

Describing diamond beauty - assessing the optical performance of a diamond

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Abstract: A diamond's optical performance is the visual interaction of the diamond reflecting and refracting the surrounding light to the viewer. It is this performance of the diamond that results in its beauty. This work advances the idea that the best diamond cuts 'evolved' to have the highest optical performance in a variety of typical viewing and illumination circumstances. Current and historical descriptors of diamond beauty and performance are reviewed. The rationale is put forward for the need to augment the current, single, quantitative measure of brilliance - light return intensity with the qualitative aspect of 'contrast brilliance'. Contrast brilliance is explained, and illustrated with diamond photography. The relationship between contrast brilliance and scintillation is also examined.

Introduction

When a gemmologist or appraiser evaluates a diamond, it is rated in four categories: cut, colour, clarity and carat weight. These characteristics, known as the 4Cs, are used in assessing the value of a diamond along with its rarity and beauty.

When the discussion of diamond qualities turns to cut there is general agreement that this C has the greatest influence on the diamond's beauty. The term cut may bring to mind any of three features of a polished diamond.

1. Shape such as round, pear, oval, cushion or rectangular.
2. Style of facet pattern such as radiant, step cut or princess cut.
3. The angles and proportions of a particular style and shape.

This article confines the meaning of cut to the angles and proportions of a particular shape and style of a diamond, such as the familiar 57-facet round brilliant.

There are several elements to the quality of cut. Judgement of these elements falls in two distinct categories.

The first category is craftsmanship. Examples of craftsmanship are perfection of polish, facet meet points, facet alignment, symmetry, facet angles and proportions. Most grading of diamond cut being done to today makes judgements that fall within this category.

The second category is an assessment of the extent to which all the various factors of craftsmanship have or have not actually resulted in a beautiful diamond. This category is 'direct assessment' of aspects of diamond beauty as opposed to the indirect assessments of beauty in the first category. Two important examples that fall in this second category are measures of brilliance and fire.

The quantity together with the 'quality' of the light returned from a diamond to the eye

of the viewer is critical to the viewer's judgement of the diamond's performance and beauty.

Diamond beauty - brilliance, fire and sparkle

An important property of a well-cut diamond is its ability to reflect colours and light from a broad range of surrounding directions and angles. A well-cut round brilliant diamond reflects and refracts the surrounding panorama of light to the viewer in a mosaic - even artistic - composition possessing vibrancy and vitality.

In order to describe the beauty of a diamond we need words that express what we observe of a diamond's optical interaction with the panorama of light that surrounds it. This article refers to the visual interaction of the diamond reflecting and refracting the surrounding light to the viewer as the 'optical performance' of the diamond. This optical performance results in the beauty of a diamond and is unique. The beauty that results from this unique performance has stirred emotions and engendered devotion unsurpassed by any other gemstone.

Historical and contemporary terms describing diamond beauty

Brilliance, fire and scintillation (sparkle with movement) are three words that have evolved to describe diamond beauty. These are the terms currently used in the diamond industry by gemologists, diamond cutters and sellers to convey aspects of diamond beauty with simplicity and clarity.

The most beautiful diamonds have "the most vivid fire and the greatest brilliancy" proclaimed Marcel Tolkowsky (1899-1991) was the historical influential Belgium diamond cutter and mathematician who was credited with the key design proportions of the ideal round brilliant. Both he and his contemporaries used these two terms, brilliance and fire, to describe the beauty of a diamond.

The third descriptor of diamond beauty called scintillation has since been added.

Combined with 'contrast brilliance', a related forth aspect of diamond beauty introduced by this article, the jeweller is armed with the necessary vocabulary to explain why one diamond has superior beauty to another.

Brilliance

The *Diamond Dictionary* (Gaal, 1977) defined brilliance as: 'the intensity of the internal and external reflections of white light to the eye from a diamond or other gem in the face-up position.' It is important to note here that brilliance was being defined as the intensity of light return. This brightness measure which is a single value lacks any detail of the important variations in intensity across the diamond.

Fire

An important aspect of the quality of light return is the dispersion of light into rainbow colours, which are seen as the diamond's 'fire'.

Scintillation or sparkle

When diamond beauty is characterized by only the two primary aspects, fire and brilliance, all aspects other than those related to fire would necessarily fall under the term brilliance. With the definition of brilliance narrowed to the single quantitative measure of light return intensity, other descriptors are needed for the various qualitative aspects of diamond brilliance.

One such quality is called scintillation – the word used to describe sparkle occasioned by movement of the diamond, the illumination or the observer. This quality of light return is the sharp, on-off, bright-dark sparkle or flashes of light 'dancing' from the crown of the diamond.

The historical use by Tolkowsky and others of the word 'life' has a meaning similar to scintillation.

These three terms used today to describe diamond beauty - brilliance, scintillation and fire - were the respective qualities that Tolkowsky noted in *Diamond Design* (Tolkowsky, 1919, p.24). He said: "The general trend of European diamond polishing is the constant search for greater brilliancy, more life, a more vivid fire in the diamond, regardless of the loss of weight." These are the qualities that diamond cutters of his day were seeking in their search for the most

beautiful diamond cut, maximizing these qualities of diamond beauty has remained the goal of diamond cutters from that time to the present.

Contrast quality of brilliance

This article advances the idea that another descriptor is needed to augment the current characterization of diamond brilliance. This additional descriptor is distinct from the single, quantitative definition of light return intensity.

Why is this additional descriptor of brilliance needed?

Human perception of brilliance goes beyond the intensity returned from the crown of a diamond. Intensity variation or contrast in light and dark areas across the diamond gives it an aspect of brilliance that has been described as 'snappy', 'dramatic' and by Bruton (1978, p.227) as 'hard' or 'sharp'. These descriptions are the opposite of 'watery' and 'glassy' used in *The Diamond Dictionary* (Gaal, 1977) to describe the weak appearance of a 'fish-eye' diamond.

In this article the term 'contrast brilliance' is adopted to describe this aspect of brilliance. The term is needed because this aspect of diamond beauty influences our judgement of which diamond cuts are the most brilliant. Recognizing this contrast aspect of brilliance gives us a means for explaining why one diamond cut may be perceived as less brilliant than another even though it may have had an equal or greater light return intensity.



fig 1

It is worth noting that an emerald cut diamond is normally perceived to be less brilliant than a round cut mainly because it has less contrast brilliance even though it may have a similar intensity of light return.

The contrast aspect of brilliance is related to a property of human vision called 'simultaneous contrast'.

Simultaneous contrast

When a bright reflection is simultaneously in contact with a dark one, our vision enhances the perception of this difference, and the bright reflection looks brighter because of its proximity to the dark reflection.

One consequence of this phenomenon is our general preference for greater contrast in a scene. Note the example in Figures 1 and 2. Most people would agree that the greater contrast in Figure 2 makes the photograph more appealing.

The following experiment is designed to illustrate and support the idea that contrast influences the perception and judgement of brilliance. The diamond image in Figure 3 was printed with maximum contrast. The same diamond image in Figure 4 was printed with less contrast between the bright reflections and the adjacent dark reflections.

Using the current quantitative definition of light return intensity, the Figure 4 image would emerge as having the greater brilliance. However, we would probably all perceive the Figure 3 diamond image as more brilliant. The perception of greater brilliance in Figure 4 is due to the white reflections in



fig 2

Figure 1: Photograph of a scene printed with less contrast.

Figure 2: Photograph of Figure 1 printed with greater contrast.

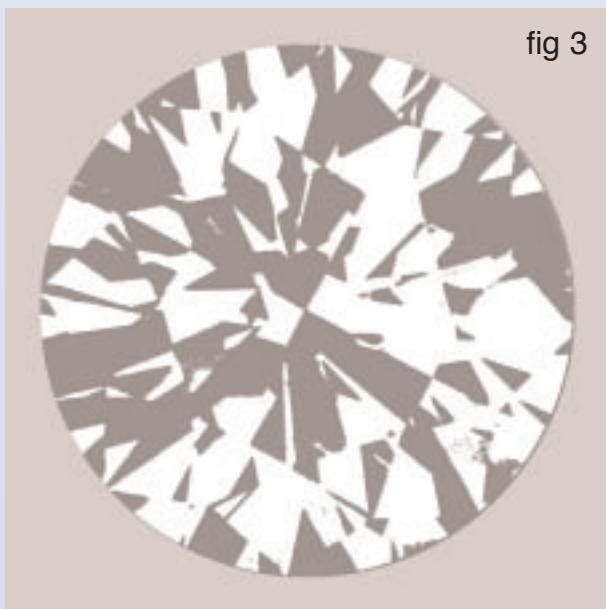


Figure 3: Diamond image printed with maximum contrast; it has a lower light-return intensity than the image in Figure 4.

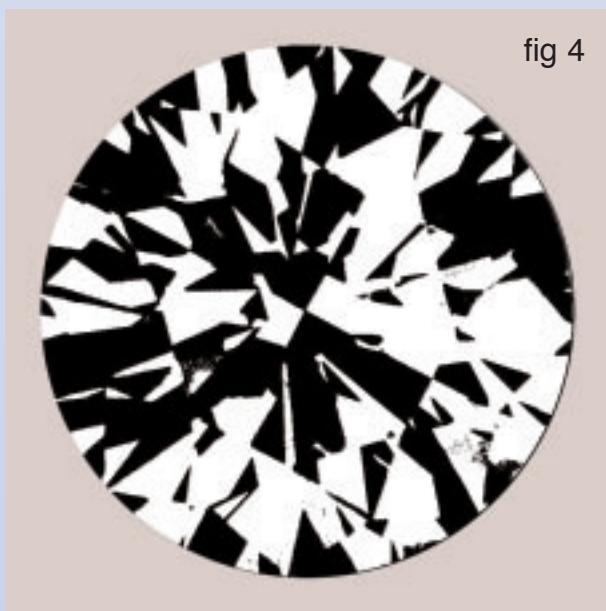


Figure 4: Diamond image printed with less contrast but a greater intensity of light return than that in Figure 3.

that diamond appearing brighter and more intense because of greater contrast with the dark reflections. Actually, the white reflections in both *Figures 3* and *4* have the same intensity.

This demonstration illustrates and supports the influence and importance of contrast to the perception and judgement of brilliance.

Dependence of diamond beauty upon viewer and illumination circumstances

Both intensity and contrast aspects of brilliance depend not only upon the cut of the diamond, but also its illumination.

Figures 5 and 6 are two photographs of the same diamond illuminated in different ways. In *Figure 5* the diamond was uniformly illuminated from above with no obstruction from the presence of the viewer. This resulted in a diamond image with high light return intensity but low contrast. This type of uniform illumination results in lack of contrast and an unfamiliar and undesirable diamond appearance.

The illumination of the diamond in *Figure 6* consisted of several bright lights mostly positioned at high angles over the diamond. This high-contrast lighting resulted in a diamond image exhibiting high contrast brilliance.

Figures 5 and 6 have demonstrated that the light intensity and contrast aspects of brilliance are interrelated with the diamond's illumination. It is often overlooked that the perception of diamond beauty in all its aspects is influenced by the character of the illumination. It is crucial to note that the perception that a diamond is beautiful depends upon the ability of the cut to take full advantage of the lighting under which it is being viewed.

Evolution of excellence in diamond cutting

The development of diamond cutting judged most beautiful evolved through 'cut and try' experimentation. Because success was judged under standard or typical illumination (discussed below), the finest cutting inevitability evolved to have the greatest beauty in those typical viewing and non-uniform illumination circumstances.

This article advances the idea that diamond cuts judged to have ideal optical performance and beauty possess brighter, more evenly distributed, higher contrast reflections in a variety of typical illumination circumstances.

The value of a measure of diamond beauty is how well it agrees with human judgement.

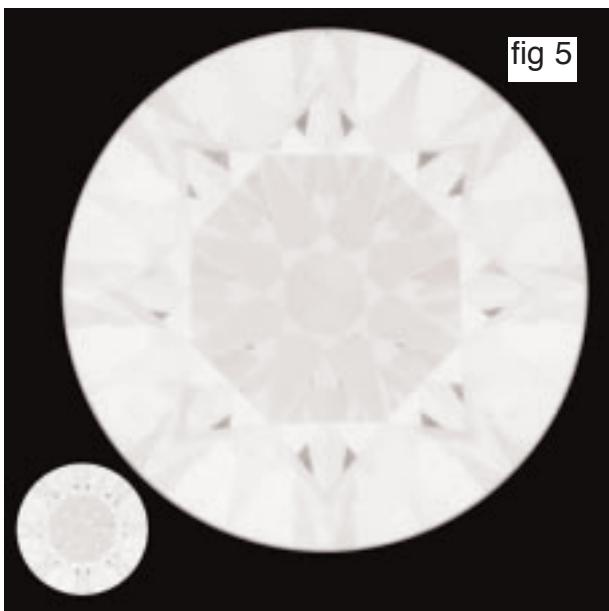


Figure 5: Diamond exhibiting high light return brilliance but low contrast brilliance.

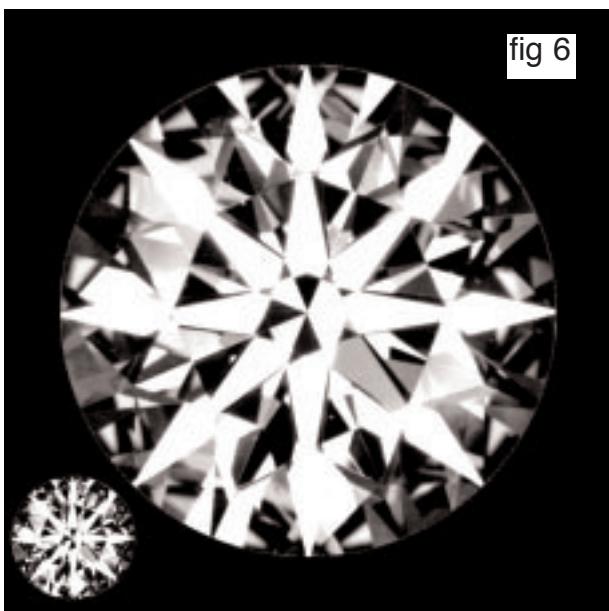


Figure 6: Same diamond as that in Figure 5 exhibiting high contrast brilliance.

“Perception of beauty is everything.” To be meaningful and agree with human judgement, measurements of diamond beauty should be made in typical illumination circumstances. Measurements of beauty in atypical lighting can give high scores to cuts that have lower scores in typical illumination. For example, measurements of brilliance in uniform lighting (such as that illuminating the diamond in *Figure 5*) can give high brilliance scores to cuts that have lower perceived brilliance in typical illumination.

Typical illumination and viewer obstruction

There is a short list of key characteristics of typical viewing circumstances that has influenced the evolution of the most beautiful and highest performing diamond cuts. One key, ever-present feature of typical illumination is the physical presence of the viewer in the diamond’s panorama of illumination. Although this ‘viewer obstruction’ at first sounds as though it is a disadvantage, it most often adds contrast to the illumination that is favourable to well-cut diamonds. For example, in *Figures 7 and 9* where there is open sky



Figure 7: Face-up photograph of a 2.25 ct diamond exhibiting brilliance and blue fire occasioned by bright, overcast sky partially obscured by the viewer.

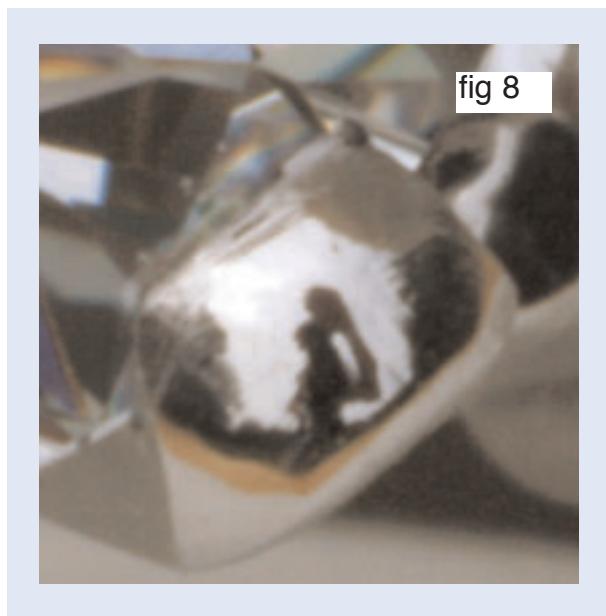


Figure 8: The pattern of illumination of the diamond in Figure 7 as seen mirrored in the ring’s prong. The overcast sky is partially obscured by the silhouette of the viewer’s head, torso and outstretched hand and arm.

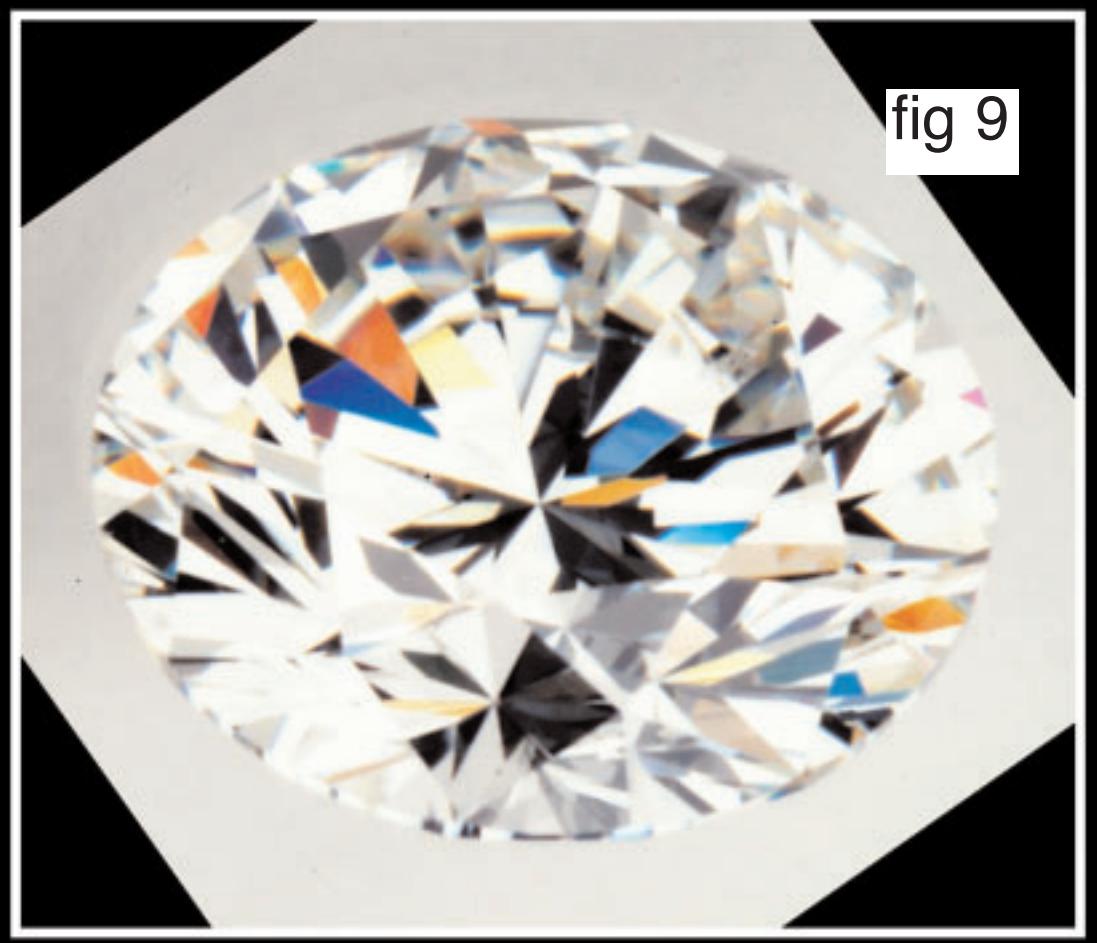


fig 9

Figure 9: Tilted round brilliant cut diamond displaying fire and contrast brilliance under the partially obscured illumination of bright, overcast sky.

illumination, it is the viewer obstruction that introduces contrast to otherwise diffuse illumination. This is effectively illustrated by the image in the ring's prong in *Figure 8* which acts as a convex mirror reflecting the entire panorama of illumination.

The dark appearance of the viewer in the prong is the factor providing the primary contrast in illumination. It is the synergy of the diamond's cut taking advantage of this contrast in illumination that produces the contrast and fire present- in the diamonds in *Figures 7, 9 and 10*. Without the contrast introduced by viewer obstruction, even an ideal cut would have a somewhat lifeless appearance, similar to that of the diamond in *Figure 5*.

The factors that characterize this contrast quality of brilliance are the sharpness, number, sizes and uniformity of the distribution of the diamond's mosaic pattern of reflections.

How can we assess this new concept of contrast brilliance?

The answer is simple. All these aspects may be observed and evaluated from stationary images or 'snapshots' of a diamond under a duplicate of typical viewing and illumination circumstances. Because diamonds are most often viewed in the face-up position, the most important, one frame, snapshot to examine for contrast brilliance is this normal, face-up view.

Relationship between the contrast quality of brilliance and scintillation

What is the difference between contrast brilliance and scintillation? Clearly, the diamond's mosaic pattern of reflections has

aspects common to both contrast and scintillation such as those already mentioned. However, the contrast quality of brilliance is the diamond's 'static contrast', whereas scintillation is the 'dynamic contrast' due to movement. Contrast brilliance is one frame or snapshot of the moving picture of scintillation. In fact, the change in contrast brilliance with movement from one movement to the next is scintillation. Contrast brilliance and scintillation are perceptually and mathematically related in this way. (Mathematicians may recognize scintillation as the partial derivative of contrast brilliance with respect to movement)

Conclusions

These examples, illustrations and photographs support the need for the additional descriptor of contrast brilliance. Contrast brilliance complements the light return intensity aspect of brilliance, which is the current widely used definition.

Recognizing this stationary aspect of brilliance gives us a means for explaining why one diamond cut may be perceived as less brilliant even though it has an equal or greater intensity of light return.

The established language for describing diamond beauty includes the terms brilliance, fire and scintillation or sparkle. Contrast brilliance adds a second dimension to the measure of brilliance, which is currently confined to the intensity of light return. Recognition of this additional quality aspect of brilliance helps explain why one diamond cut is preferred over another.

References

- Bruton, E., 1978. *Diamonds*. 2nd edn. Chilton Book Co.
Radnor, PA. 532 pp
- Gaal R.A.P., 1977. *The Diamond Dictionary*. 2nd edn.
Gemological Institute of America, California. 342
pp
- Tolkowsky M., 1919. *Diamond Design*. Spon &
Chamberlain, New York. 104 pp