

A NEW ERA FOR OPAL NOMENCLATURE

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ABSTRACT

Opal is a relatively common mineral species that is found in many locations world wide. For many years a reason for the spectacular phenomenon known as *play-of-colour*, as seen in precious opal, remained a well hidden secret. It was not until the 1960s that Australian scientists working at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) used a new instrument now known as the electron microscope to reveal the inner structure of opal and how this is responsible for generating the *play of colour* of precious opal.

Opal often was referred to as a 'semi-precious gemstone', until unique Australian black opal was discovered and successfully marketed. Today, all varieties of precious opal, which are mined in the Australian states of New South Wales, South Australia and Queensland, support a \$A500 million per year industry.

One problem that the opal industry has been required to face, however, is how does one describe a gemstone that occurs both with and without a *play-of-colour*, in almost every colour of the rainbow, in every tone of lightness and darkness from black to white, and in every degree of transparency from opaque to perfectly transparent. Also this unique gemstone displays differences in mineralogy that reflect the varying geological environments in which it forms.

The opal nomenclature that follows is a result of three years of striving within Australia's opal industry to achieve co-operation and to formulate a nomenclature for opal which is accepted uniformly throughout the industry.

in this gemstone. Aspects of this long-running discussion can be seen in the long list of papers published throughout the forty year history of *The Australian Gemmologist*. But, how to best describe opal (arguably the most beautiful of gemstones) has been a contentious and difficult issue for a very long time — and may well remain so for some time to come.

However, as a consequence of factors such as: growing international and local awareness of opal as a major Australian resource; the emergence world-wide of a real desire to standardise all terminology related to gemstones; and the ever growing number of synthetics and imitations that are appearing in world markets; it has become necessary to agree on some well based concepts of how a unique gem material, such as opal, should be described.

It was late in 1993 that the Australian Gemstone Industry Council requested the then President of The Gemmological Association of Australia (GAA), Grahame Brown, to initiate investigations into the possibility of establishing a uniformly accepted nomenclature for opal. After a short time, a working sub-committee of the GAA was formed that consisted of representatives of The Gemmological Association of Australia, the Australian Gem Industry Association (AGIA), and the Lightning Ridge Miners Association (LRMA). Now, after three years of discussion, correspondence, and a plethora of drafted documents, and what seemed to be a never ending train of ideas and criticisms, a final draft nomenclature has been agreed-to, ratified, published, and is presented in this paper.

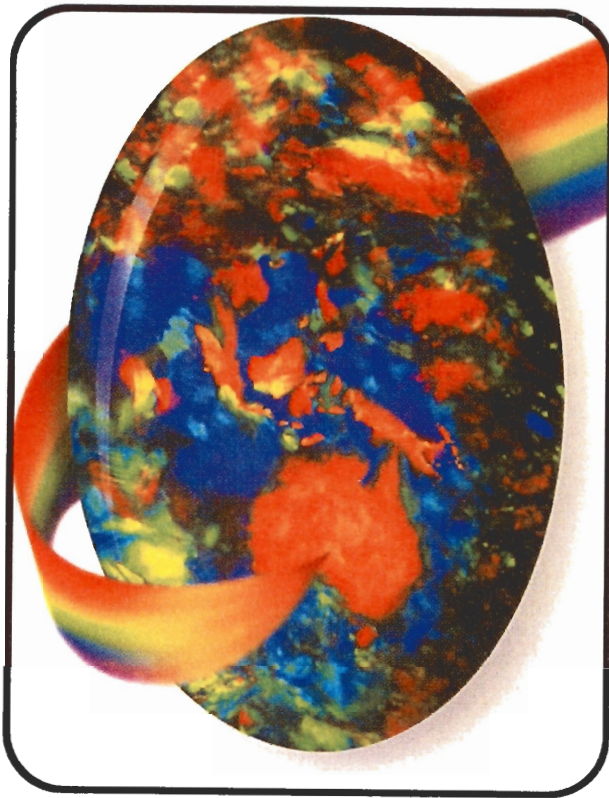
The Australian Gemstone Industry Council (AGIC) has accepted this nomenclature in its final draft, as has the GAA's 1996 and 1997 Federal Conferences in Tasmania and Perth — albeit with one or two small amendments to the final draft. Now the AGIC hopes to actively progress production of a full colour publication and video on this opal nomenclature for distribution on a world-wide basis over the next twelve months.

As Chairman of the GAA's Opal Nomenclature sub-committee I would like to express my gratitude to Jack Townsend (South Australia), Kathy Endor (Queensland) and Andrew Cody (Victoria) for their untiring efforts and fruitful discussions. Also, this author wishes to express his appreciation for the work and constant liaison of the AGIA sub-

INTRODUCTION

For many years the terminology and nomenclature used to describe opal has been widely discussed and debated by gemmologists and those members of the gem and jewellery industry who have an interest

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AUSTRALIA'S NATIONAL GEMSTONE

committee members Glenn McKean, Drago Panich, Peter Sherman, and Peter Evans, as well as the generous support and hospitality offered by members of the LRMA — in particular Joe Schellnegger, Maxine O'Brien, and Frank Palmer.

I would encourage all members of the GAA to read and to use this nomenclature — in their every day activities, such as buying and selling, and in scientific correspondence and lectures. This nomenclature remains, according to GAA Past President Ronnie Bauer and the AGIA's Andrew Cody, a 'living document'. As time passes there will be, no doubt, more discussion and criticism of this nomenclature. This will be most welcome, as are any questions — all of which may be forwarded in writing to the GAA's Opal Nomenclature Subcommittee either care of the Federal Office of the GAA at P.O. Box A791, Sydney South NSW 1235, or direct to the author at P.O. Box 692, Sutherland NSW 2232.

The nomenclature and classification of opal, that follows, is reproduced, *verbatim*, from the Resolutions of the Federal Council of the Gemmological Association of Australia (dated 17th May, 1997).



OPAL NOMENCLATURE AND CLASSIFICATION

INTRODUCTION

Opal is Australia's National Gemstone. Australia produces 95 per cent of the world's supply of precious opal. This nomenclature encompasses all types and varieties of opal. It provides a standardisation of terminology, but does not establish any methodology of valuation.

The Australian Gemstone Industry Council Inc., in collaboration with the Australian Gem Industry Association Ltd, The Gemmological Association of Australia Ltd, the Lightning Ridge Miners Association Ltd, and the Jewellers Association of Australia Ltd, has produced the following nomenclature for the classification of opal.

OPAL CLASSIFICATION

Opal is a gemstone consisting of hydrated amorphous silica with the chemical formula $\text{SiO}_2 \cdot n\text{H}_2\text{O}$. There are two basic forms of opal described by visual appearance.

Precious Opal – is opal which exhibits the phenomenon known as *play-of-colour* (Figs. 1A-D), which is produced by the diffraction of white light through a micro-structure of orderly arrayed spheres of silica.

Common Opal and Potch – is opal which does not exhibit a *play-of-colour* (Fig. 2). The distinction between common opal and potch is based on their formation and structure. Potch is structurally similar to precious opal but has a disorderly arrangement of its silica spheres. Common opal shows some degree of micro-crystallinity.

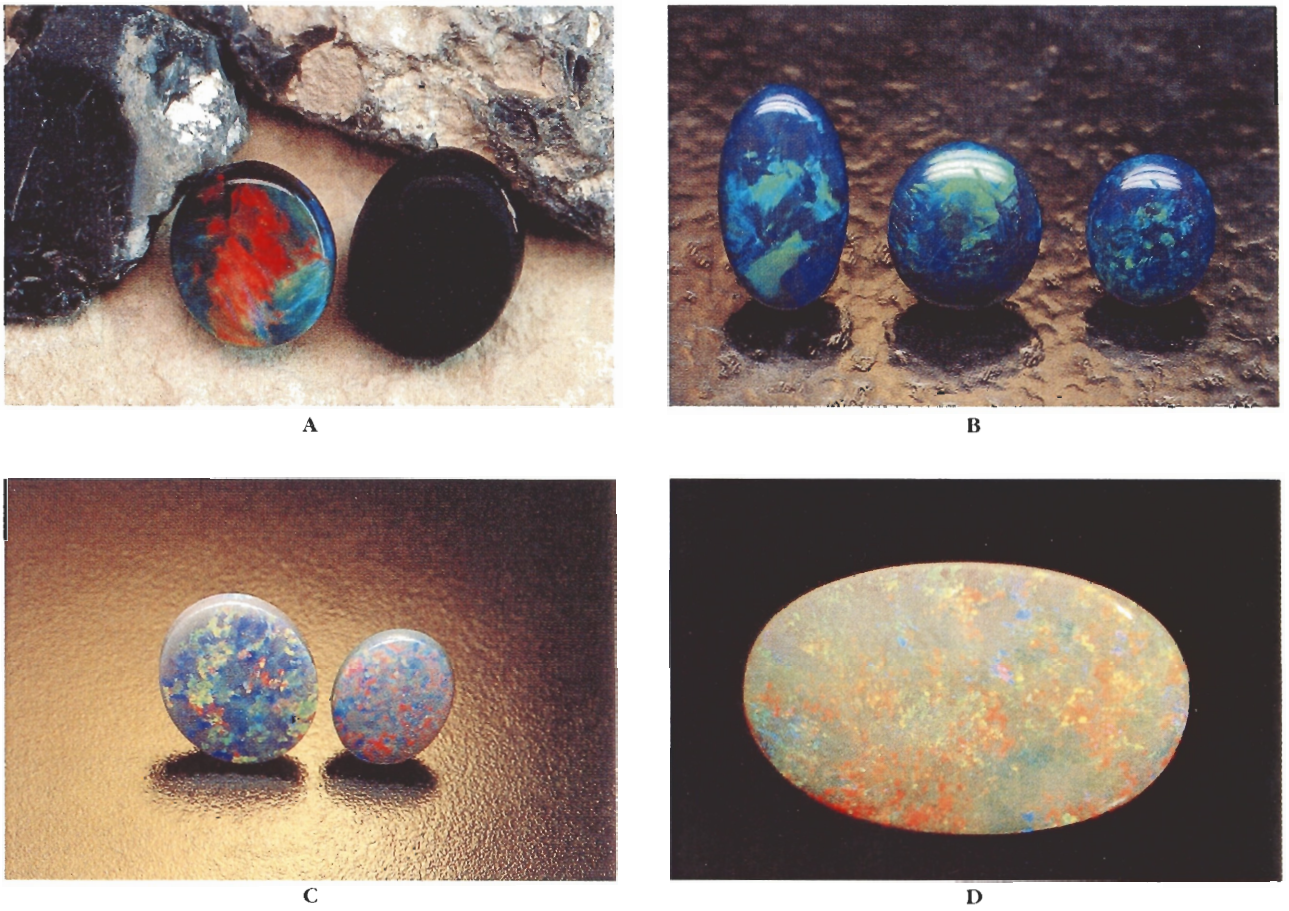


Fig. 1. Black, dark and light precious opals displaying a strong *play-of-colour*. (A) Black opal of N2 body tone and a dominant red-orange *play-of-colour*. (B) Black opal of N3 body tone and a dominant blue-green *play-of-colour*. (C) Dark opal of N5 body tone and a green *play-of-colour*. (D) White opal of N1 body tone and a red-blue *play-of-colour*. (Photographs, R. Weber).

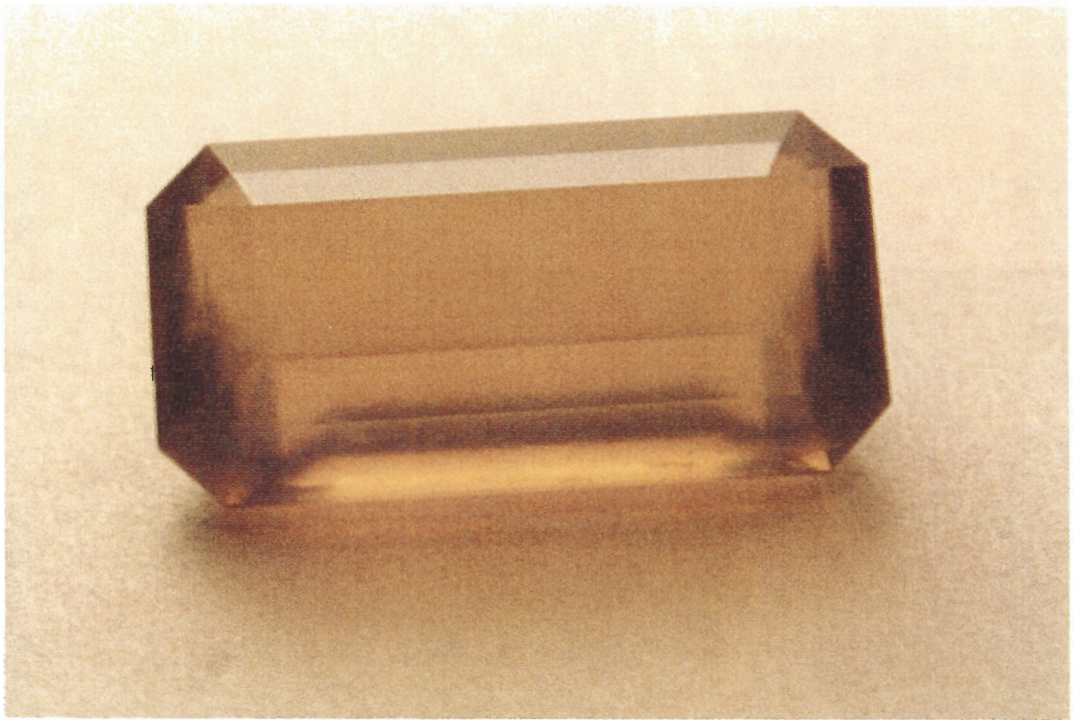


Fig. 2. A faceted common 'sun' opal from Australia. (Photograph, G. Brown).

TYPES OF NATURAL OPAL

Natural opal is opal which has not been treated or enhanced in any way other than by cutting and polishing. There are three types of natural opal, with varieties described by the two characteristics of *body tone* and *transparency*.

Natural Opal Type 1 – is opal presented in one piece in its natural state apart from cutting or polishing, and is of substantially homogenous chemical composition. (See figure 3A).

Natural Opal Type 2 – is opal presented in one piece where the opal is naturally attached to the host rock in which it was formed and the host rock is of a different chemical composition. This opal is commonly known as *boulder opal*. (See figure 3B).

Natural Opal Type 3 – is opal presented in one piece where the opal is intimately diffused as infillings of pores or holes or between grains of the host rock in which it was formed. This opal is commonly known as *matrix opal*. (See figure 3C).



A. Natural opal type 1 (All opal)



B. Natural opal type 2 (Boulder opal)



C. Natural opal type 3 (Matrix opal)

Fig. 3. Types of natural opal. (A) Natural opal type 1 (B) Natural opal type 2 (C) Natural opal type 3. (Photographs, R. Weber).

VARIETIES OF NATURAL OPAL

The variety of natural opal is determined by the two characteristics of *body tone* and *transparency*.

Body Tone

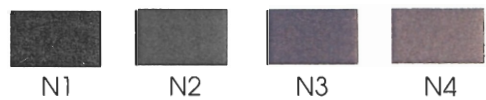
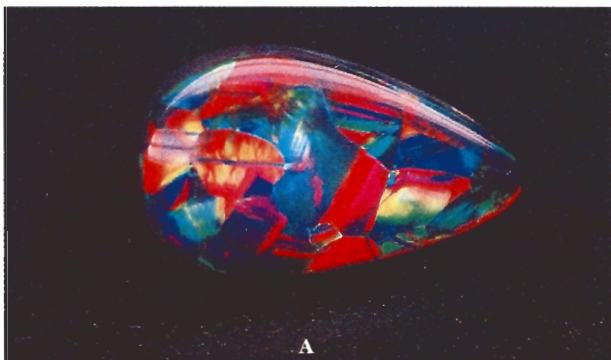
The *body tone* of an opal is different to the *play-of-colour* displayed by precious opal. *Body tone* refers to the relative darkness or lightness of the opal, while ignoring its *play-of-colour*. This is assessed on a Scale of *Body Tone* (Fig 4.).

The boxes (below) comprising this scale, represent approximate values of body tone in equal intervals from black to white. This arrangement is in agreement with all known scales of tone used in colour science, and is well illustrated in the commercially available *Rock-color Chart*[†] produced by the Geological Society of America. An AGIA scale of *Body Tone* is being developed, using computer-generated graphics, and when available, will correlate with the GSA *Rock-color Chart*.

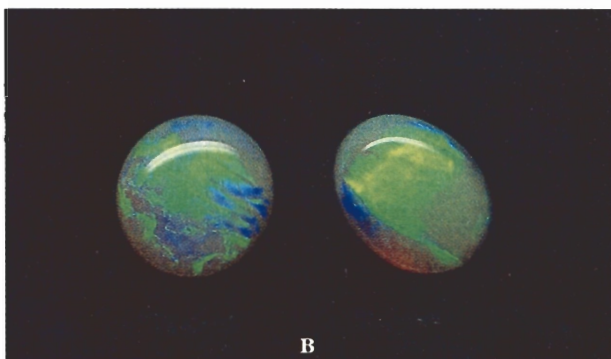


Fig. 4. Approved scale of body tone for precious opal

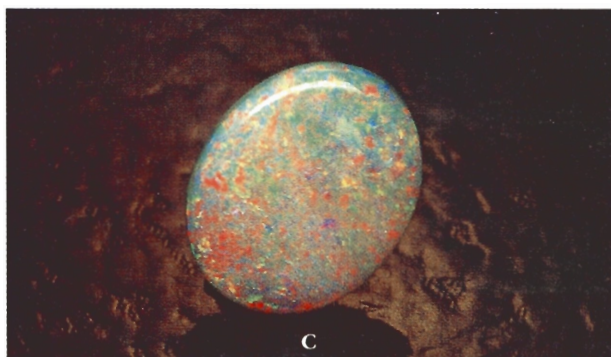
There are three varieties of opal based on *body tone*.



Black Opal – is the family of opal which shows a *play-of-colour* within or on a black *body tone* when viewed face-up. (See figure 5A), and may be designated N1, N2, N3 or N4 on the Scale of *Body Tone*.



Dark Opal – is the family of opal which shows a *play-of-colour* within or on a dark *body tone*, when viewed face-up (See figure 5B), and may be designated N5 or N6 using the Scale of *Body Tone*.



Light Opal – is the family of opal which shows a *play-of-colour* within or on a light *body tone*, when viewed face-up (See figure 5C), and may be designated N7, N8, or N9 on the Scale of *Body Tone*. The N9 category is referred to as *white opal* (See figure 1).

Fig. 5. Varieties of opal based on body tone. (Photographs, R. Weber)

Opal with a distinctly coloured body (such as yellow, orange, red or brown) should be classified as black, dark or light opal, by reference to the Scale of Body Tone, and also have a notation stating its distinctive hue appended to its determined body tone. (See figures 6, 7, 8, 9 & 10).



Fig. 6. Mexican opal of black to light body tone and of various hues. (Top) Dark orange crystal opal (Right) Light yellow crystal opal (Bottom) Dark blue crystal opal (Left) Black opal. (Photograph, Weiss Opals, Germany)

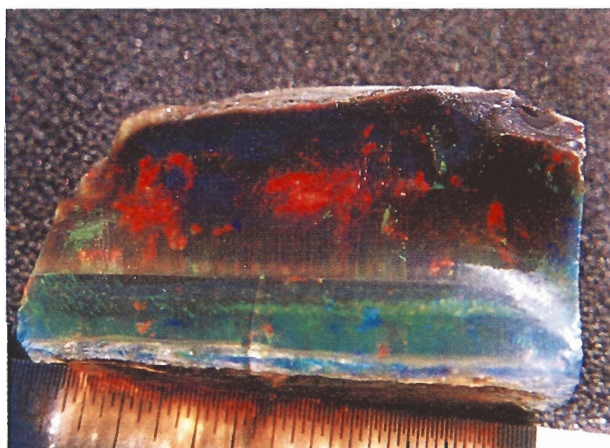


Fig. 7. Black crystal opal from Virgin Valley (USA). (Photograph, P. Brown)



Fig. 8. Indonesian opals of dark to light body tone. (Top left) Light opal (Centre) Dark orange opal (Bottom right) Dark opal. (Photograph, G. Brown)



Fig. 9. 'Hungarian' opal rough of 594g (13x7x7cm) from the Naturalhistorisches Museum, Wien. This type 1 opal displays body tones ranging from white opal (N9) to dark blue opal (N5).

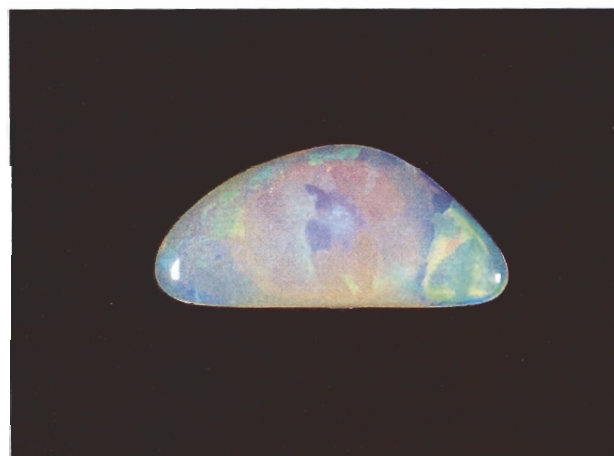


Fig. 10. Light opal of N7 body tone from Brazil. (Photograph, G. Brown)

Transparency

Opal shows all forms of diaphaneity that range from transparent to opaque. Natural precious opal which is transparent to semi-transparent is known as *crystal opal* (Figs. 11A-C). *Crystal opal* can have either a black, dark or light *body tone*. In this context, the term 'crystal' refers to the appearance of the opal and not its crystalline structure.

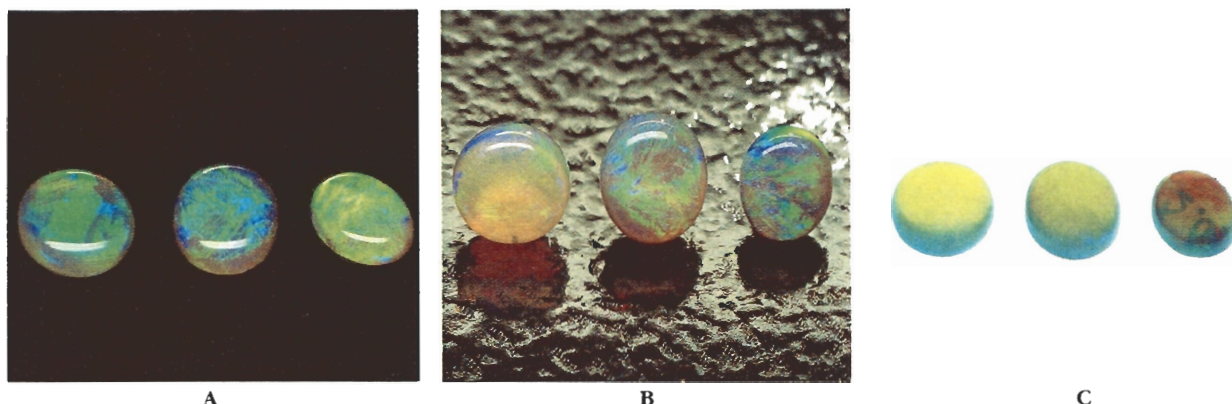


Fig. 11. *Crystal opal* displaying its identifying diaphaneity. (A) *Crystal opals* shown face-up against a black background which enhanced the brilliance of these opals' *play-of-colour*. (B) The same *crystal opals* shown face-up against a reflective background that subdues the opal's *play-of-colour*. (C) The same *crystal opals* viewed in transmitted light. Note the *play-of-colour* of these opals is hidden, and their true transparency is revealed. (Photographs, R. Weber)

OPAL TREATMENTS

Opal can be subjected to various types of treatment. Present CIBJO guidelines state that any method of treatment other than standard cutting and polishing must be disclosed and the process used specified on all invoices, advertising, and commercial documents. Types of treatments include colour and/or tone enhancement (Fig. 12), heating, painting, dyeing, resins and waxes, oiling or any application of chemicals. Opal also may be treated to change its natural appearance or durability. (See the discussion on composite opals, below). The *body tone* of opal is often enhanced (usually appearing darker) in some opal inlay jewellery where a thin piece of solid *crystal opal* has black paint or black glue applied, or the opal is set above black painted jewellery.

COMPOSITE NATURAL OPAL

Composite natural opal consists of natural opal laminates, manually cemented or attached to another material. The opal component is natural opal. There are three main forms of composite opal:

Doublet Opals – are a composition of two pieces where a slice of natural opal is cemented to a base material (Fig. 13).

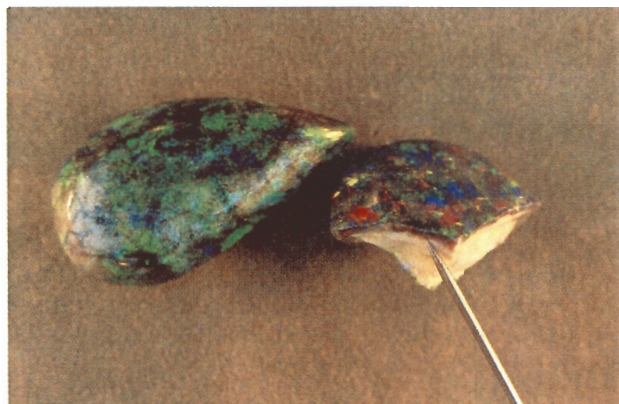


Fig. 12. Treated (carbonised) dark Andamooka matrix opals. (Photograph, R. Weber)



Fig. 13. A ring-mounted black Lightning Ridge-type composite doublet opal. (Photograph, G. Brown)

Triplet Opals – are a composition of three pieces where a thin slice of natural opal cemented between a dark base material and a transparent top layer (usually of quartz or glass).

Mosaic and Chip Opals – are a composition of small flat or irregularly shaped pieces of natural opal cemented as a mosaic tile on a dark base material (Fig. 14) or encompassed in a resin.

SYNTHETIC OPAL

'*Synthetic Opal*' (Fig. 15A) is material which has essentially the same chemical composition and physical structure as natural opal but has been made by laboratory or industrial process. Synthetic opal composites exist as synthetic opal doublets, triplets or mosaics. These must be disclosed as *synthetic opal composites* (Fig. 15B).

IMITATION OPAL

Imitation Opal (Fig. 16) is material which imitates the *play of colour* of natural opal, but does not have the same physical and chemical structure or gemmological constants as natural opal.



Fig. 14. A mosaic dark opal composite. (Photograph, R. Weber)



Fig. 16. A 'thin-film' imitation dark opal by Pauley. (Photograph, R. Weber)



Fig. 15A. A Gilson™ synthetic black opal. (Photograph, G. Brown)

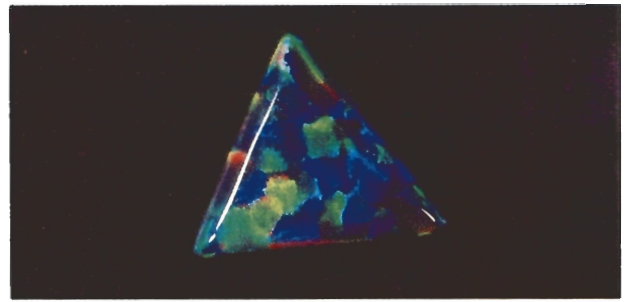


Fig. 15B. A black Gilson™ synthetic opal composite doublet. (Photograph, G. Brown)

CLASSIFICATION REPORTS

The classification reports for the following types of opal should include the following:

Natural Opal

1. **Type** of opal.
2. **Variety** of opal, as black opal, dark opal or light opal with a body tone value classification from N1 (black) to N9 (white) based on the Scale of Body Tone.
3. **Transparency** as opaque, translucent or transparent. Make note if it is *crystal opal*.
4. **Weight** and **dimensions**.

Treated Opal

1. **Type** of opal.
2. **Variety** of opal as black, dark or light opal.
3. **Transparency** as opaque, translucent or transparent. Make note if it is *crystal opal*.
4. **Type of treatment** and process if known.
5. **Weight** and **dimensions**.

Composite

1. **Type** of composite, i.e. doublet, triplet, mosaic or chip opal.
2. **Treatment process**, where relevant.
3. **Dimensions**.

Synthetic and Imitation

1. **Gemmological category** (including manufacturer, if known).
2. **Description** (body tone).
3. If **composite**, mention **type** i.e. doublet, triplet, mosaic or chip.
4. **Weight** and **dimensions**. Only dimensions if composite.

Origin

Any indication of the origin of opal, by the use of geographical location, should not be used unless it is qualified as an indication of the type of locality only as recommended by the International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones (CIBJO) e.g. Lightning Ridge type black opal.



HOW TO USE THE NEW OPAL NOMENCLATURE

This nomenclature for opal has been designed for use throughout the gemstone and jewellery industry, not only in Australia but internationally. While preparing this nomenclature, the sub-committee has been cognisant of conventions of international trade organisations, such as the International Confederation of Jewellery, Silverware, diamonds, pearls and stones (CIBJO), the International Colored Gemstone Association (ICA), as well as the linguistic problems associated with different languages and the differing connotations these languages may place on an internationally acceptable nomenclature.

This new nomenclature has not been designed to force any changes to the various colloquial terms used to describe opal in Australia, or indeed in countries overseas such as Mexico. Colourful language, Australian colloquial terms for opal, and terms that have been a part of the Australian scene for hundreds of years have added significantly to the mystique and folklore of everyday language used on the opal mining fields. Expressive local terms and older historical terms always will exist in the opal miner's vocabulary. These will remain to have their rightful place in our gemstone history and in the tale-telling for years to come.

The purpose of the nomenclature, therefore, remains to provide a basic description of the gemstone we all prize and know as opal. This nomenclature is for everyone to use and understand. Simple descriptive terms, that can be used by the majority of people, from the customer to the scientist, have been chosen. These provide the gemstone industry as a whole with a logical and unbiased way of grading and evaluating opal. However, simple terms do become difficult when the many different types, formations, pseudomorphic fossil replacements, mineralogical types, and geological occurrences of Australian opal are considered.

Having said that, there are a few items of terminology which it is hoped this nomenclature will remove from common usage. In particular, the terms that have been deliberately removed, due to the linguistic problems they create, are 'semi-black', 'grey', and 'solid'.

To begin with the first part of the nomenclature, mention is made of *precious opal*, *potch* and *common opal*. The best way of determining the difference between these is to observe whether or not the opal you are viewing shows the phenomenon which we all know as *play-of-colour* (compare Figs. 1 & 2). It is possession of this optical phenomenon for which opal is most prized. The

differentiation between these basic forms of opal is therefore quite simple. If the opal displays a *play-of-colour* it is termed *precious opal*. If a *play-of-colour* is not displayed, then the opal is either *common* or *potch opal*. While it is recognised that the term *precious* is neither a scientific nor gemmological term, it is retained in this nomenclature for simplicity, and with the intention of further enhancing the value of opal as a gemstone by removing it from any historical association with 'semi-precious' gemstones.

In an attempt at keeping the nomenclature simple to use, the terms *common opal* and *potch opal* have not been separated. It must be recognised, however, that there are distinct mineralogical differences between *potch* and *common opal*. (Jones & Segnit, 1971).

The term 'solid' has been removed from opal terminology, for the simple reason that all types of opal are essentially solid from a scientific point of view. That is, opal does not exist naturally either as a liquid or a gas. 'Solid' has been replaced by the gemmological term *natural opal*. Correlating with this use is the recommendation that when describing doublets and triplets that the term *composite* be used instead of 'assembled' (See Figs. 13, 14 & 15B). This also is the terminology currently recommended by CIBJO.

Essentially there are three types or forms of *natural opal*, which are termed simply *opal*, *boulder opal* and *matrix opal* (See Figs. 3A, B & C).

Perhaps the most contentious issue in the nomenclature concerned introduction of the term *body tone*, to describe the comparative lightness or darkness of an opal as distinct from its *play-of-colour*. Technically, it would have been best just to have two types of 'body tone' — either 'black or white' or just 'light or dark'. However, the sub-committee rightly decided not to attempt to change too much of the terminology that had been in common use for over a hundred years. So, inclusion of the term *black opal* was considered to be an imperative. Following much discussion the term *body tone* was included in the nomenclature to describe the comparative lightness or darkness of opal — irrespective of its *play-of-colour*. The term *tone*, which is used by colour science, is in agreement with terminology used internationally to describe the lightness or darkness of particular *hues* or *colours*.

The Scale of Body Tone, as illustrated in the nomenclature above (Fig. 4), ranges from N1 to N9. The prefix "N" reflects the neutral tone of this scale. The steps in the scale of body tone, which are arranged to indicate approximately equal decreases of darkness, are difficult to reproduce accurately on the printed page. A rough gauge can be obtained by printing this scale with the assistance of a good computer and a quality laser or ink jet printer.

After examining current industry standards, the N4 category was decided to be the cut-off point for *black opal*. The AGIA is currently attempting to produce a scale of body tone, using commercially available computer scanning devices and suitable software. However, at the time of publishing this paper, this scale is not yet available. The current reference, used by the Lightning Ridge Miners Association, is the neutral tone scale specified in the American Geological Society's *Rock-colour chart*[†]. This has proved to be a good guide, for in most instances it will be possible to correlate the different 'tone scales' into a simple and repeatable system.

An acceptable descriptive term was sought also to describe those opals that have distinct body colours or hues, such as those displayed by both *Mexican fire opal* and *honey opal* from Lightning Ridge — considerable amounts of which consists of *common* or *potch opal*. However, as an acceptable all round term could not be found to describe these opals, the committee decided to describe them by determining their body tone/s, their primary and secondary body colour/s or hues, and their transparency (See Figs. 6, 7, 8, 9 & 10).

To determine the *body tone* of an opal, then, one examines the piece of opal, face-up, and determines (by visual comparison) its position in the scale of body tone.

- If the tone of the opal appears darker than N4, then the opal may be classified a *black opal* (Fig. 5A). Consequently, any opal with a body tone darker than N4, irrespective of hue, can correctly be termed *black opal*. Some *boulder opal* possesses this body tone, so it is very correctly termed *black boulder opal*. It is also appreciated that some very dark red Mexican-type opals would have dark enough body tones to be categorised as *black opal* (See Fig. 6, left).
- If the opal is lighter than N4, and its tone corresponds to N5 or N6 on the scale of body tone, then it is classified as *dark opal* (Fig. 5B). If, in addition, this opal has a decided *hue* colour, it is additionally classified as, for example, a *dark blue opal* (See Fig. 6, bottom).
- If, on the other hand, the *tone* of the opal corresponds to N7, or lighter, it is classified as *light opal* (Fig. 5C). If this *light opal* also has a hue, then it is termed, for example, a *light yellow opal*.

When to term an opal a *crystal opal* also provided considerable discussion. The key to classification as *crystal opal* is really the transparency of the opal (See Fig. 11). Perhaps a better term would have been 'transparent opal'; but any change in terminology from *crystal* to 'transparent' may take many many years to progress. The obvious problem with the term *crystal opal* is, of course, the basic fact that that opal has no crystal

structure. Again the sub-committee decided that it was unwise to change a term that had been in common use for so many years. The sub-committee further believes that overseas gemmological communities may yet force a change in this usage, if strict terminology is ever to be implemented.

The range of *transparency* considered acceptable for defining *crystal opal* (transparent to semi-transparent) was taken straight from Robert Webster's discussion on transparency in his world-renowned textbook *Gems*. The committee decided that *transparency* did not need to be re-defined in the nomenclature; but just stated as a classifying category.

To grade the transparency of an opal with the nomenclature, how transparent the opal is must be determined. If the opal is only translucent, then it is not termed *crystal opal*. It should be remembered that in some instances the play-of-colour of *crystal opal* will be so strong or brilliant that assessment of transparency, by the normal 'read-through' criterion, may not be possible as the opal can not be 'read-through'. When this occurs the best test of transparency would be to 'look-through' the opal with transmitted light. If transparency exists then this will be readily apparent. If the material remains only translucent, then it is correctly labelled as *light opal*. It is hoped that future scientific advances may yield a better and more accurate method of assessing transparency.

A note also should be made concerning the removal of the term 'jelly' opal. The basic facts are that due to the extreme transparency of this opal it becomes a type of lower quality *crystal opal* that displays subdued low quality *play-of-colour*. In spite of any restriction applied by this terminology the term 'jelly' opal will probably remain in colloquial use for many years to come.

The description of composite stones (Figs. 13, 14, 15B) requires only a small change in nomenclature. Instead of these opals being described as 'opal doublets' or 'opal triplets', the nomenclature emphasises their composite nature by terming these *doublet opals* and *triplet opals*. In this terminology, which emphasises the composite nature of these opals, it is the first word of the term that precisely identifies the material.

The rest of the nomenclature discusses opal treatments, synthetics and imitations. These are not associated with the descriptive nomenclature for natural opals, but have been included to complete the nomenclature. These descriptions are in accordance with the latest edition of CIBJO's *Classification of materials and Rules of application for diamonds, gemstones, and pearls*.

Acknowledgements

The author wishes to thank Peter Sherman and Frank Palmer for providing specimens for examination. Rudy Weber's photographic talents are gratefully acknowledged.

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- † Copies of the *Rock-color Chart* may be purchased either from The Geological Society of America, P.O. Box 9140, Boulder Colorado 80301 (for US\$26.00, plus postage), or from Prospectors, P.O. Box 339, Seven Hills NSW 2147 (for \$A48.00).

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