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GEMS **AND** PRECIOUS STONES OF **ARIZONA
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INTRODUCTION

Nearly all the known varieties of gems and precious stones are
found in the United States, and several varieties are found in Arizona.
Little systematic mining has been carried on for them, and no exten-
sive search for them has been made, except in the states of Maine
and North Carolina. In most cases, the discovery of gems in the
United States has been accidental in connection with other substances
that are being mined, or in small veins.

These gems are mostly sold in local markets; gem collectors and
mineralogists also purchase them, for private collections, as a rule.

**ARIZONA GEMS**

The best known gems found in Arizona are the turquoise, garnet,
peridot, chrysocolla, azyr-malachite, malachite, agate, chalcedony,
amethystine quartz, diamond (meteoric) dioptose and topaz.

*Turquoise:* Turquoise is a phosphate of alumina and copper. As
a rule, it has greenish or light milky blue color; also it is commonly
a dark blue, which fades on exposure. These varieties are hardly
worth the cost of cutting. The gem stone should be a clear dark
blue, which will not fade. When veined or mottled with the gangue
matrix the substance is known as matrix turquoise. This matrix is
usually as hard as, and even harder than, the turquoise itself. The
color of the matrix should be pleasing, and harmonize with the blue
of the turquoise.

Turquoise occurs as veins or vugs in acid igneous rocks. It seems
to have been formed by deposition from warm waters, and is usually
associated with altered rocks.

*Garnet:* Garnet is a complex silicate of calcium and aluminum, in
which the calcium is frequently replaced by more or less iron and
magnesium, and the aluminum, by chromium and iron. It varies in
color from white to black-red, yellow, green and brown shades. The
best quality garnets are dark red, free from specks and cracks or

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other flaws. This variety is called pyropene garnet. When of a
purplish tint, it is known as almandine. The brown variety is in-
correctly called hyacinthe.

The precious garnet found in Arizona is known as the Arizona
Ruby, although it is not at all related to the true ruby; it is as
fine as any found in the world. They are gathered as worn, rounded
pebbles, in gravel deposits in the northern part of the state, mostly by
the Moqui Indians. The gem has not been found in place in this
state, but was probably formed in basic rocks, such as peridotite. It
also occurs in mica schist rocks in other localities, and may be found
in such rocks in this state.

*Peridot:* Peridot is a clear pure crystalline variety of the mineral
chrysolite or olivine, a magnesium-iron silicate. The best quality
stones have a clear yellow-green tinge. It is usually brown or olive
green (olivine) and rarely a clear golden yellow (chrysolite). The
material from Arizona comes from altered peridotites, in the north-
em part of the state, near Ralkai and Rice. It is usuallly found in
sands and gravels. Large good stones are hard to find. The stone
is increasing in popularity.

*Chrysocolla:* Chrysocolla is a hydrous silicate of copper. It is
not of much value as a gem stone unless it has been silicified. It is
of a light blue color, usually, or it may be more or less mottled. It
is found in many copper mines of the state, being very abundant in
the Globe district.

*Azurite and Malachite:* Azurite and malachite are hydrous silic-
ates of copper. Azurite is the blue carbonate, and malachite green.
The two minerals are nearly always very closely associated, and the
combination is known as azure-malachite. Malachite is most valu-
able when it shows rounded or oval Workings and a silky lustre.
These minerals are common in the copper mines of Arizona.

*Agate:* Agate is a variegated chalcedony which is a variety of
quartz. The variegations usually take the form of bands, which,
when parallel and of alternating colors, form onyx and sardonyx.
When these variegations take the form of moss-like or dendritic
growths, the mineral is called moss agate. It is usually formed by
successive deposition in cavities in eruptive rocks. They are found
in many places in the state; in place in lavas, in sands and gravels,
and embedded in limestones.

*Chalcedony:* Chalcedony is quite common in Arizona, usually

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of a bluish gray or buff color. The red variety, carnelian, and the
green variety, chrysoprase, have not been found in Arizona. It is
formed in rock cavities, and found in place or in sands and gravels.
A variety of chalcedony known as "turtle-back" or moonstone has
been found here. It shows a peculiar mottled appearance, when cut,
resembling the back of a turtle. Chalcedony is often called moon-
stone when cut, but improperly so.

*Amethystine Quartz:* Amethystine quartz is a clear purple col-
ored quartz. The best known occurrence is in the McConnico dis-
trict. According to the Mineral Resources of the United States
for 1908, one crystal from this district was sold to Tiffany, of New
York City, for $59.00. The great objection to it as a gem is
that it loses color. It is found in veins and vugs, often with silver
and lead ores.

*Diamond:* The only diamonds found in Arizona are meteoric,
and occur in meteoric iron found at Canyon Diablo, near Coon
mountain, in the northern part of the state. The crystals are very
small, and have no commercial value.

At one time, in 1870, a company was organized for the explora-
tion of diamonds and other gems in Arizona and New Mexico.
A great quantity of gems said to have been found in these fields was
exhibited, and expeditions to the locality gathered approximately
6000 carats of rubies and 1000 carats of diamonds.

*Topaz:* Topaz is a fluo-silicate of aluminum, usually clear and
colorless, but most valuable when golden yellow1 or blue in color.
It is found in the northern part of Arizona. The golden yellow var-
iety is very apt to fade.

**METHODS OF EXTRACTION AND PREPARATION.**

Most of the gems and precious stones found in Arizona are merely
by-products of the mining of other substances, and are sorted out
from poorer specimens. The turquoise, garnet and peridot are mined
separately. There are several companies that have produced tur-
quoise in Arizona. The garnets are gathered from the sand and
gravel beds in which they are most commonly found.

In preparing precious stones for market, the best specimens are
first selected, cleaned, cut in various shapes, and polished. Poorer
specimens are also cut and polished, or they may be reserved for use
in private and public collections.

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**THE GEM INDUSTRY.**

There was a large decline in the gem industry in 1914, due to
the restricted conditions imposed by the conflict in Europe. This
decrease had not been expected, but nevertheless, almost all gems
fell off in production; turquoise, however, showed an increase.

The total value of the gem production of 1914 was $124,651. The
following table shows the total value of the production of gems
which, although found in Arizona, may or may not be produced in
the state.



(Note. It is to be understood that this does not represent the
Arizona production. No figures as to that are available.)

The value of the imports of precious stones into the United
States in 1914 was $19,211,084, showing a decrease of $26,220,914
from 1913.

**ESSENTIAL PROPERTIES OF GEMS.**

Gems are certain minerals which, by reason of their brilliancy,
hardness and rarity, are valued for personal decoration; the term is
extended to include pearl. \_ (Definition from Encyclopedia Brit-
tanica). In a restricted sense the term is applied only to precious
stones after they have been cut and polished as jewels, while in their
raw state, the minerals are conveniently called gem stones.

The general properties which determine the value of a gem are:

(1) hardness; (2) specific gravity; (3) crystalline form and
cleavage; (4) color; (5) optical properties, refraction and dispersion,
person.

(1) Hardness A high degree of hardness is a desirable property
of a gem, for no matter how brilliant and beautiful a mineral may

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be, it is less valuable to the jeweler if it is not sufficiently hard to
withstand the abrasion to which articles of personal use are sub-
jected. (This statement does not apply to pearls and a few other
gems.) If not sufficiently hard, the stone may be badly scratched;
it will at least soon become dull by wear. An arbitrary scale of
hardness has been adopted, with the diamond, the hardest known
gem, placed at the top with a value of 10. The ruby and sapphire
come next, with a value of 9; the topaz is placed at 8, and quartz at 7.

(2)     Specific gravity: This property in itself does not directly
affect the value of a gem stone, but it is very valuable in distinguish-
ing one stone from another.

(3)        Crystalline form and cleavage:: The majority of gem
stones are crystalline in character. They lose their original crystal-
line form in cutting, but due to the crystalline structure, most gem
stones have definite cleavagee planes. This property is usually taken
advantage of in dressing stones preparatory to cutting.

(4)     Color: The beauty and consequent value of gems depend
mainly on their color. Some stones, of course, as the diamond, re
valued for absence of color, but this is the exception. Color is
usually due to the presence of some foreign pigmentary matter,
usually in small proportions. The coloring matter may be evenly
distributed throughout the stone, or in regular zones, or in quite
irregular patches.

(5)     Optical properties: Refraction. The brilliancy of a cut
stone depends on the amount of light reflected from its faces; in
the form known -as the "brilliant", the gem is so cut that much of
the incident light, after entering the stone and suffering refraction,
is totally reflected from the facets at the back. The amount of
light which is thus returned to the eye of the. observer will be
greater as the angle of total reflection, or critical angle, is smaller,
but this angle will be small if the refractive power of the stone is
great; so that the brilliancy depends directly on the refractivity.

Dispersion: The play of colors exhibited by a cut stone, often
known as its "fire", is due to the decomposition of the white light
which enters the stone, and is returned, by internal reflection, after
resolution into its colored components.

VALUE OF GEMS
*Wholesale Prices:*

Turquoise is worth up to $100 a pound at the mine, in the rough,
but usually is less valuable. Matrix material brings from $5 to $25
per pound. Cut matrix turquoise costs from 10 cents to $10 a

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carat. Cut clear blue turquoise costs from $1 to $10 a carat, the
price increasing with size. When cut in large quantities, stones may
be cut for three to five cents a carat.

Garnet is sold in the rough as single stones, and brings a price
rather less than one fifth the price of cut stones. Cut pyropene gar-
nets are worth from 50 cents to $2 a carat, depending on the quality.
Almandine garnets, if resembling the emerald, cost $12 to $15 a
carat. The cost of cutting is $1 to $1.50 per carat.

Peridot is also sold as separate stones. Cut material runs from
*$2* to $15 a carat. $5 usually buys a good stone. Cutting costs
from $1 to $1.50 a carat.

Copper bearing stones, excluding high grade malachite, sell for
about $10 a pound. When cut, they are sold by the stone rather
than by carat, and are sold so as to make a profit. No definite price
can be set. They cost from five cents to ten cents a carat for cutting.

Chalcedony, unless of the turtle back variety, is hardly worth $1
per pound. Cut material is barely worth the cost of cutting, which
is 5 to 10 cents a carat. Turtle back variety may bring $5 or more
for a stone.

Amethystine quartz is almost valueless, except as mineral speci-
mentsm unless it holds its color. The cut American material is
hardly worth more than the cost of cutting. But foreign material
may be worth $4 a carat when cut. The cost of cutting is from
50 cents to $1 a carat.

Topaz is bought by the single stone. Fine gem crystals, when
colored, may be worth $50 to $100. Cut material, in dark blue
shades, brings $10 to $25 a carat; the fine golden yellow brings $4 a
carat; diamond cut white stones bring $1 to $2 a carat. The cost
cutting is about $1 a carat.

ECONOMIC CONSIDERATIONS

With the exception of a very few valuable and highly prized stones,
the production of gems is almost always more or less spasmodic.
The cause of this is usually over production during a period of de-
mand. This over production is often purposeful as an example,
the tourmaline mines of San Diego County, California, produce a
large supply, which provides for the market demands for a time,
and when this supply runs low, the mines are again operated until
the stock is replenished.

In figuring upon a deposit of gems or precious stones, usual pre-
cautions must be taken. The product must, of course, be of good
quality. The demand for the material should be known and a market arranged for. The question of transportation does not
enter, to any great extent, since the bulk is not large, and the
quantity small.

**FUTURE OF THE INDUSTRY**

There is *no question but* that there *will always* be a large demand
for gems. Aside from a few varieties, as the diamond, ruby, pearl,
Sapphire, etc., the demand is quite variable, but is always sufficient
to repay small efforts in the production of various stones.

In Arizona the turquoise and garnet are sure of a wide market,
at almost all times. Gems of the copper group, azurite, malachite,
dioptase, etc., will find a market, not always steady, but fairly so,
especially with curio seekers.

Although there is, as has been seen, quite a wide variety of gems
and precious stones in Arizona, one could hardly say that prospects
of any great or continued production are good. What production
there is will probably always be on a small scale.

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