

The Gem Deposits of Southern California

By RICHARD H. JAHNS

ON a warm June day nearly 76 years ago, Henry Hamilton was picking his way along the brushy southeastern slope of Thomas Mountain in the Coahuila district of southern California's Riverside County. As he crossed a small gullied area, he noticed several rough mineral fragments of attractive pink and green color. Carefully tracing the occurrence of this loose "float" material to its source higher on the hill, he encountered a ledge of light gray rock in which a few irregular cavities were lined with crystals of quartz and other minerals. Among these others were beautifully transparent pencil-like crystals of red, pink, green, and blue color. These constituted the first California discovery of gem tourmaline, a material that already had been mined in eastern parts of the United States.

A little mining was done at the new locality, and some

excellent gems were obtained. As the interest of other men was quickened by Hamilton's success, additional deposits were soon discovered in the same general area, but it was not until nearly 20 years later that any important find was announced. This, in an area 24 miles to the southwest, was an occurrence of tourmaline with large quantities of the lithium-bearing mica, lepidolite. The deposit was exposed on a hill slope immediately north of the little mission town of Pala, on the San Luis Rey River. In addition to large quantities of lithium minerals, it yielded numerous specimens of lilac-colored lepidolite with coarse sprays of deep pink tourmaline. These found favor in museums and collections the world over.

The greatest discovery of all was made still later, in 1898, when several blue, green, and red crystals of tour-

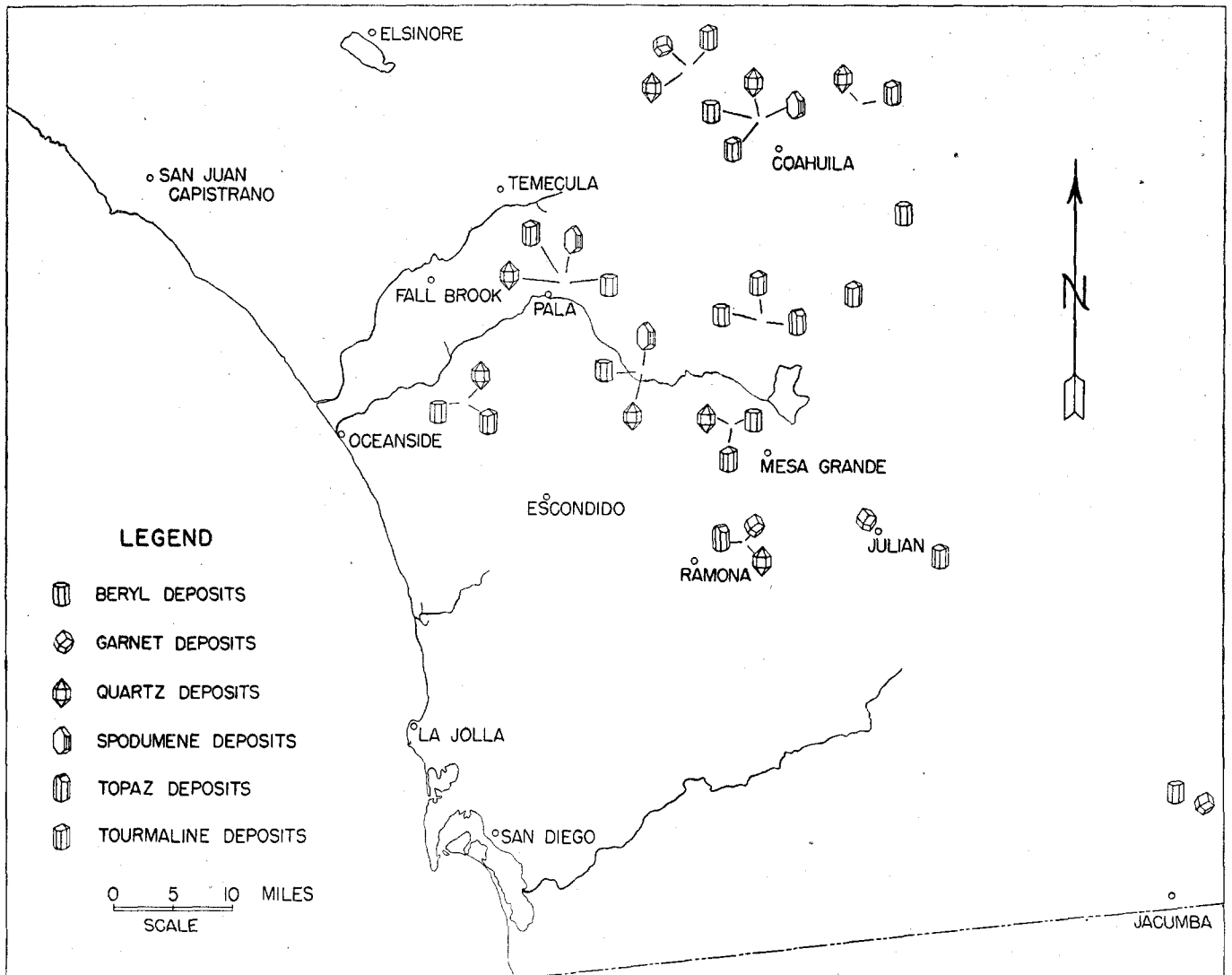
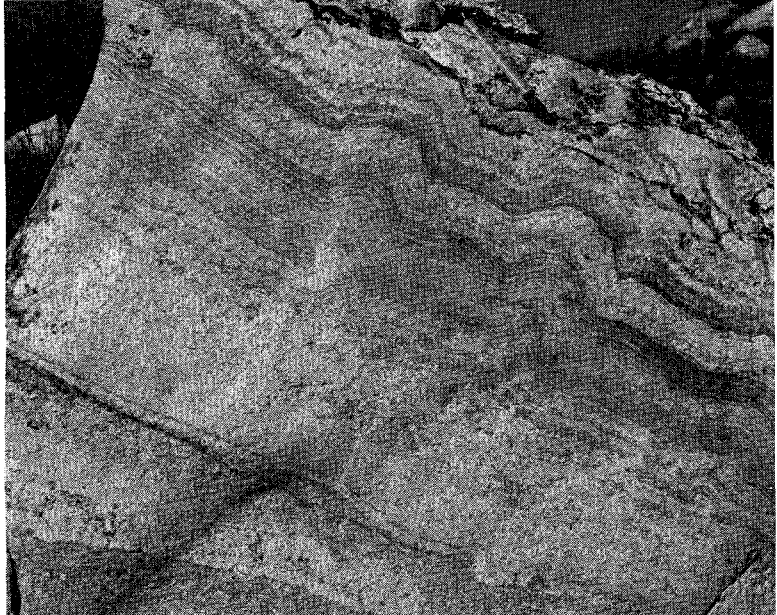


Fig. 1 Map of southwestern California, showing locations of principal gem deposits.

Fig. 2 Typical well-developed "line rock." This garnet-rich rock has been used locally as a decorative stone in fireplaces and garden walls. Hammer at top of boulder is for scale.



maline were shown to cowboys by Indians living near Mesa Grande. The source of this material was found to lie on a high wooded slope south of the San Luis Rey River and about 11 miles south of Palomar Mountain. This ledge became the site of the world-famous Himalaya Mine, the greatest producer of gem tourmaline in North America.

Tourmaline was not the only mineral involved in a series of spectacular discoveries made during the period 1902-1905. Frederick M. Sickler, while working a lepidolite deposit a short distance northeast of Pala, encountered numerous transparent masses of a mineral colored in delicate tints of pink, lavender, lilac, and blue-green. These were subsequently identified as a rare, remarkably clear variety of the lithium-bearing mineral spodumene. The pinkish to lilac-colored types were given the name kunzite, in honor of Dr. G. F. Kunz, who first identified them in his capacity as mineralogist for Tiffany and Company of New York. Kunzite thus is one of California's own minerals.

Additional spodumene deposits soon were discovered in the Pala area, and mining for this mineral, tourmaline, and lepidolite led to recognition and recovery of fine transparent quartz crystals and a beautiful pink to deep peach-colored variety of beryl. The aquamarine and emerald varieties of beryl were well known at the time, but this type was new, and was named morganite in honor of the noted financier. Such beryl also was encountered during mining in the Mesa Grande and Rincon districts.

Tourmaline was found on the slopes of Aguanga Mountain, near Palomar Mountain; at several places in the Mesa Grande area; near the town of Ramona; and at numerous other localities during subsequent years. Colorless to blue topaz, some of it in large, perfect crystals, was discovered at several Aguanga Mountain and Ramona localities, and subsequent mining yielded stones of quality equal to that of the best material obtained from Brazil. In addition the essonite, or hyacinth variety of garnet was found in the Ramona deposits, chiefly as honey-colored to orange-red transparent crystals. It also occurs in the Mesa Grande area; in the vicinity of Jacumba, far to the south near the Mexican boundary; and at several intervening localities.

The locations of the principal gem-producing areas of southern California are shown in Fig. 1. All are in the province of the so-called Peninsular Ranges, a series of ridges and mountains that extends southward from the edge of the Los Angeles Basin. This great highland mass separates the Salton-Imperial depression on the east from the coastal areas on the west, and also forms the "backbone" of much of Baja California. It is characterized by medium- to coarse-grained igneous rocks that range widely in composition.

All the gem materials and minerals occur in pegmatite, a granitic rock characterized by extreme coarseness

of grain. The pegmatite ordinarily forms dikes, and these tabular masses range in thickness from less than an inch to 100 feet or more. In most places the pegmatite is surrounded by other, less coarse-grained igneous rocks of more basic composition. In most areas the dikes trend north to north-northeast and dip westerly at gentle to moderate angles. Although they consist chiefly of graphic granite, a peculiarly regular intergrowth of quartz in microcline feldspar, careful examination discloses numerous variations in their composition and internal structure.

Many of the pegmatite masses are very regular in thickness and attitude, and most of them contain little or no gem material. Others are "two-ply" features, with upper parts of graphic granite and lower parts of a strikingly layered, much finer-grained rock that consists mainly of sugary albite feldspar with garnet, black tourmaline, or both minerals. The latter has been termed "line rock," owing to the appearance of its many thin, sub-parallel garnet- or tourmaline-rich layers on most outcrop surfaces (Fig. 2). A little of this material has been used as an ornamental stone, but none of it has yielded gems.

In the central part of some dikes, commonly along or near contacts between "line rock" and overlying graphic granite, is the so-called "pocket zone," "pay streak," "clay layer," or "gem strip" (Fig. 3). Ordinarily this is an irregular series of tabular or pod-like masses that are rich in quartz. Associated with the quartz are albite, microcline, and orthoclase feldspars, muscovite and lepidolite micas, tourmaline of various colors, beryl, and rarer minerals. These masses generally are surrounded by pegmatite rich in muscovite and coarse grained of black tourmaline.

Some well formed quartz crystals weighing 100 pounds or more have been encountered during mining, although few gem crystals of quartz or other minerals exceed six inches in maximum dimension. The gem material of best quality is found embedded in a pink to pinkish brown clay, which is thus regarded by miners and prospectors as a very favorable indication of "pay stones" (Fig. 4). Some of the gem crystals are loose in the clay, some are attached to other minerals that line the clay-filled "pockets," and a few are wholly or almost wholly embedded in solid pegmatite.

Most of the pegmatites that contain gem tourmaline, topaz, garnet, or beryl are 5 to 20 feet thick, although there is little systematic relation between thickness and gem content. Indeed, the famous Himalaya pegmatite, in the Mesa Grande district, was only 1 to 5 feet thick where richest in gem minerals. There is a definite re-

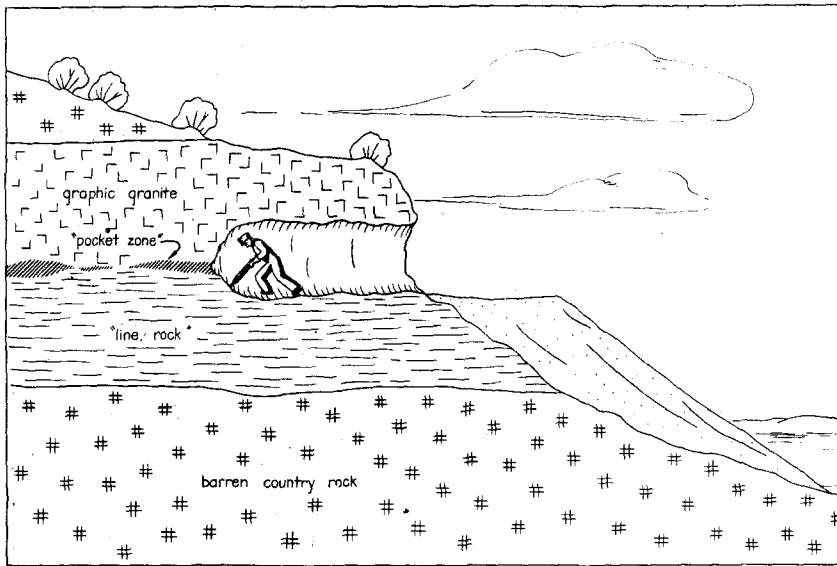


Fig. 3 Diagrammatic cross-section showing distribution of the gem-bearing "pocket zone" and the other rock types characteristic of many southern California pegmatite dikes.

lation, on the other hand, between the occurrence of kunzite and the local thickness of spodumene-bearing pegmatite dikes. Such dikes characteristically thicken and thin, or "pinch" and "swell," as traced along their outcrops. The central part of each bulge or "swelling" is commonly marked by a pod-like mass of quartz or of quartz with long, thin, lath-like crystals of spodumene (Figs. 5 and 6).

The spodumene is opaque and white to pinkish in color, and much has been thoroughly decomposed to a clay-like substance. Inside some of the crystals, however, are fragments of clear kunzite, which appear to represent those parts of the crystals that escaped alteration. The proportion of clear material is rather high in the crystals nearest the centers of the largest pegmatite bulges, and a very few laths are entirely unaltered. Gem crystals of this type are known to reach thicknesses of 2 inches and lengths of nearly a foot, but unfortunately are exceedingly rare.

The mining of pegmatite gems in southern California reached its peak during the decade 1902-1912, when material valued at more than \$1,500,000 was marketed. Tourmaline, which represented most of the output, was graded on the basis of size, color, transparency, and freedom from bubbles, inclusions, and other imperfections. Nearly all the gem crystals are shaped like a short lead pencil, with diameters of most ranging from one-eighth inch to four inches or more. They are characteristically hexagonal, with flat or nearly flat terminations. A wide variety of colors has been found, but red, pink, salmon, green, dark blue, and black are most widespread. Many crystals are bi-colored or multi-colored, with sharp or gradual changes from one end to the other or from the interior outward. Some crystals with pink interiors and green rims are known as "watermelon" tourmaline.

Most transparent crystals of high quality were cut into gems, which commanded prices of \$2 to \$10 per carat. Current prices are somewhat higher than this. Much pink material of slightly inferior grade was sold to Chinese markets, where it was highly prized as carving material. Thousands of crystals, representing a wide range of quality and size, also were marketed as specimens in all parts of the world. So much tourmaline was sold during the "golden decade" of mining, however, that the market collapsed shortly before World War I, and only during recent years has it shown signs of recovery.

During World War II, a little tourmaline of deep green and blue color was sold from the Pala district. This represented material left over from previous production, and was used because of its piezoelectric properties. The current demand for such material, as well as for gem stock of highest quality, far exceeds the present available domestic supply.

The rough crystals of kunzite are blade- or lath-shaped, and nearly all are deeply striated and grooved (Fig. 7). Most are small, with lengths of two inches or less, but some nearly a foot long and weighing 24 ounces or more have been recovered during mining. The limiting factor for size of top-quality cut stones is the thickness of the source crystal, as the deepest colors are obtained only when the stones are viewed parallel to the long axis of the crystal. The mineral is a very difficult one to prepare as a gem, owing to its two directions of perfect cleavage and hence its tendency to

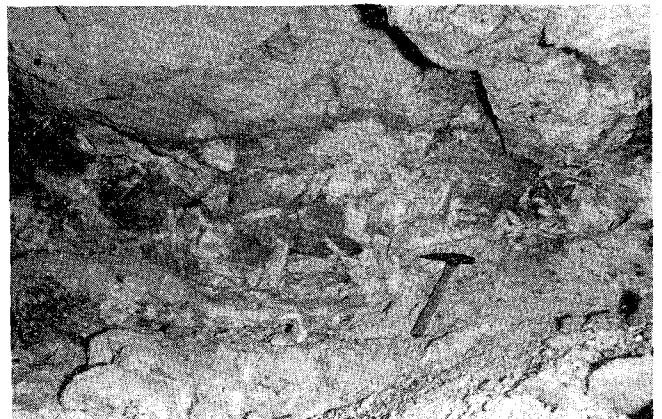


Fig. 4 "Pay streak" in Pala Chief mine northeast of Pala. Crystals of spodumene (white) are embedded in a matrix of clay and quartz (dary gray). Some of the spodumene crystals contain material of gem quality.

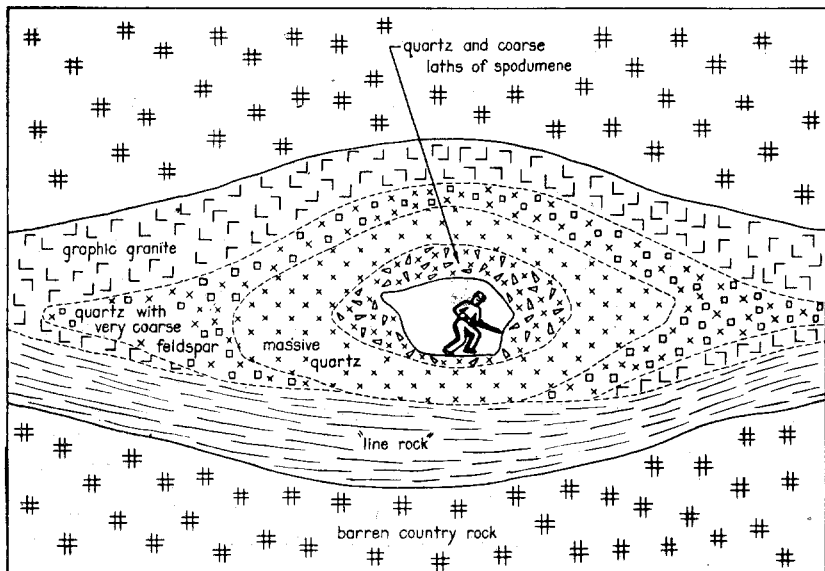


Fig. 5 Idealized cross-section of a typical spodumene-bearing pegmatite in southern California.

break near the edges during cutting. However, it yields stones of exceptional beauty.

Current prices for facet-cut stones of this high quality range from \$2 to more than \$25 per carat, depending chiefly upon the nature and depth of their color. Kunzite is so rare that it also has considerable value as a specimen material. It has been mined sporadically during recent years in the Pala district, and three mines are being reopened for systematic operation at the present time.

Colorless to blue topaz has been mined chiefly from deposits near Ramona and on Aguanga Mountain (Fig. 1). It has found a ready market, commanding prices of \$5 to \$15 per carat in the form of facet-cut stones. Much specimen material has been sold as well.

Quartz, garnet, and both aquamarine and pink to salmon-colored varieties of beryl represent only a small proportion of the gem production of southern California, in terms of both bulk and value, but they are widespread in their occurrence and in their distribution in gem and mineral collections. A large pocket of peach-colored beryl crystals was encountered during recent wartime mining for quartz crystals of radio grade in the Pala district, and other crystals of similar form and color have been encountered from time to time in the search for kunzite. Still other occurrences have been reported during recent years from deposits in Riverside County.

The moribund gem mining industry of southern California, with a total recorded production valued at more than \$2,000,000, is currently showing signs of revival. Although "bonanza type" operations probably

are gone forever, it will be interesting to see whether a gradually rising market and a modern approach to pegmatite geology and mining will sustain activities at somewhat less spectacular levels.

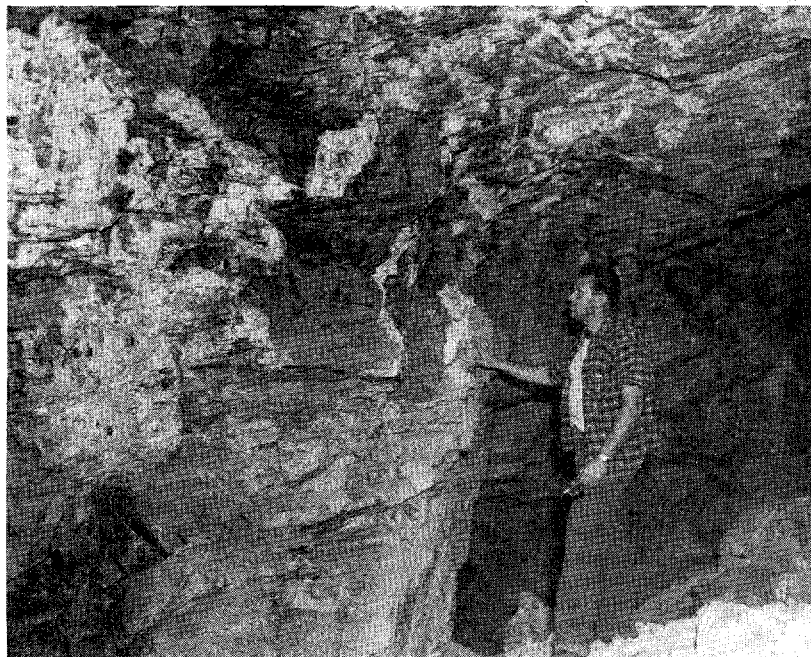


Fig. 6 Don M. George Jr. examines spodumene-bearing pegmatite in the Stewart mine, near Pala. Spodumene crystals (light gray) are abundant in the roof over his head, and lepidolite mica forms most of the rock below his hand.

Fig. 7 Leonora S. Reno, secretary of the Division of the Geological Sciences, admires three giant crystal fragments of gem spodumene. The largest ones are two very remarkable specimens from the collection of T. W. Warner, Pasadena.

