Fig. 8a and b. Same as in Fig. 7 for plate Te_{20} 646 (GBS 1901 + 14). Three comparison stars are shown; the object in question is the one at the very left. **a** In transmitted light the object is star-like. **b** In reflected light through the glass all stellar images are invisible (except possibly the right one where a slightly enhanced number of grains appears), whereas a bright irregular spot indicates a defect of type iii) (cf. Fig. 4b) at the glass/emulsion boundary

of the faults, a variety of microscopic defect structures [like i)–iv)] can be expected. It is also imaginable that different origins result in the same microscopic structure of a fault. Therefore, it seems difficult to assign one special fault to any one of the possibilities i)–iv).

It seems obvious that the fault images in Figs. 2–6 are due to silver clusters. One way to find out how these silver clusters have formed would be the examination of plates prior to exposure. However, the competing demands of low intensity illumination (to prevent exposure) and high intensity illumination (because of the low reflectivity of the emulsion) necessitate special requirements if optical methods are to be used.

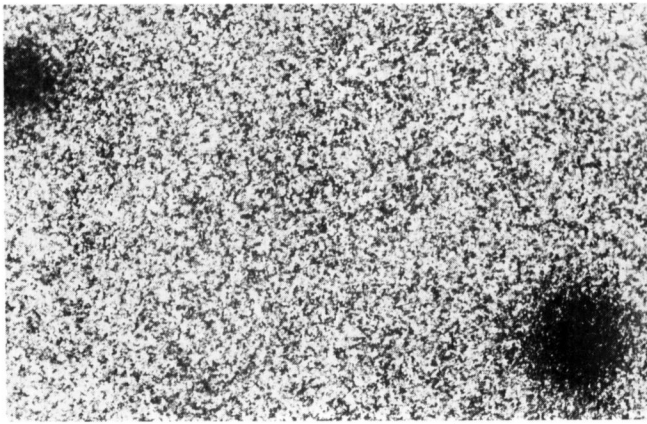
Whatever the origin of the star-like plate faults is, it is clearly possible to recognize by our method such images as faults, if they reach one of the emulsion boundaries. Only silver clusters of substantially smaller size than the depth of the emulsion and located completely within the emulsion are hard to detect using reflected light.

4. Optical flash images in GRB error boxes

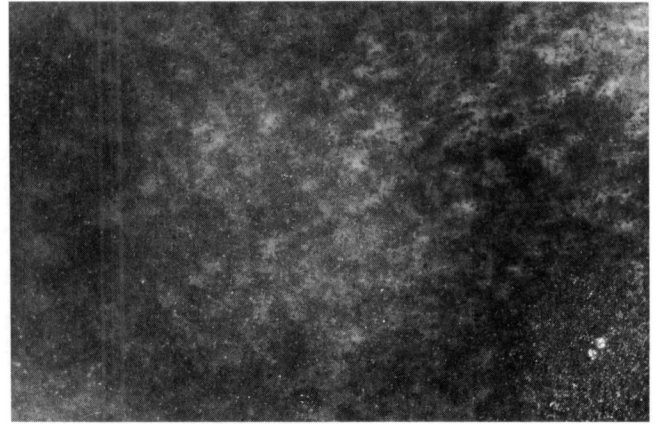
4.1. Flash images found by our group

During the last five years various star-like images have been found on Sonneberg plates in or near several GRB error boxes (Scholz, 1984; Greiner and Flohrer, 1985; Flohrer and Greiner, 1986; Greiner et al., 1987a). Though obviously not confirmed by duplicate plates these objects have been regarded as good candidate optical counterparts up to now. Furthermore, microdensitometry of some of these objects suggested them not to be plate defects but images of point sources (Greiner et al., 1987b).

All the seven candidate objects (Table III in Greiner et al., 1987a) have now been included in the examination. It turns out that four of these objects are definitely plate defects. These are the objects on plate Te_2 7679 in the error box of the γ -ray burst source (GBS) 1703 + 01 (Fig. 7), on plate Te_{20} 646 (Fig. 8) and plate

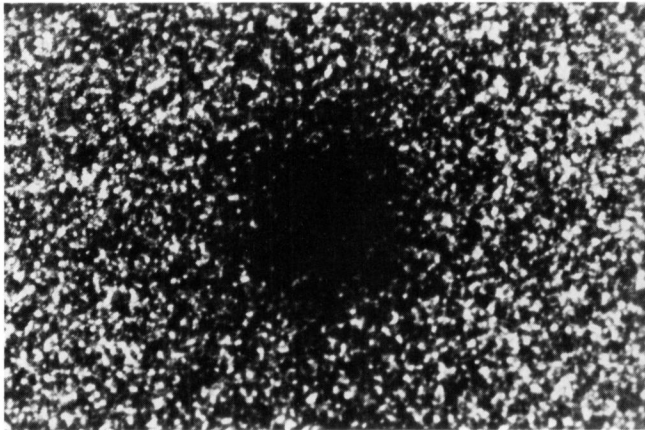


a

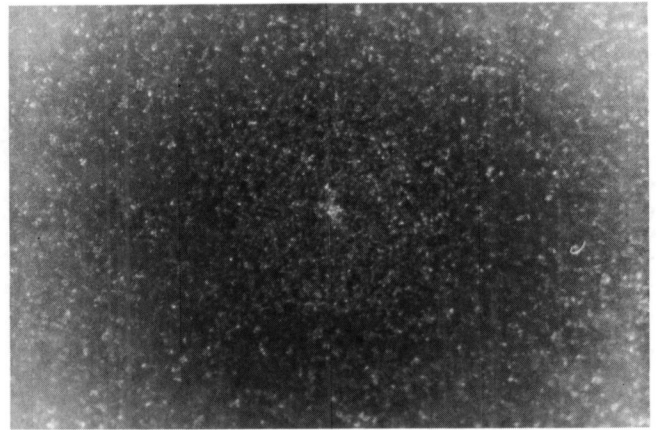


b

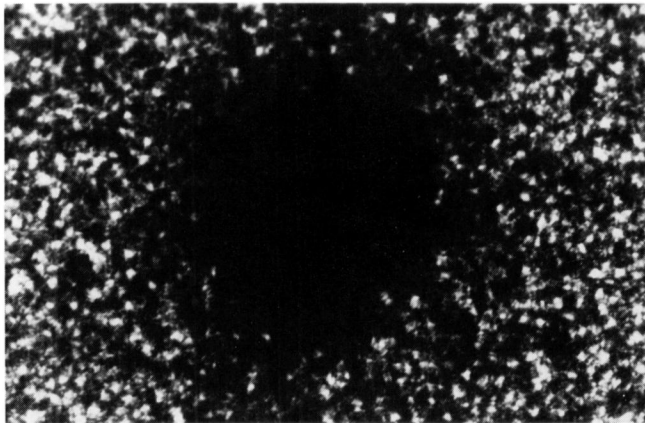
Fig. 9a and b. Same as in Fig. 7 for plate Te_2 1994 (GBS 1901 + 14). **a** In transmitted light the object (lower right) is completely comparable to stellar images (left). **b** In reflected light through the glass the distortion (type iii) at the glass/emulsion boundary is clearly seen, whereas the stellar image is invisible



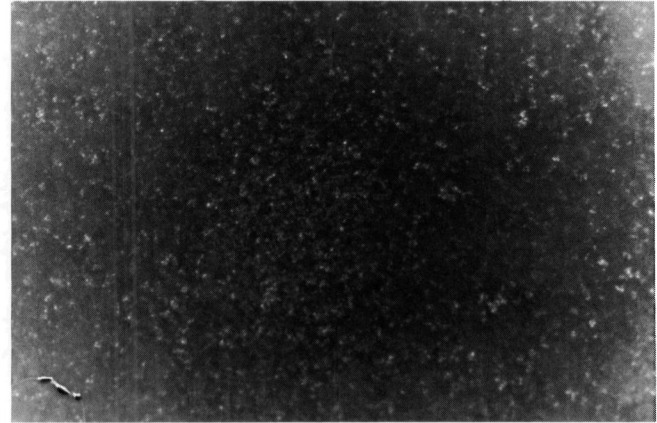
a



b



c



d

Fig. 10a–d. Same as in Fig. 7 for plate Te_2 39 (GBS 2252–02). **a** The object in question in transmitted light is star-like. **b** The object in question in reflected light shows a grain concentration. The comparison with a slightly brighter star (**d**) in the immediate vicinity of the object reveals the defect nature. **c** A slightly brighter comparison star in the vicinity of the object of **a**) (in transmitted light). **d** The comparison star is invisible in reflected light, and so should be the object if it would be real. The field dimensions are $350 \mu\text{m} \times 320 \mu\text{m}$

Te₂ 1994 (Fig. 9) near GBS 1901+14, and on plate Te₂ 39 near GBS 2252-02 (Fig. 10).

The defect nature of all these four objects is noticeable only at the glass/emulsion boundary in reflected light. It is interesting to note that in transmitted light these objects not only look like real stellar images but that the density profiles which had been measured for all but the last object (Greiner et al., 1987b) do not show any difference compared with those of neighbouring stars of similar magnitude.

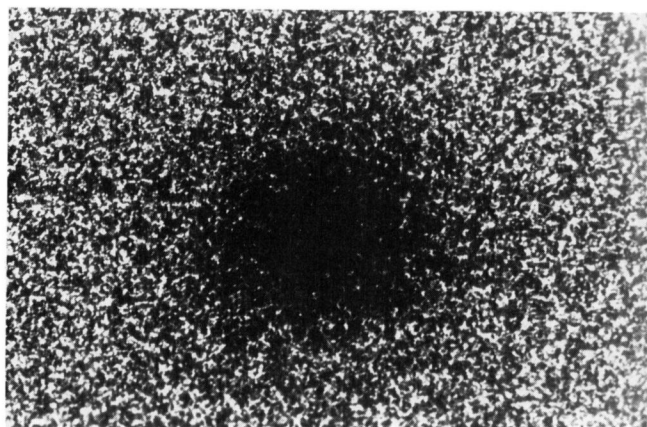
For the remaining three candidates (for details see Greiner et al., 1987a) no decision can be made. The object on plate E 8024 near GBS 2252-02 is invisible in reflected light from either side of the plate. This also holds for the somewhat brighter stars in the immediate vicinity. The object's brightness is only 1 mag above background. This is also the case for the object in the GBS 1201+22 (plate Te₁₉ 6166). It is invisible by reflected light through the glass, like neighbouring stars of similar or even slightly brighter magnitude. The overall background noise prevents one to look through the glass through the emulsion to regions near the surface. On the emulsion surface the object shows the usual relief structure. In the case of object T 5053 near GBS 1901+14 which shows the distortion caused by the objective, the relief structure as well as the appearance at the glass/emulsion boundary are comparable with those of neighbouring stars. Thus, these three objects are comparable to their neighbouring stars also

when observed in reflected light. However, this cannot yet be regarded as evidence for real flash images because μ -sized impurities within the emulsion are possible causes which (in most cases) will not be detectable by our method.

In view of the conclusion drawn from the plate fault statistics that to be confirmed optical counterpart candidate objects should have a brightness of at least 1.5 mag above the limiting magnitude of the plate, two of the three remaining objects could be regarded to be "almost certainly" plate defects. However, it would be more satisfactory, to check this using an appropriate method. Optical methods seem to be ruled out but, for instance, measurement of the silver content throughout the emulsion, or other methods, may help to distinguish even such faint objects.

4.2. The Meinunger-object

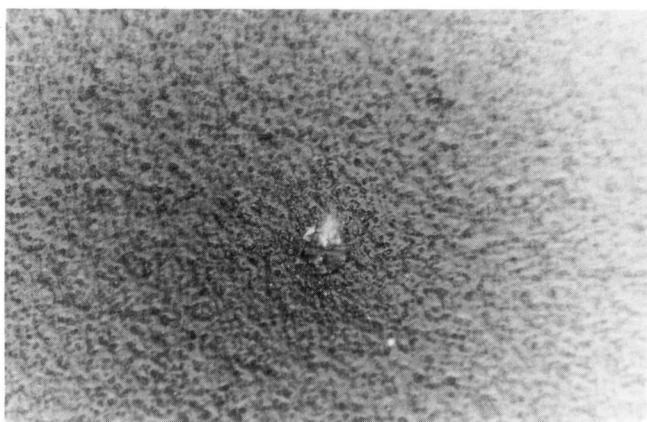
A very bright ($m = 11.4$ mag, ≈ 6 mag above background) object was found by Meinunger (1986) on a plate from 1978 Oct. 7. There is no object on a plate taken immediately after the discovery plate; no synchronous plate exists for most of the exposure time. Recently, Hudec et al. (1989) produced photodensity profiles (2D and 3D) of the object which are identical with those of neighbouring stars except for the lowest equidensity curve. The authors conclude that the object "seems to be caused by a celestial object (flash) of strophysical origin ... However, ... the possible explan-



a



b



c



d

Fig. 11 a–d. The Meinunger-Object (plate GC 3486). **a** It is a completely star-like image when observed in transmitted light. **b** In reflected light a distortion on the surface of the emulsion is seen (type ii), cf. Fig. 3). The focus is on the emulsion surface. **c** View in reflected light with the focus $4 \mu\text{m}$ above the surface. **d** View in reflected light with the focus $10 \mu\text{m}$ above the surface. **b–d** clearly show the defect nature. The field dimensions are $435 \mu\text{m} \times 290 \mu\text{m}$

ation of the object as a false event of instrumental or terrestrial origin cannot be entirely ruled out”.

The inspection of the object by reflected light (Fig. 11) immediately shows a $10\ \mu\text{m}$ high relief structure of fault type ii). Though relatively bright the object is clearly a plate defect.

4.3. The Hudec-objects near GBS 1810+31

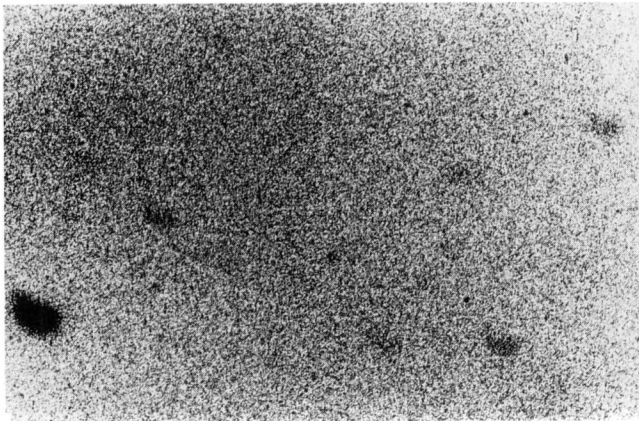
Probably the most exciting candidate up to now for a GRB optical counterpart was found by Hudec (1986) on three plates at an identical location but at different exposure dates. Subsequent investigations convinced Hudec et al. (1988) to believe that “the object is of true astrophysical origin and probably the optical counterpart to the GBS” 1810+31. However, re-investigation confirmed the location of the GRB event (Laros, 1988) with a distance of $5'$ to the optical images. Further scepticism on the GRB optical counterparts arose from deep broad-band CCD imaging of the field around the optical images (Hartmann et al., 1988; Ricker et al., 1989), which places severe constraints on possible quiescent counterparts. However, also these authors suppose that the images were those of a true cosmic source, albeit of unknown character, and calculate a probability of $P \approx 2 \cdot 10^{-7}$

for the coincidence of three irrelevant images inside the localization circle (Hartmann et al., 1988).

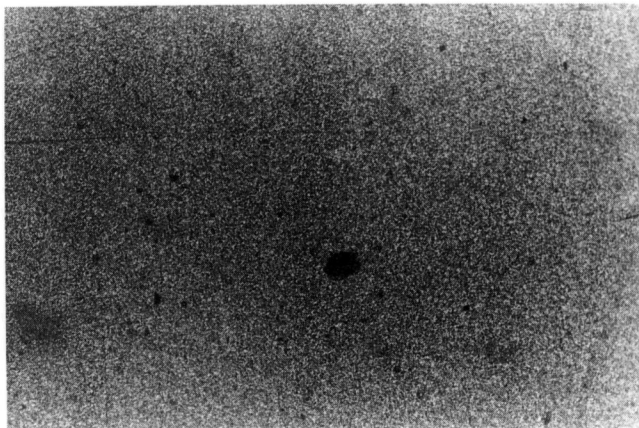
Microscopy in reflected light reveals that two of the three images (Figs. 12 and 13) are definitely plate defects at the glass/emulsion boundary. Thus, there is at least no repeating optical flash source!

We stress again that any probability statement concerning the occurrence/non-occurrence or repetition of flashing optical events should be regarded with scepticism as long as the objects are not definitely proven to be real. In the present case, the *a priori* very low probability of finding three plate faults on different plates with the same coordinates sometimes had been considered as evidence for a stellar origin of the “images”. This turns out to be wrong.

Concerning the third plate (Fig. 14) a decision based on our incident-light microscopy is difficult. Using reflected light through the glass the object as well as neighbouring stars of similar brightness are not visible. They are too faint to reach the lower parts of the emulsion. On the surface of the emulsion the object shows the usual relief structure, though somewhat lower as that of real stars. However, and more significant, the relief structure is clearly elongated (visible also by transmitted light), in contrast to

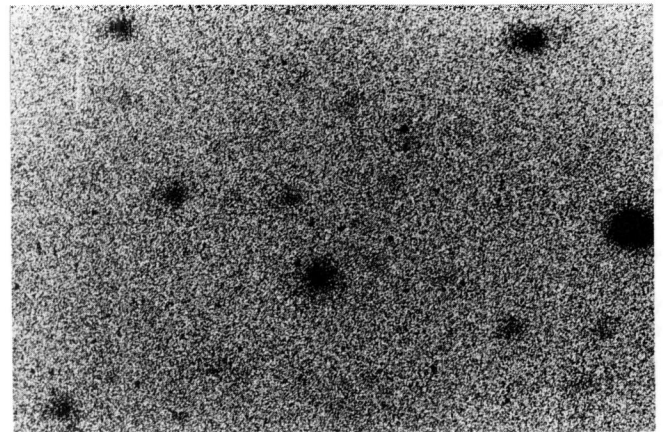


a

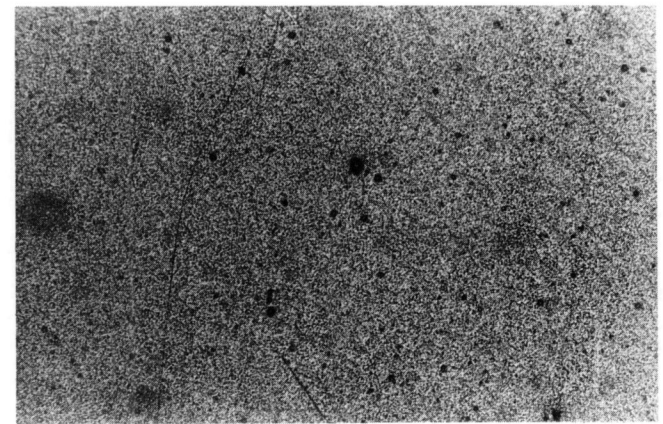


b

Fig. 12a and b. Hudec' object on plate A 4287. **a** In transmitted light a faint spot is visible near the center which slightly differs in form from stellar images. **b** Inspection in reflected light shows several defects on the surface of the emulsion, one of which has caused the candidate object. The brightest stars also can be seen. The field dimensions are $3.5\ \text{mm} \times 2.3\ \text{mm}$



a



b

Fig. 13a and b. Same as in Fig. 12 for Hudec's object on plate A 4328 with nearly the same field of view. **a** In transmitted light a bright star-like image is visible (north of the center). **b** The view in reflected light again reveals several ring-like distortions on the emulsion surface, the largest of which has caused the object in question

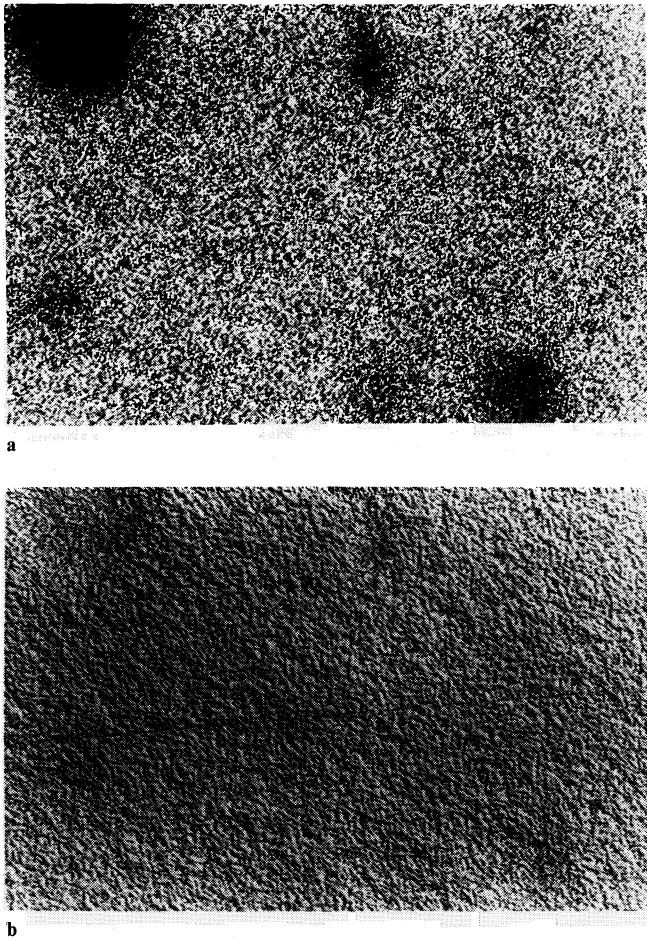


Fig. 14a and b. Hudec's object (top) on plate Te 1647 is clearly elongated, in contrast to the stellar images. A moving object is ruled out due to nonappearance on a subsequently exposed plate. **a** View in transmitted light. **b** The view in reflected light shows the relief structure of the stars as well as of the elongated object. Note the different field dimensions of $870\ \mu\text{m} \times 580\ \mu\text{m}$ compared to Figs. 13 and 14. Also, the scale of the original plate is different from that of plates A 4287 and A 4328, respectively

the real stars. This might suggest a pressure-induced halide reduction by a mechanical impact.

A careful examination of this plate (Te 1647) supports the defect hypothesis for this third object: 1) Due to a mechanical error all stars at the centre of the plate are elongated in north-south direction. In contrast, the stars are round and sharp on a good plate (for instance Te 1623). 2) Around the region of the error box (outer area of the plate) on a good plate the stars are optically distorted; they form ellipses with the long axis in east-west direction (axis ratio about 1.5:1). On Te 1647, real stars are therefore roughly round but diffuse around the GRB error box where the object in question is located. If the object would have arisen from a short flash it should have been distorted (according to 2)) in the east-west direction. This is not the case. The object is elongated approximately in the north-south direction and sharp (Fig. 14). Also, a object moving on the sky during the 40 min exposure time is ruled out: A good plate (Te₁ 509), the exposure of which began approximately 1 h later and lasted 40 min, shows no object at the given or nearby positions. Thus, also this third object is thought to be a defect.

5. Conclusions

Though previous methods of defect recognition on photographic plates by comparison of image shape, density profiles or equidensity curves are valuable, they fail for star-like objects mainly because they all are based on the use of transmitted light. As had been shown, microscopy in reflected light turns out to be a method by which a lot of star-like plate defects can be recognized. These have different appearances depending on the nature as well as the origin of the fault.

The only limitation of the method arises when investigating very faint objects which do not reach the emulsion boundaries. In view of these faint images it is interesting to ask whether one can distinguish ordinary silver structures from those reduced by photographically active centers in the emulsion.

The present investigation shows that most of the published archival candidate objects for GRB optical counterparts are plate defects. Apart from conclusions concerning other branches of astronomical photography, which we do not discuss here, this negative result has two main implications:

1. It is still questionable whether γ -ray bursts are accompanied by optical flashes.
2. All archival photographical candidate objects which are not confirmed by a duplicate plate should be examined in reflected light, resulting in a much more convincing evaluation of the objects nature.

Thus, even more laborious work is necessary.

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