Rapid Sight Estimates of Diamond-Cutting Quality

Part I

by
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Most gemologists look at diamonds every day. How much of what we see conveys a message? Each diamond brilliant reveals its character at a glance, if the everpresent clues are noted and appreciated.

Large numbers of diamonds are quality graded in the GIA Laboratories each year. In the process of selecting brilliants that met certain preset standards, characteristics associated with particular sets of proportions and facet angles began to become obvious. After further study, it was apparent that pavilion and crown angles and proportions could be judged within very narrow tolerances by examining the stone face up under 10x. To be able to do this is often important to a diamond man, both for selecting goods and for appraising; therefore, becoming familiar with the key characteristics described in this article is a worthwhile pursuit.

The facet angles and proportions of a diamond brilliant determine the percentage of light impinging on the crown that will be reflected as white light or prismatic fire. In its recent courses, the GIA utilizes a method by which proportions may be used to judge accurately the degree to which excess weight has been retained in cutting from the usual octahedral rough. This information is used in a system that determines accurately the price of the stone. By utilizing the methods outlined herein, it is possible to determine the key proportion characteristics of a diamond brilliant quickly without resorting to measurements.

So-called ideal figures for a diamond brilliant are those worked out a number of years ago by an English mathematician, Marcel Tolkowsky, to yield maximum brilliancy consistent with a high degree of fire for light impinging on the crown from all angles; the key angles and proportions of this cut are

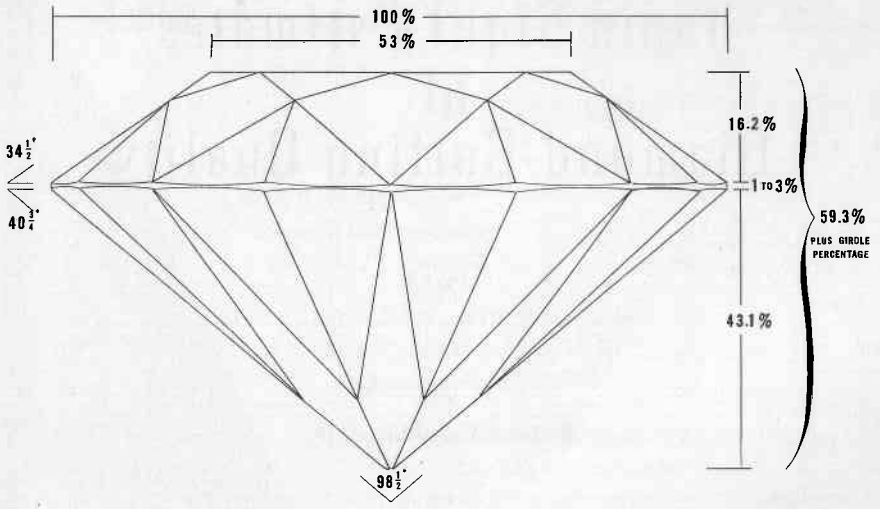


Figure 1a

shown in *Figure 1 a.* Although few stones are cut to these proportions today, many cutters continue to use the angles shown when beauty is their goal. Few ever use a 53% table today, but a number use a 55% to 58% figure, thereby very slightly thinning the crown from the Tolkowsky recommended proportions. Most cutters are using proportions yielding a 60-70% crown.

The ideal cut makes an excellent comparison against which value can be measured, since it provides the least weight yield of any commonly encountered kind of cutting from octahedral rough. An octahedron is the most common diamond crystal form *(Figure 1 b)*. Although many octahedra are modified by forms with more faces than the octahedron, most diamond crystals are basically octahedral in outline.

Departures from Tolkowsky's figures are made to save weight, making possible lower per-carat prices. However, any significant departure is made at the expense of brilliancy or fire or both — and thus, at the expense of beauty. The departures from an ideal shape seen most commonly today are those that make the crown thinner and the table wider. More and more often the pavilion is made deeper. Another common departure is one that leaves unnecessary thickness in the girdle.

The characteristics that identify various proportions and cutting angles can be seen through the table or crown of a diamond under low magnification. Experienced cutters are aware that some brilliants look blackish from above and others watery. Some of them may associate these two characteristics with deep pavilions and very flat pavilions, respectively. However, these features and the characteristics of the many pavilion angles between those so flat they cause

a "fisheye" and those so steep they cause a black center have never been recorded.

A view through the table of a diamond shows a mirror image of the facets of the crown on the pavilion facets. The portion of this crown reflection that is visible depends on the height of the crown and on the angle of the main pavilion facets to the girdle plane. Looking through the table, the mirrored reflection of the crown is imperfectly shown, because of the many planes represented by the different facets of the pavilion. At the center, surrounding the culet in a well-made diamond, is the reflected image of the table. This is surrounded by black images of the star facets, and these, in turn, by less easily identifiable reflections of the near-table portions of the bezel facets. *Figure 2* is a dark-field photograph focused on the reflections of the crown

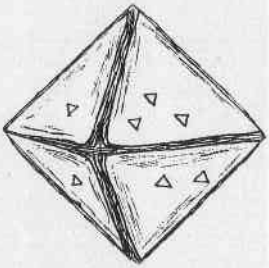
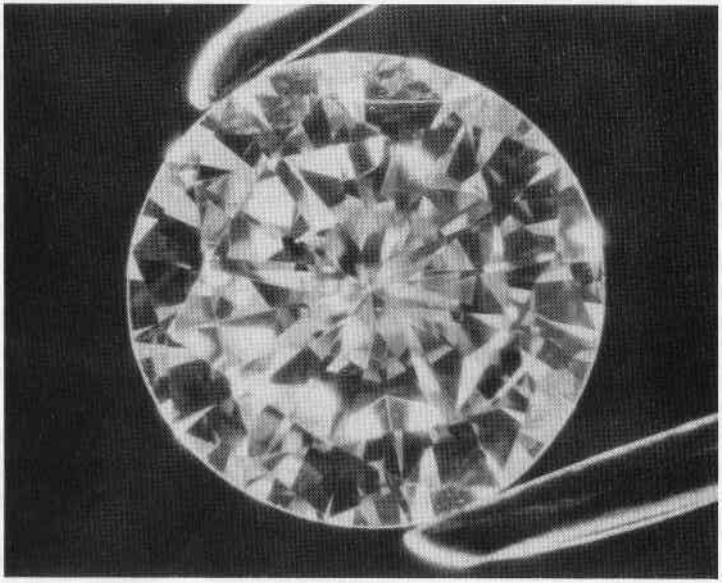


Figure 1b

in the pavilion, as seen through the table. The table reflection occupies over 50% of the table diameter and is seen to be roughly octagonal in shape. It is surrounded by dark reflections that are basically triangular in outline, which represent the star facets. Between the stars, toward the edge of the table, are

Figure 2



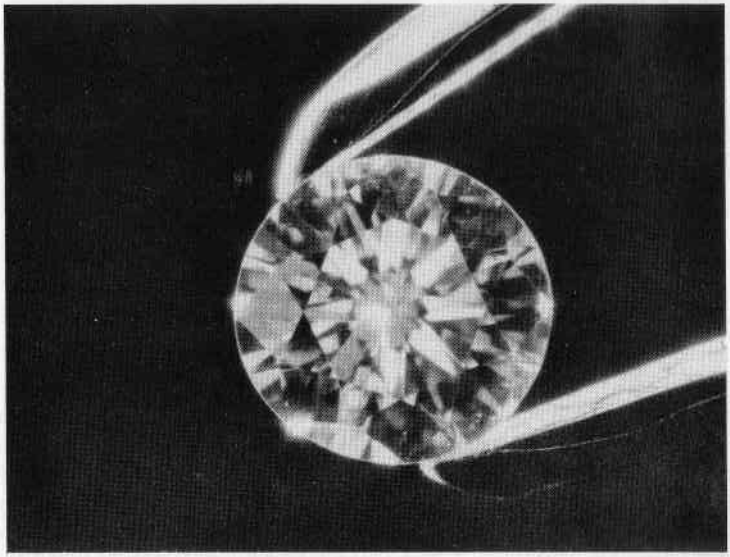


Figure 3

seen brighter reflections of the bezel facets. This photograph was chosen because it shows rather well the distinct table and star reflections. Actually, this stone is somewhat too deep in the pavilion, as is indicated by the large size of the table reflection in relation to the 66% table.

Variations in angles and proportions increase or decrease the area of the reflected crown that is visible through the table and also change the intensity of reflected light. Although these variables and others are interrelated, there are enough differences in the characteristics of different proportions to make it possible to make accurate estimations of any brilliant examined. To an experienced eye, the size, color and position of the table reflection and the evenness of the symmetry are very revealing. If a diamond has a pavilion angle near the ideal 40¾ to 41°, there should be a gray reflection of the table in the center of the pavilion. *Figures 3 and 4,* which will be explained more fully later, show table reflections in brilliants with ideal pavilion angles. The reflections differ somewhat in size because of the height of their respective crowns.

The important factors in visual proportion analysis are: (1) the size of the table reflection, (2) its lightness or darkness (i.e., its position on a white-to-black scale), (3) its position, (4) how much of the crown is reflected in the pavilion when looking through the table, and (5) the position of bright reflections. An explanation of these points and their relationship to a diamond's appearance through the table is the subject of the remainder of this article.

Perhaps the key characteristic is the

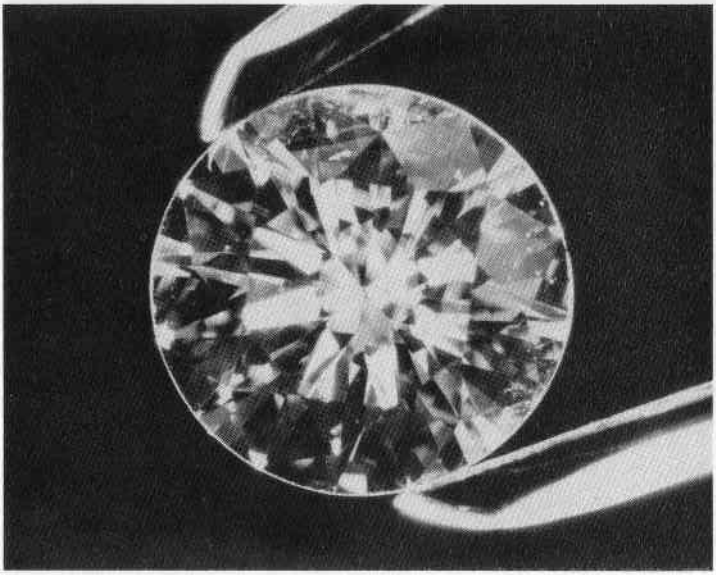


Figure 4

size of the table reflection. It depends on three elements: (1) the size of the table itself, (2) the angle of the pavilion facets to the plane of the girdle, and (3) the distance from the table to its reflection in the pavilion, again relative to girdle diameter.

The size of the table is the first item that is noticed when one looks at the crown from above. If the table is exceedingly large, one can be almost certain that the crown is thin; if it is small, usually the crown is much thicker, and the angles are likely to approach or exceed the ideal 34 to 34½°. Relative crown thickness may be assessed roughly by examining the diamond in a direction parallel to the girdle.

Obviously, the larger the table, other factors being equal, the larger will be its reflection on the pavilion, as seen through the table. More important in judging proportions is the angle of the pavilion facets to the plane of the girdle: other factors being equal, the steeper the pavilion angle, the larger will be the table reflection through the table.

The third important factor is the combination of crown thickness and girdle thickness, which together determine the relative distance of the table reflection from the table itself. The higher the crown, the smaller will be the table reflection on the pavilion facets. Usually, the larger the table, the thinner the crown; and when the crown is thin, the table reflection is relatively close to the table itself, unless the girdle is exceptionally thick. The closer the reflection is to the table, the larger its relative size, other factors being equal.

Since the size of the table reflection in the pavilion depends on more than

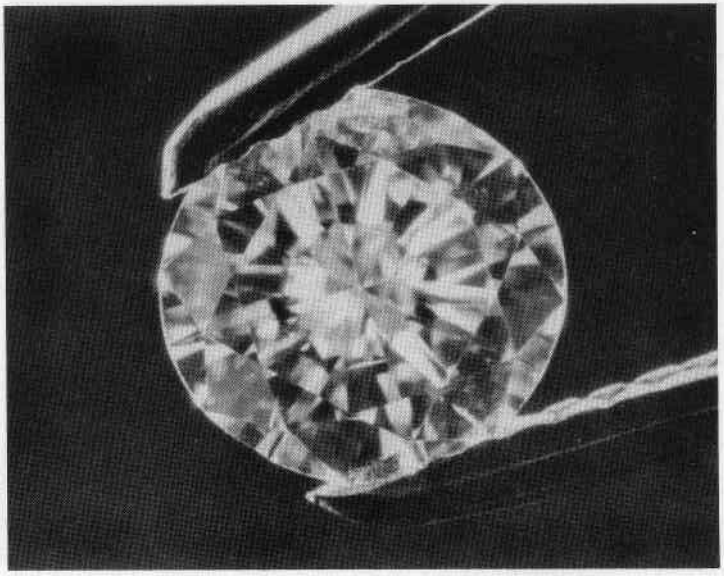


Figure 5

one variable, it might seem at first that it would be difficult to use it in judging proportions; however, there are other related characterictics that help to resolve this problem. It was stated earlier that the steeper the pavilion angle in relation to the plane of the girdle, the larger is the table reflection. Related to this is the fact that, in addition to increasing in size relative to the table size itself, the table reflection darkens with increasing steepness of pavilion angle. When the pavilion angle is very flat, it may be impossible to see a table reflection directly through the table. As long as a table reflection is visible, the lesser the pavilion angle (i.e., the shallower the pavilion), the whiter and brighter will be its reflection. With increasing angle, the table reflection grows larger and darker until, at approximately a 45° pavilion angle, it is completely black. Unless the crown is high, which would tend to make the table smaller, the table reflection covers the whole table when the pavilion angle approaches 45°. Most of these conditions are best described not in words but by photographs that show the conditions as they are seen in diamond brilliants.

(The photographs were taken at 12.5x by Jeanne G. M. Martin, using a special dark-field illuminator and an Exakta 35mm. single-lens reflex camera.)

Figures 3 and 4 show table reflections seen through the table; in this case, both pavilion angles are ideal. The distinct difference in size of the reflections relative to table size is accounted for by the higher crown of the diamond pictured in *Figure 3*. The thin crown of the brilliant in *Figure 4* increases the

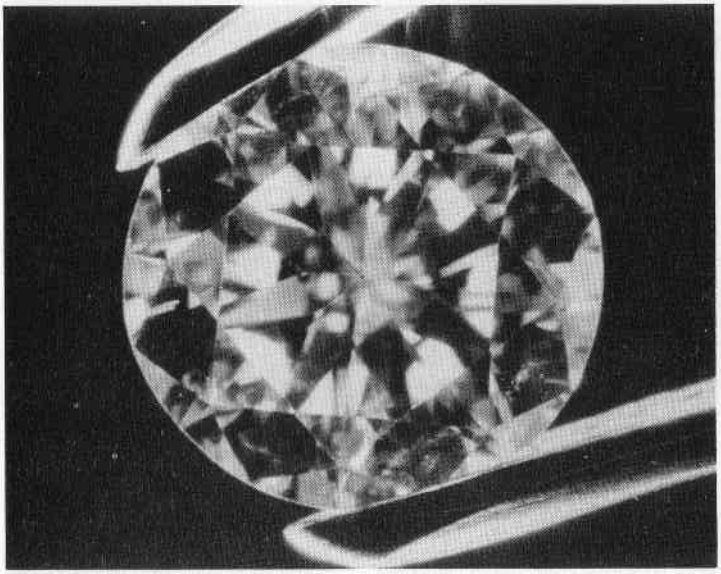


Figure 6

size of the table reflection. In *Figure 5,* the table reflection is distinctly larger; this brilliant has a flat crown and a pavilion angle near 42°. In general, *Figures 5 through 10* show a progression in depth of the pavilion; that is, an increasing angle of the pavilion main facets to the girdle. They trend toward a darkening of the table reflection and an increase in its size relative to the size of the table. *Figure 6* shows a pavilion that is only very slightly too deep, so the table reflection is neither very large nor very dark. In *Figure 7,* the table reflection is dark gray, and in *Figure 8* it is very dark. *Figure 7* has a larger table and thinner crown, so its table reflection is larger but only very slightly darker; its pavilion angle is only a fraction of a degree greater than that in *Figure 6.* In *Figure 8,* the diamond pictured has a distinctly deeper pavilion; the angle is near 42½°, instead of the ideal 40¾ to 41°. Note that the table reflection in *Figure 8* is large, covering much of the table, and that the area around it is bright. *Figure 9* shows a diamond with a larger table reflection, the center of which is dark. The large table reflection is caused by the combination of a large table, a thin crown and a deep pavilion. In this case, the proportions are approximately as follows: a 11% crown, a 46% pavilion and a 2% girdle. The crown angle is flattened to near 31° and the pavilion angle is deepened to 42½°. The diamond shown in *Figure 10* has a slightly deeper pavilion (43°); the total depth is 61%. The table reflection extends almost to the edge of the table. The diameter of the table is 61% and the crown is thin, but not as thin as that in *Figure 9.* The larger table reflection

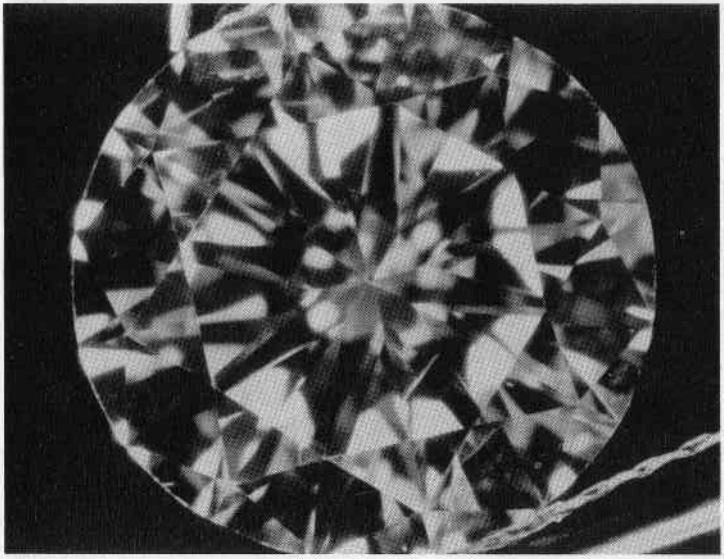


Figure 7

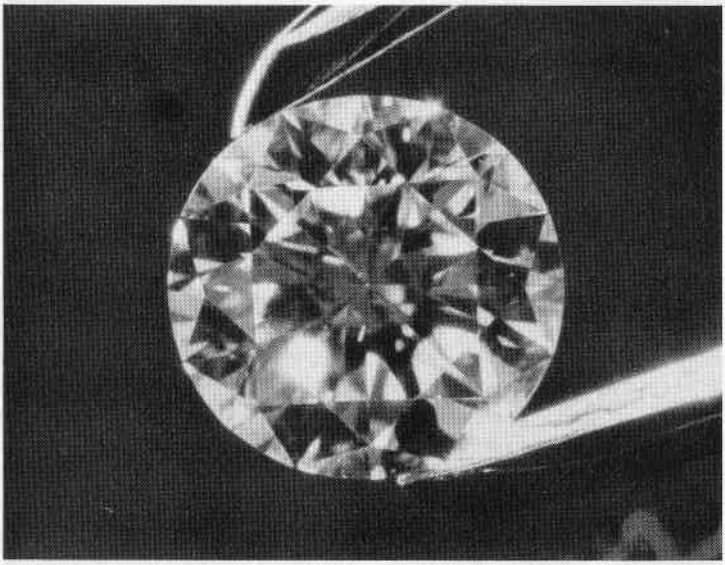


Figure 8

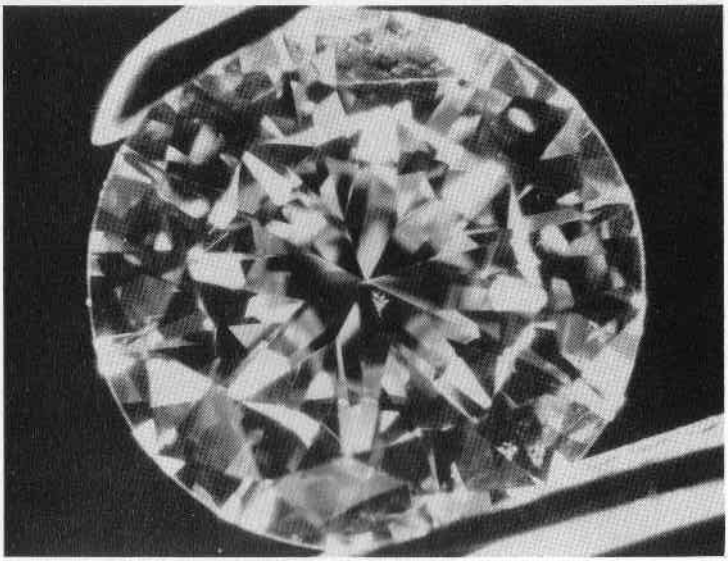


Figure 9

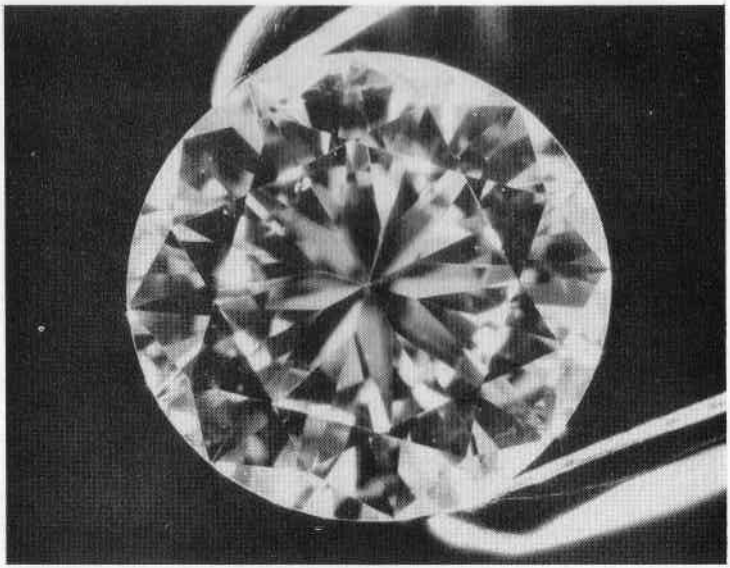


Figure 10

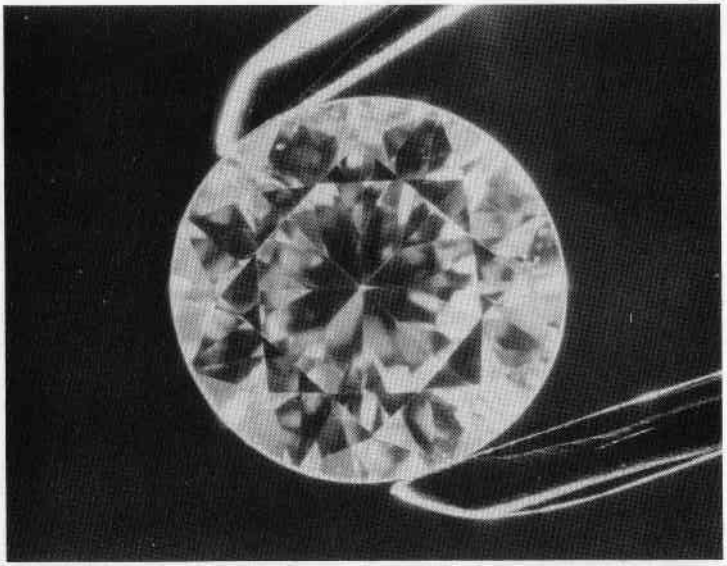


Figure 11

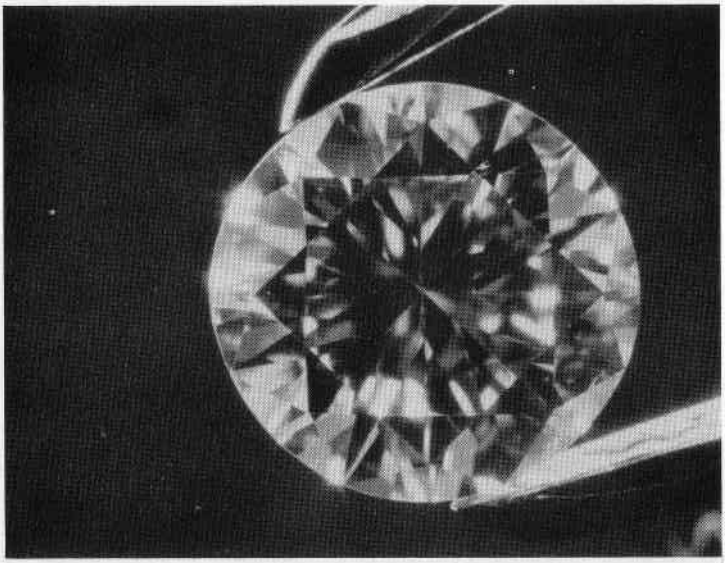


Figure 12

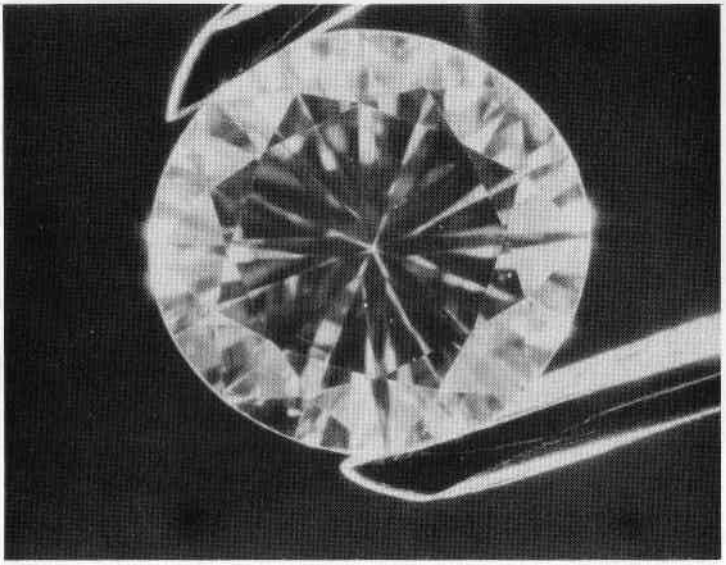


Figure 13

is caused by the deeper pavilion.

In *Figure 11,* the whole area under the center of the table is black, with the exception of a few bright reflections at the edge. This pavilion angle is slightly greater than that in *Figure 10* but the crown is thicker, reducing the size of the table reflection to comparable size in relation to the width of the table. The total depth of the stone is greater: 63% of the girdle diameter. With the exception of a few bright reflections along one side, the black table reflection in *Figure 12* covers the whole table. Despite the fact that the pavilion angle is 43° +, its total depth (62.7%) is slightly less than that of the preceding figure, because the crown angles are slightly flatter. The complete table area of *Figure 13* is covered by black reflection of the table, so that no other crown-facet reflections are seen through the table; in addition, the crown is very flat. In this case, the pavilion angle is 45½° and the bezel angle is 30°. To summarize, *Figures 4 through 13* show various steps in a deepening pavilion; however, those from *Figure 5 through Figure 8* show very gradual changes from the ideal figure. *Figures 9, 10 and 11* are all significantly overdeep in the pavilion and are on the borderline of being black centered. *Figures 12, 13 and 16* are examples of stones that face up with a black center, reducing the appearance of brilliancy materially. This is easily seen by the unaided eye, whether the diamond is mounted or loose.

Diagnosis of the table reflection is made easily on mounted as well as loose goods. The diamond in *Figure 14* has an enormous 71% table and the crown angle is flat, as well. The gray-table

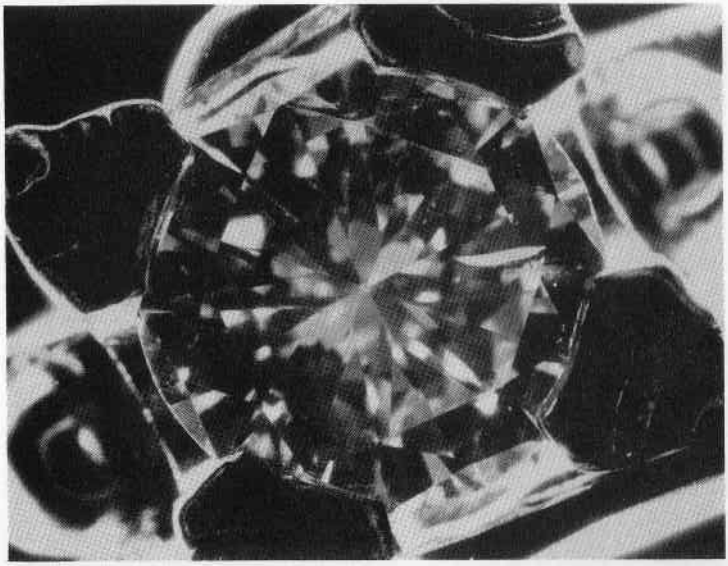


Figure 14

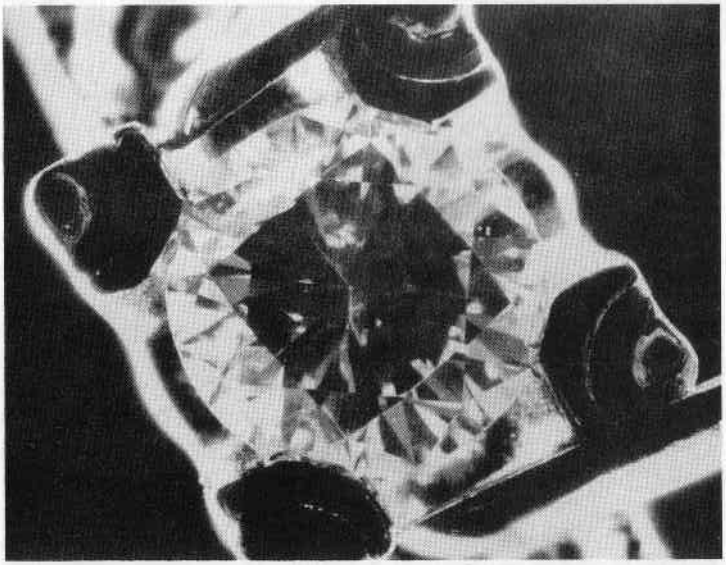


Figure 15

reflection suggests that the pavilion angle is close to the ideal 41°. Although the total depth of the stone is near 54%, the thickness of the thin crown, plus a thick girdle, totals only 11%.

Even though the diamond in *Figure 15* is mounted, it is obvious that it has a black center; its depth is 67%, despite a 64% table and a thin crown. This condition, as in *Figures 12 and 13,* is clearly evident to the unaided eye.

In order to gain first-hand familiarity with the effects on appearance caused by differences in angles and proportions, many diamonds should be examined. In addition to the direction through the table, they should be viewed parallel to the girdle, to check girdle thickness and crown angle. In the beginning, diameter and depth measurements should be made as a confirmation of visual findings. An alternative is to utilize a Proportion Viewing Screen for initial confirmation of interpretations of appearances seen through the table.

Once the diamond man becomes familiar with the effects of minor variations, measurements will be unnecessary.

If the pavilion angle is so flat that no table reflection is visible directly through the table, the area under the table may appear dark, but a reflection of the girdle is visible at the edges of the table. This will be pictured and discussed in a continuation of this article in the Winter, 1962, issue, which will consider the effects of flat pavilions, poor symmetry and other conditions.