INTERNAL STRUCTURES AND IDENTIFICATION OF GILSON SYNTHETIC OPALS

*By E. A. JOBBINS and MISS P. M. STATHAM**
Institute of Geological Sciences, London SW7 2DE
and
K. SCARRATT
Gem Testing Laboratory, London EC1N 8AU

THE French chemist, Pierre Gilson, has been synthesizing gemstones for some years now, and we have recently had the opportunity to examine a number of his synthetic opals. His latest opals, both black and white, were so convincing—almost too good to be true—that we felt it desirable that some of their internal structural features should be more generally known. Our survey includes Gilson synthetic opal cabochons obtained in London from early 1974 until December 1975.

FIG. 1. Synthetic black opal (Gilson, early 1974) showing longitudinal banding, with some "herring-bone" structure; note "equigranular" appearance near bottom of photograph. ×4·5, reflected light.

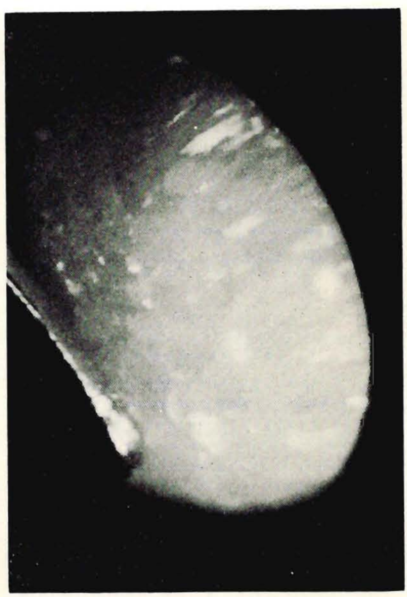

FIG. 2. Synthetic white opal (Gilson, late 1974) showing columnar structure extending from girdle; note "equigranular" texture on top of stone. ×8, reflected light.

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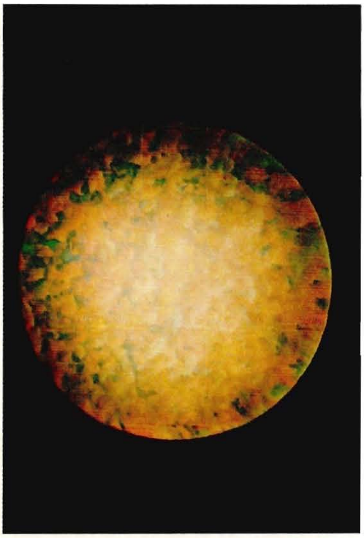

FIG. 3. Synthetic white opal (Gilson, late 1974) showing "equigranular" mosaic. ×5, transmitted light.

FIG. 4. Synthetic white opal (Gilson, Nov. 1974) showing "dendritic" line structure or "healed-scar" effect. ×13, transmitted light.

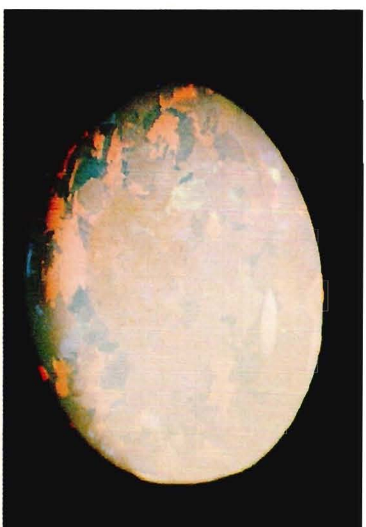

FIG. 5. Synthetic white opal (Gilson, Sept. 1975) showing broadly "equigranular" texture, overall milkiness, and turbid central patch. ×5 reflected light.

FIG. 6. Synthetic white opal (Gilson, Nov. 1975) showing pinkish-buff matrix colour, pale pink, blue and yellow patches and "dried leaves" effect. ×4, transmitted light.

FIG. 7. Synthetic white opal (Gilson, Nov. 1975) showing "lizard skin" effect. × 12, transmitted light.

FIG. 8. Synthetic black opal (Gilson, Dec. 1975) showing "lizard skin" effect and crenulate margins. × 12, reflected light.

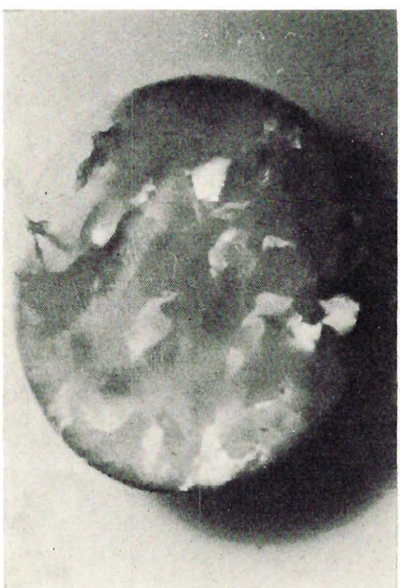

FIG. 9. Synthetic white opal (Gilson, Nov. 1975) immersed in chloroform showing transparency spreading from girdle at top left. × 5, reflected light.

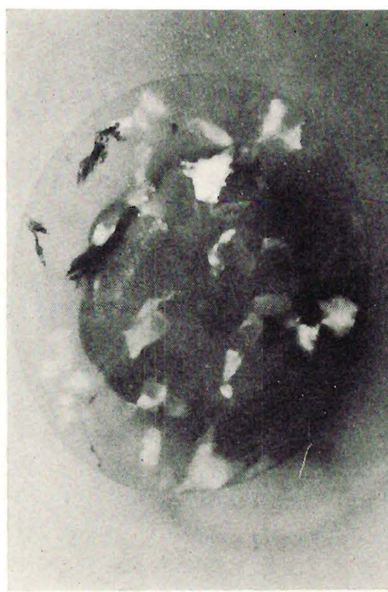

FIG. 10. Synthetic white opal (Gilson, Nov. 1975) immersed in chloroform for 2 minutes showing transparent margin and turbid central patch; note iridescent areas (showing as light patches). × 5, reflected light.

The synthetic black opal (early 1974) is quite characteristic, showing well-defined longitudinal bands with some fine striae along their length and some at oblique angles giving rise to "herring-bone" patterns between adjacent bands (see Fig. 1). The transverse section of the longitudinal bands (where it can be seen near the girdle) shows an equidimensional mosaic similar to the overall appearance of the later Gilson opals. Surface blemishes resemble evaporated drops of water on glass. These opals are transparent to some degree and show a dark brown body colour.

Seen by transmitted light the white opal cabochons (late 1974) display a pronounced "equigranular" texture (many "grains" are around 0·75 mm across, but generally in the range 0·5—1·5 mm) resembling a quartzite in thin section if viewed from above or below (see Fig. 3). However, the side elevation (Fig. 2) shows the columnar structure which seems to be characteristic of opals of this date. The general colour effect by transmitted light is produced by the pinkish-buff matrix, but patches of "washed-out" pale pink, greenish-blue and yellow are also evident (see Fig. 3). Natural opals that we have examined recently usually do not show this colour variation, but range from shades of very pale yellow to brownish-orange in transmitted light. By reflected light the earlier synthetic opals show patches of colour in a turbid matrix. In these and later synthetic opals the mosaic pattern appears to remain static with changing viewpoint and at certain angles almost the whole area of the base shows one colour by suitable reflected light. In contrast, in many natural opals the iridescent pattern appears to change shape and depth to a varying degree as the viewpoint is altered.

Synthetic white opals obtained in November 1974 also show an equidimensional aspect, but with coarser "grains" generally in the range 0·5—2·5 mm, many around 1·5 mm across. The general appearance by transmitted light is again of a pinkish-buff matrix with pale bluish and yellow areas; however, the overall appearance gives the impression of dried leaves, caused by the twisted shadows at "grain" interfaces. Greater magnification (see Fig. 4) of the material reveals the "dendritic" pattern resembling rivers with their many tributaries in hill and valley country—a feature described by Scarratt (1976). The columnar structures previously described are still present, and it is possible to identify a characteristically shaped "grain" on the top of the stone and to recognize a similarly shaped

FIG. 11. Synthetic white opal (Gilson, Nov. 1975) showing mosaic, "lizard skin" effect and overall iridescence in yellow-green. ×4, reflected light.

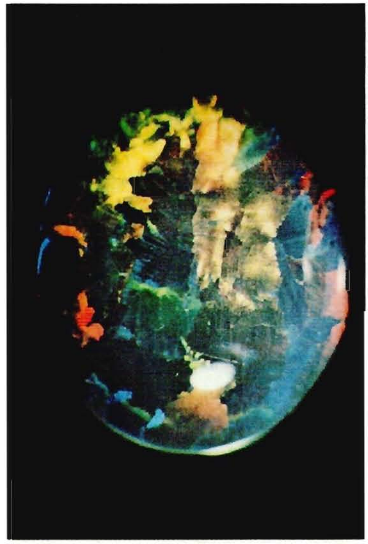

FIG. 12. Synthetic black opal (Gilson, Dec. 1975) showing mosaic with distinctly crenulate boundaries and "lizard skin" effect. ×4, reflected light.

FIG. 13. Synthetic black opal (Gilson, Dec. 1975) showing mosaic with distinctly crenulate boundaries and "lizard skin" effect. ×4, reflected light.

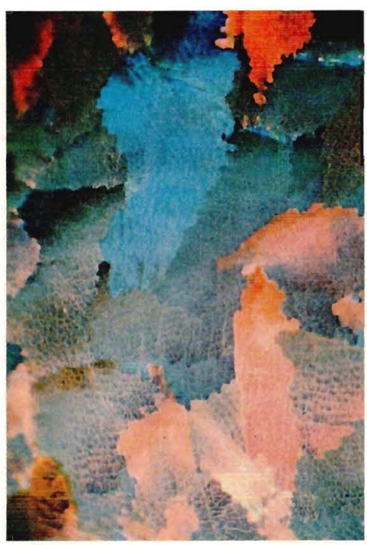

FIG. 14. Synthetic black opal (Gilson, Dec. 1975) showing "lizard skin" effect and crenulate margins. × 12, reflected light.

"grain" on the under-surface, a reasonable indication that the column extended from top to bottom of the cabochon.

Specimens of synthetic white opal obtained in September 1975 also appear generally equidimensional, but with more irregular boundaries to the mosaic. One stone (see Fig. 5) has a very turbid centre patch (see Scarratt 1976). At higher magnification fine lines are evident in the reflected coloured surfaces, sets of lines sometimes intersecting at angles reminiscent of amphibole, pyroxene or calcite cleavage traces.

The latest white opals (obtained in November 1975) also show an equidimensional aspect with a mosaic to 3 mm across or more, and with finely crenulate boundaries to the "grains" (see Fig. 11). On magnification (by reflected and transmitted light) the "grains" show a distinctive pattern resembling lizard skin or fish scales (see Fig. 7). The columnar structure seen in earlier white opals is still discernible but greatly reduced in its impact. By transmitted light the overall pale pinkish-orange colour and the pale bluish and yellow patches are still apparent, as is the "dried leaves" effect (see Fig. 6). An overall milkiness or turbidity is discernible by transmitted light, but becomes very noticeable by reflected light, adjacent "grains" often displaying different degrees of turbidity with the "lizard skin" effect apparently superimposed.

The latest (December 1975) synthetic black opals are very striking in appearance. In contrast to earlier material they are almost opaque and only transmit light (a very dark brown) on the thinnest of edges. By reflected light (see Figs. 12 and 13) they show a generally equidimensional mosaic with distinctly crenulate margins to the "grains" (cf. the white opals of November 1975). Magnification reveals the presence of the distinct "lizard skin" effect (see Fig. 14). By reflected light, areas which are not orientated to show a play of colour, show a milky effect "superimposed" on the general dark matrix colour.

Many, if not most, gemmologists will have convinced themselves that they can recognize natural opal at a glance, but nevertheless, they may not be familiar with the detailed appearance of the iridescent patches when magnified. Therefore, we show patterns seen in several natural opals at our disposal, but these patterns are but a small fraction of the various possibilities (see Figs. 15 to 18).

The synthetic white opals examined showed a very weak off-white (often bluish-white) fluorescence under short-wave (2357Å)

FIG. 15. Natural opal, showing mosaic with some "albite twinning" structures. ×7·5 reflected light.

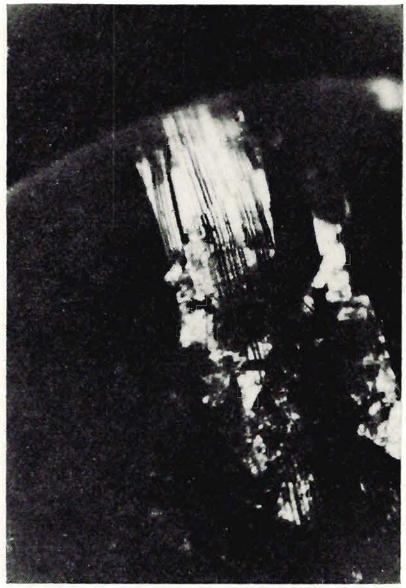

FIG. 16. Natural opal, enlarged view of "albite twinning" structure. ×30, reflected light.

FIG. 17. Natural black opal showing iridescent areas with intersecting sets of parallel lines. ×6·5, reflected light.

FIG. 18. Natural white opal showing typical irregular ragged iridescent areas. ×12 reflected light.

UV light; a stronger, generally whitish, fluorescence was observed under long-wave (3650Å) UV radiation, with a short greenish phosphorescence which could only be seen after the eyes had become dark adapted. The synthetic black opals examined were inert. Not all the natural opals examined fluoresced, but others showed a strong (usually whitish) fluorescence, brighter under long- than short-wave radiation, and a strong, readily visible, persistent phosphorescence following long-wave irradiation.

In view of the known porosity of some opal we were reluctant to carry out refractive index measurements using the normal dark coloured, halogen-bearing contact liquids; instead we used the colourless liquid benzyl benzoate (R.I.1.567) and obtained a series of readings by direct and distant vision techniques. However, since there were no really plane surfaces good results were not forthcoming but were within the range 1·45 to 1·47 for the synthetic opals tested.

To remove quickly the small residual mark caused by the benzyl benzoate it was decided to wash one opal in pure chloroform, which has a similar refractive index (1·45) to opal. On immersion the test stone immediately appeared to lose some iridescence and became more milky. Within 30 seconds the girdle of the stone became transparent (see Fig. 9), showing only iridescent patches and resembling water opal. The transparency spread quickly towards the centre of the stone and within 2 minutes one half the width of the stone was transparent (see Fig. 10), showing an extremely pale yellowish body colour. These changes were accompanied by the vigorous emission of tiny bubbles. After 15 minutes the transparent area extended across two thirds of the width of the stone, but the central turbid patch did not diminish further after 30 minutes immersion.

On removal from the chloroform the stone immediately regained a milky appearance, and the base seemed normal within 2 minutes, although it took 14 minutes to dissipate all traces of transparency from the curved top of the stone, the joints in the mosaic pattern being outlined in white at one stage during the drying out process. The original appearance of the stone was completely restored after evaporation of the chloroform.

The other synthetic opals examined also became transparent on immersion in chloroform, but the size and shape of the residual milky patch and the rate of change were somewhat variable. Black synthetic opals immediately lost iridescence on immersion followed by some loss of turbidity, and then appeared as sombre, dark brown, translucent cabochons sometimes with black spots or other markings. They quickly regained their beauty on removal from the chloroform.

The use of chloroform as an immersion liquid with similar refractive index to opal obviously helps to achieve transparency and it appears that the abundant pores of the synthetics rapidly fill with chloroform—the air being dispersed as bubbles. It would seem that the milky appearance of these opals is directly related to the high porosity, light being reflected or diffused at the surfaces of the minute pores.

For comparison, a series of both black and white natural opals was then immersed in chloroform. In general there was a slight loss of iridescence with an apparent increase in turbidity, and the margins of the stones were, of course, less well-defined when viewed in the chloroform. In the stones examined we saw no spread of transparency as seen in the synthetics and it would appear that in the stones tested the solvent penetrates to a more limited extent or not at all, indicating that the Gilson synthetics are more porous than their natural counterparts which were tested. The fact that the synthetics adhere to the tongue (indicating high porosity) whereas the natural stones tested did not, bears out the differences in porosity.

It is tempting to suggest that behaviour on immersion in chloroform is a useful guide in the testing for Gilson synthetics, but considerable caution should be exercised since chloroform is a very powerful solvent (and anaesthetic!) and could damage the cement of any doublet (its true nature possibly concealed by a setting) subjected to this treatment, and could carry any surface contaminant into the pores of the opals.

Summary

The following properties of Gilson synthetic opals appear to be worthy of note, and taken together should assist in their identification:

1. The stones show a broadly equidimensional mosaic viewed from above or below.
2. Many white synthetic opals show a pronounced columnar structure viewed from the side.
3. Some white synthetic opals show a distinct "dendritic" structure at higher magnifications by transmitted light.

4. By transmitted light the overall pale pinkish-buff matrix colour is interspersed by patches of pale pink, greenish-blue and yellow.
5. By transmitted light there is often a "dried leaves" effect caused by discontinuities between adjacent "grains".
6. In later black and white synthetic opals a "lizard skin" or "fish scale" effect is seen on magnification, both by transmitted and reflected light.
7. Many Gilson opals have high porosity and tend to absorb liquids rapidly, and in this connexion it has been noted that the synthetics tend to stick to the tongue, whereas many natural stones do not to the same extent.
8. Many Gilson opals become transparent on immersion in chloroform (and possibly other solvents also).

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