AMERICAN GEM TRAILS

Books by Richard M. Pearl

AMERICAN GEM TRAILS
SUCCESSFUL MINERAL COLLECTING AND PROSPECTING
HOW TO KNOW THE MINERALS AND ROCKS
WONDERS OF GEMS
WONDERS OF ROCKS AND MINERALS
MINERAL COLLECTORS HANDBOOK
GEMS, MINERALS, CRYSTALS, AND ORES:
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AMERICA'S MOUNTAIN:
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With Dr. H. C. Dake
THE ART OF GEM CUTTING

AMERICAN GEM TRAILS

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AMERICAN GEM TRAILS

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To my wife's father

WILLIAM WILSON WARDELL

whose memories of
Aspen – Cripple Creek – Ouray
and other Colorado mining camps
recover a vanished era of greatness

PREFACE

The discovery and recovery of gems in the United States forms an interesting phase of the story of America, of American mining in particular. In one sense, it constitutes a small but rich aspect of a very large subject. Nowhere, since the Indian ruled this land, has gem production assumed the proportions of a major industry—although the red man had considered the turquoise deposits of the Southwest in this light. In another sense, however, the finding and winning of gems in the United States is broader than many familiar fields of commercial mining, because it has entered directly into the lives of so many hundreds of thousands of hobbyists—mineral collectors, amateur lapidaries, rockhounds, and junior-grade pebble pups—you or your neighbors or your friends or relatives.

Over the years, diamonds have been our most valuable mineral import, and the American consumer is the world's best customer for gems, both foreign and domestic. A number of gems have been named after American persons and places. The localities from which they come include areas of great fascination. There is legend and history, excitement and romance, science and technology and humanity in the little-known panorama of gems in America. It is presented here for you to enjoy.

This book began as long ago as 1937, with a term paper in a course in economic geography at the University of Colorado. A couple and a half decades and twenty other books went by before it was resumed. Meanwhile, the publication by John Sinkankas, under the title *Gemstones of North America,* of a revision of George F. Kunz's classic work, *Gems and Precious Stones of North America,* has made unnecessary for another generation another extensive book on this subject. The usefulness of a book having the more modest scope of the one you are reading seems evident to the author, and it is published with the hope that you will be pleased. *American Gem Trails* is designed to supplement and complement *How to Know the Minerals and Rocks,* a simplified field guide, and *Successful Mineral Collecting and Prospecting,* a survey of the mineral hobby and business—both books by the same author and publisher.

I wish to acknowledge the capable cooperation of Elizabeth Shafer with the writing of Chapters 8 and 9, dealing with gems of the American Indian. My student Carl Tahkofper, a native-speaking Comanche, has given me information of value on this subject. My wife, Mignon Wardell Pearl, has been of much assistance in the preparation of the manuscript, which was typed by Mrs. J. V. Winters. Christopher D. Wadsworth made the drawings. Credit for the photographs is given in the back of the book. The following individual acknowledgments for pictures and information specifically furnished for this book are gratefully made:

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AMERICAN GEM TRAILS

CHAPTER 1

GEMS IN AMERICA

"To write well and worthily of American things."
—HENRY JAMES: *Letter to Charles Eliot Norton*

Gem stones have long been an attractive feature of the natural resources of the United States. When white men first came to the Western Hemisphere, they found the Indians familiar with as many varieties of gems as were known in all the rest of the world. Some deposits had been worked at least two thousand years ago, and certain turquoise mines were of great economic and political importance in the era before the arrival of the conquistadores. Arrowheads and spear points were fashioned from obsidian and a number of kinds of gem minerals, and well-shaped crystals were buried with the dead. The native races attached supernatural powers to stones that were attractive because of their colors; the wealth of fascinating gem lore is based principally upon the symbolism of color.

The New World was explored and subdued and the young nation established. Its industrial power grew upon the foundation of mineral deposits that were discovered as the wilderness was opened, and the boundaries were pushed inexorably across the Shining Mountains to the shores of the Pacific. With these mines of metal and coal and other mineral products, there came to light an occasional source of gem stones that added

a touch of glamour to the more prosaic earth materials. The first gem-mining firm was organized in 1880.

Although the monetary value of America's gems has not been large in comparison with that of other types of minerals, the total has reached a respectable figure, and certain mines and other deposits have proved profitable indeed to their operators. The mining of pegmatite deposits has yielded gem quartz, tourmaline, beryl, and spodumene as a coproduct. Turquoise is a byproduct of copper mining; gem garnet, of abrasive-garnet mining; and agate and petrified wood, of the operation of gravel pits. Production has fluctuated radically with the rise and decline of individual sources. Today, more gem properties are owned, leased, or staked as mining claims by mineral and lapidary clubs than by established commercial concerns. Most gems are extracted with hand picks and shovels and are hand sorted, perhaps by panning. The private owners or leasers of gem-bearing ground often uncover it with power-operated, dirt-moving equipment and open it for a fee to the collector.

The flourishing of the rockhound, as described in Chapter 2, is a recent American phenomenon of astounding proportions, and with it has come an enthusiastic interest in American gems that thrives in virtually every hamlet and every neighborhood in the fifty states. The tourist helps to enlarge further this expanding interest, even though, as Sidney H. Ball once expressed it, he is apt to buy as a souvenir of his vacation "a South American stone cut in Germany and mounted in Providence, Rhode Island." Although he may occasionally be led astray, his interest in local stones and their historical association helps to maintain a regular market for the miner and the merchant of gems.

Americans as a nation are the most lavish buyers of gems, taking the largest part of the world's output; the declared value of imports in 1962 was $224,506,000. The cost of the

diamonds owned in the United States is doubtless well over $5 billion. Almost all the gems sold and bought here have been imported from outside the North American continent. Nevertheless, certain of our domestic gems are unique, being known no place else, and others of them equal or even surpass in quality the gems of the same kind found elsewhere.

Four influences seem principally responsible for the course of the gem industry in the United States as it has actually developed. First, the age-old lure of gems for man and woman—it is no different here than in any other place or time. Second, the vast extent of territory. Other huge nations—Brazil, Canada, China, Australia, the Soviet Union—have either yielded a substantial wealth in gems or offer promise of so doing. Third, the satisfying diversity of the geologic framework, discussed in Chapter 4, and the resulting multifariousness of minerals created within it. Last, the same impetus to search and recovery that the favorable mining laws, the accessibility of public land, and freedom of enterprise have contributed to the evolution of a vigorous mineral industry in this fortunate land.

CHAPTER 2

THE NEWEST STONE AGE: GEM HOBBY AND GEM CRAFT

"So much one man can do,
That does both act and know."

—ANDREW MARVELL: *Upon Cromwell's return from Ireland*

In a talk delivered in Denver in 1948 at the first annual convention of the American Federation of Mineralogical Societies, Leland Quick, founder and former publisher and editor of *The Lapidary Journal*, characterized our time as the Second Stone Age. He had reference to the resurgence of interest, by large numbers of people, in the rock and mineral products of the earth.

The Old and New Stone Ages—the Paleolithic and Neolithic periods of anthropology—are recognized as the earliest intervals of human development and the longest aspect of human history. Beginning with a random use of whatever rock material was available, man advanced to a more skillful use of tools for scraping, chopping, and pounding. The perfection of the cutting edge was a major step forward. Paleolithic man emphasized three principal kinds of stone artifacts: core tools, for his hand-ax culture; flake implements; and blades. The Neolithic Age saw these stone-working techniques modified by an increased use of grinding and polishing. Modern European explorers found the Stone Age still persisting when they arrived in the American continents, Africa, and Australia.

We are at present in the second phase of the Second Stone Age. The first phase, during the last quarter of the nineteenth century and the first quarter of the twentieth, was marked by the building up of large private and museum cabinets of specimens under the sponsorship of wealthy men who were patrons of science and natural history. Some of them were themselves surprisingly knowledgeable, while others merely financed the actual field collectors. The results of their philanthropy are discussed in Chapter 50.

Then, beginning in the second quarter of our century, and greatly intensified after World War II, came the second phase—the Era of the Rockhound. Numerous factors have combined to produce this situation. None of these is more significant than the general increase in leisure and prosperity in the United States. Hobbies, as well as people, have proliferated on every hand, and the rockhound hobby has benefited more than most. Like many of the other hobbies, it does not necessarily require the expenditure of more than a nominal amount of money in order to be enjoyed, but spending often seems to make it more pleasurable. In other words, money is not necessary but it helps. The do-it-yourself trend, which may cost more than it saves, is most conspicuously seen in the lapidary aspects of rockhounding.

The art and craft of gem cutting has a deeper significance than merely giving its practitioners something to do. This is because—unlike most hobbyists—the amateur lapidary can carry his activity from its most primitive form—finding rough minerals and rocks in the field—to the completed stage of mounting it in jewelry. (Silversmithing has become an integral part of this branch of the hobby.) The lapidary therefore can, and many do, perform all the operations involved. In this way, he has restored to himself the sense of fulfillment that the modern world has removed from so much of life, especially in work. He is in succession a specialist in several unlike arts—from

prospector to jeweler—creating a complete product of satisfying beauty.

The invention of Carborundum was a milestone in the development of lapidary techniques. The introduction, in recent years, of other abrasives and other kinds of equipment has done much to promote the rockhound hobby in this country.

An outgrowth of the past, prosperous decade or two has been an increase in motor travel and the availability of the jeep-type vehicle, a direct result of the war.

So much equipment is now on sale that the hobbyist can do almost everything for himself. This contrasts with the days when Burton O. Longyear, America's pioneer amateur lapidary, had to invent his own machine, which he carried in a suitcase and operated on his lap. With it, he shortened the tedious train rides between his home and college, in Michigan, about 1890. Only much later was the apparatus motorized. This forestry professor, now retired in Phoenix, is still fashioning exquisite gems at the age of ninety-five.

The American capacity for mass production shows in the fad for tumbling gems in rotating barrels and similar devices. It yields smooth, colorful gems in quantity, as cheaply as any foreign source of supply.

The growth of the cities has caused a reaction in the form of camping and other outdoor recreation, and again rockhounding has profited. The uranium boom of the mid-1950s arrived at just the right time to spur the interest in minerals to best advantage. Never before in history had so concerted an effort been made to find a single mineral resource. With the decline of uranium prospecting, the search for rock and mineral specimens again took on its family characteristics, and this too accompanied the spirit of family togetherness that was abroad in the land. Seriously intentioned pebble pups in America are now much more numerous than were all the world's mineral collectors a few years ago.

The American penchant for joining is clearly reflected in the hundreds of gem, mineral, and rock clubs that have sprung up. Many of them are affiliated into regional federations, and these federations into the American Federation of Mineralogical Societies.

The adult-education movement also has influenced the rockhound hobby. All large cities and many small ones offer courses in mineralogy, geology, and the lapidary subjects. These owe their existence mainly to the expansion of the hobby, and many of them are sponsored by clubs, though taught through the schools.

Sustaining such activities is the coming-of-age of science in America. To meet the demands placed upon them by inquisitive youngsters, teachers of elementary grades are improving their knowledge of the mineral kingdom by taking the courses referred to and by reading books. Long neglected in favor of other subjects, earth sciences—which, as physiography, went out early in the century—are returning rapidly to the high schools, particularly in the North Atlantic states.

More literature on the subject is available and is being bought. One attractive book on rocks and minerals has sold five million copies at a dollar each through a bewildering multiplicity of outlets. Other books have been issued at all levels from the beginning reader to the technically trained man or woman who wants to get acquainted with this fascinating aspect of science and nature.

CHAPTER 3

AMERICAN GEM NAMES

"Call things by their right names."
GREGORY:
Life of Hall

Six gem minerals, first described in this country, bear the names of American people and places. These are legitimate names, recognized and used in scientific circles around the world. In addition, there are some acceptable synonyms for gems and ornamental stones more properly known under their mineralogic names—such as Lake Superior, or Isle Royale, greenstone, for chlorastrolite from Michigan (see Chapter 38); utahlite, for variscite from Utah and Nevada (see Chapter 35); and californite, for massive, green idocrase from California.

Grading into this kind of gem name are the many unnecessary local names, especially for the quartz gems, that have been coined by individuals rather than derived from folklore. These—such as Amarillo stone for figured chalcedony from Texas and medfordite for moss agate from Oregon—are superfluous and tend only to confuse the beginning student and collector of gem stones. Some have been devised solely as trade names. Fortunately, even the rockhound clubs and magazines are beginning to take action to discourage their increase. Some fanciful names, such as Apache tears for rounded lumps of obsidian (see Chapter 34), are charming and acceptable.

Some names, such as myrickite, which is clear chalcedony spotted with red cinnabar, are applied to material that is distinctive enough to seem worthy of a separate name. This gem from California, named after F. M. Myrick, and binghamite, a silica replacement of goethite from Minnesota, named after William J. Bingham, are attractive but of minor standing.

In a quite different category are the seemingly endless names that misrepresent the true nature of the material. These purport to be something they may resemble in color only, and sometimes scarcely even that. "Alaska black diamond," a currently popular, widely sold form of hematite, not only is not diamond but does not come from Alaska. "Colorado jade" for green feldspar of the amazonstone variety (see Chapter 31), and "Arizona ruby" for pyrope garnet (see Chapter 17), have their counterparts throughout the world in "Cape ruby," "Brazilian emerald," and a host of others. The use of quotation marks around these inaccurate names has become a nearly universal warning.

A large number of such stones are labeled diamonds. Most of them turn out upon examination to be quartz of the rock-crystal variety. The "Pecos diamond" from Texas is a familiar example. The "Washita diamond" and "Hot Springs diamond" also come from the same general region of the United States—the Arkansas quartz deposits are the nation's finest. They occur lining cavities in sandstone and massive quartz of the Ouachita Mountains, in Saline, Garland, and Montgomery Counties; exceptional crystals weighing as much as 600 pounds have been found. Plain "Alaska diamond"—white, not black—is likewise rock crystal, as is "Hawaiian diamond." So lustrous are the "Herkimer diamonds" from New York that they seem almost to deserve the name. As doubly ended crystals, they grow in cavities in limestone at Middleville, Newport, and Little Falls, in Herkimer County, and are picked up from the overlying soil.

Another well-known gem of the same kind is the "Cape May

Quartz crystals from Hot Springs, Arkansas.

diamond" from New Jersey. It is found as rounded pebbles rather than crystals, sometimes from inland gravel pits, but mostly on the beaches of Cape May County. Rumors have circulated to the effect that these have been shipped to Europe for the purpose of training apprentice diamond cutters, but such a chamber of commerce-type story seems most unlikely, both from the nature of the diamond-cutting process and from the availability of similar material closer at hand—Europe, in fact, has its "Cornish diamond" and "Rhine diamond."

There are a few exceptions to this identification of false diamonds as quartz. "Pennsylvania diamond" is pyrite, "Nevada diamond" is obsidian, and "Colorado diamond" is smoky quartz. But the rest are colorless quartz. So many suspected diamonds

have been sent for identification to the U.S. Geological Survey and the Smithsonian Institution that personnel in these agencies devised a standard reply in the day when nearly every household had kerosene on hand. This suggested that the finder of a supposed diamond immerse it in that liquid, in which quartz becomes nearly invisible. The explanation is that the light-bending power (index of refraction) of kerosene is close to that of quartz, whereas diamond would continue to show through clearly.

Let us return to the six minerals of gem quality that have American names. The most famous of these is benitoite, found along the headwaters of the San Benito River in San Benito County, California (see Chapter 30).

Across the continent, at Danbury, Connecticut, a new silicate mineral was discovered long before benitoite. In 1839, it was given the name danburite. From other, foreign localities has come attractive gem material—pink, yellow, colorless—but American specimens have apparently not been used for this purpose. Danburite is a silicate of calcium and boron, $CaB_2(SiO_4)_2$.

In the early years, crystals of danburite were called bementite by mineral collectors, after the noted collector Clarence S. Bement, a Philadelphia manufacturer. This might be regarded as a variety name for the crystallized specimen, in the same way as lintonite, a green variety of the zeolite mineral thomsonite, was named after Laura A. Linton, who first analyzed it chemically, and ozarkite, a white variety of the same mineral, was named from its occurrence in the mountains of Arkansas. In the same category are morganite, the pink, lithium-colored variety of beryl, named after J. Pierpont Morgan; and goshenite, the colorless variety of the same mineral, named for its occurrence at Goshen, Massachusetts. Bowenite, named after G. T. Bowen, a nineteenth-century American mineralogist, who analyzed it, and williamsite, for L. W. Williams, a nineteenth-

century American mineral collector, are gemmy serpentine from Rhode Island and Maryland, respectively. Here, too, belong kunzite and hiddenite, but because they are the only named gem varieties of their species, they are discussed separately below.

Colemanite is one of the borate minerals from California, where there exist some of the world's largest concentrations of these products of arid-land evaporation and subsequent geologic processes. The material that has been carved is white, rather soft, and often fluorescent. It is a hydrous calcium borate, $Ca_2B_6O_{11} \cdot 5H_2O$, named in 1883 for William T. Coleman, of San Francisco, a founder of the California borax industry, and the owner of the mine in Death Valley where the mineral was first discovered.

Sillimanite has been cut as a rather hard, transparent, violet-blue gem, as well as a grayish-green gem showing a cat's-eye effect. Some material also resembles jade of brownish or greenish color. This aluminum silicate mineral, $AlAlO(SiO_4)$, was named in 1824 after Benjamin Silliman (1779–1864), one of the most prominent of American mineralogists. He was professor of chemistry at Yale University and the founder of the still-flourishing *American Journal of Science*. Most American sillimanite occurs in New England, but gemmy specimens have come from Idaho. Foreign sources include Ceylon and Burma.

Named after the Shattuck mine near Bisbee, Arizona, the hydrous copper silicate mineral shattuckite, with the formula $CuSiO_3 \cdot H_2O$, has been cut into occasional rounded and tumbled gems. These are blue and seem to be intergrowths of shattuckite and another mineral, perhaps quartz.

Found as bluish-green crusts in the cavities of variscite nodules in Utah (see Chapter 35), wardite has occasionally been shaped to resemble turquoise. Its chemical composition is that of a hydrous phosphate, $Na_4CaAl_{12}(PO_4)_8(OH)_{18} \cdot 6H_2O$.

It was named in 1896 after Henry A. Ward (1834–1906), a naturalist and mineral dealer of Rochester, New York.

The name of the important and interesting mineral spodumene is of standard mineralogical origin—even though it does not end with the usual *ite*—but the names of both of its specially named gem varieties honor two Americans closely associated with the progress of gemology in this country. Kunzite, the lilac-colored variety, was named for George Frederick Kunz (1856–1932), long connected with Tiffany and Company and the author of extensive works on gems. Hiddenite, the emerald-green variety, was named in 1881 for William E. Hidden, who was in charge of mining operations near Stony Point, in Alexander County, North Carolina, when it was first found (see Chapter 27).

To these American gem names might be added unakite, named after the Unaka Mountains, along the Tennessee–North Carolina border. This, however, is a rock, not a mineral, inasmuch as it consists of several distinct minerals—quartz, pink feldspar, and green epidote. The different colors make it a most appealing rough material for amateur lapidaries. Nevertheless, unakite is not essentially different from many other igneous rocks that likewise show curious textures; a number of these have been given domestic names (often unnecessary), according to their geographic occurrences.

Californite, mentioned previously, may actually be a rock-like (metamorphic) mixture of idocrase and grossularite garnet or serpentine, and hence not a variety name of a single mineral at all.

CHAPTER 4

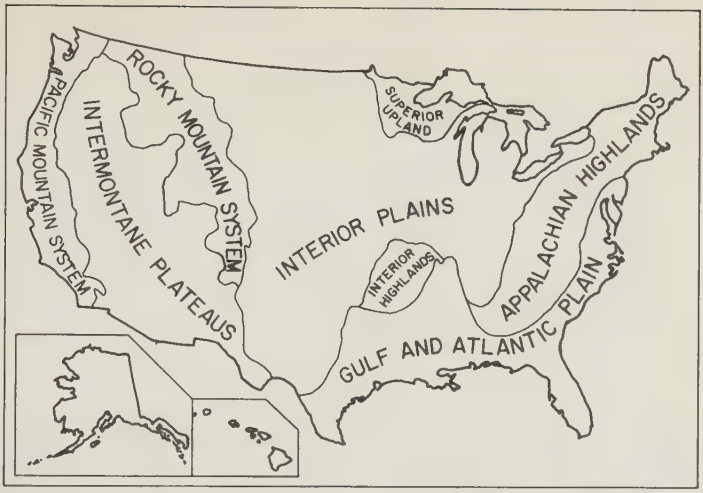
THE GEOLOGIC FRAMEWORK

"The chief foundations of all states."
—NICOLÒ MACHIAVELLI:
The Prince

The United States is more noted for the diversity of its gems than for the richness of any individual deposit. This diversity reflects not only the large area involved, but also the underlying complexity and variation of the geology, upon which mineralization depends. The oceans form natural boundaries east and west, but the north and south borders are political, and the country partakes of the character of both of its neighbors, Canada and Mexico. Alaska is rather like an extension of Canada; Hawaii, however, is a unit in itself.

The geologist may, on the largest scale, regard the conterminous 48 states as consisting of perhaps 6 major structural regions. These have been suitably subdivided into 8 major physiographic divisions, which in turn consist of 25 physiographic provinces and 78 physiographic sections.

Each of these regions is distinguished by its own type of geology, its own kinds of rocks, and its own assortment of minerals, the gems among them. Certain ubiquitous minerals are, of course, not restricted to specific areas, but—except for the quartz gems, which seem to be almost everywhere, at least in the West—the gem minerals are, by their very nature, less



Physiographic divisions of the United States.

widely distributed and hence more elusive. The "lucky" collector is often the one who has a keen sense of the rock relationships and mineral associations in the place where he is working, based usually on extensive experience. The author has emphasized this in detail in connection with gem localities in Colorado * and has shown how, in earlier years, only a few gem prospectors accounted for a large proportion of the successful discoveries. They acquired a sixth sense of where to look.

The Canadian Shield—an ancient, stable part of the continent—extends across the boundary of the United States into several of the northern states. From the standpoint of physical geography, it has been named the Superior Upland. It is a remarkably flat region consisting of Pre-Cambrian rocks of great complexity. (For your convenience, the geologic time scale is given on page 16.) These rocks have been eroded to a widespread flat surface called a peneplain, and have been stripped bare by Ice Age glaciation. The drainage is poor; hence, the land contains many lakes and swamps.

* *Colorado Gem Trails and Mineral Guide*, by Richard M. Pearl, Sage Books, Denver, 2d edition, 1964.

Geologic Time Scale

Era	*Period*	*Epoch*	*Duration in Millions of Years*	*Began Millions of Years Ago*
Cenozoic	Quaternary	Recent	(Late archeologic and historic time)	
		Pleistocene	1	1
	Tertiary	Pliocene	12	13
		Miocene	12	25
		Oligocene	11	36
		Eocene	22	58
		Paleocene	5	63
Mesozoic	Cretaceous		72	135
	Jurassic		46	181
	Triassic		49	230
Paleozoic	Permian		50	280
	Carboniferous: Pennsylvanian and Mississippian		65	345
	Devonian		60	405
	Silurian		20	425
	Ordovician		75	500
	Cambrian		100	600
Pre-Cambrian: Proterozoic and Archeozoic			900	1,500
			(Undetermined)	

The Interior Lowlands are a continuation, to the south and west, of the rocks of the Canadian Shield, which are covered by sedimentary rocks of varying thicknesses. These are folded into domes, arches, and basins, which formed during the Paleozoic Era and were partly covered by later sedimentary material. Mountains were formed in the southwestern corner of this region and then buried, to be later involved to some extent in the Rocky Mountains. The Interior Plains have been

divided into the Interior Low Plateaus, the Central Lowland, and the Great Plains. The Interior Highlands include the Ozark Plateaus and the Ouachita province.

Along the Atlantic border of the country, extending at intervals across the southern part, are folded mountains, of which the Appalachians are the principal representatives. These consist of a double belt—an inner one compressed into mountains in the Paleozoic Era, and an outer one similarly deformed three times during the same era. For convenience, the Appalachian Highlands have been separated into the Piedmont province, Blue Ridge province, Valley and Ridge province, St. Lawrence Valley, Appalachian Plateaus, New England province, and Adirondack province.

The Atlantic and Gulf Coastal Plains overlap—as thick Cretaceous and Tertiary sedimentary rocks—upon the older rocks of the eastern and southern margins of the United States and continue seaward upon the continental shelf.

Folded mountains of Cretaceous and Cenozoic age constitute the Rockies. Sedimentary rocks were compressed in the Cretaceous and Tertiary Periods, and large blocks of the earth's crust to the west of the Rocky Mountains have been uplifted from that time to the present. This separates the western interior of the country into the Rocky Mountain System (Northern, Middle, and Southern Rockies and the Wyoming Basin) and the Intermontane Plateaus (Colorado and Columbia Plateaus and the Basin and Range province).

The Pacific border of the United States is marked by a complex system of mountain belts extending in age from Paleozoic through Mesozoic and Cenozoic. The geologic history embraces sedimentary, intrusive, and volcanic rocks. The Pacific Mountain System is divided into the Cascade–Sierra Mountains and the Pacific Border and Lower California province.

CHAPTER 5

THE NATURE OF GEMS

"The flowers of the minerals."
—RENÉ JUST HAÜY

Gems are those minerals and related substances—and their manmade substitutes—that possess certain fairly definite characteristics making them desirable for personal adornment and ornamental uses. The once more or less rigid distinction between precious and semiprecious stones has lost its meaning; no accurate classification is possible on the basis of value, for a fine green demantoid garnet is worth more than many an inferior sapphire.

The three chief virtues of a gem are beauty (the prime attribute), durability, and rarity. Other, lesser factors also contribute to the value of a gem, such as skillful fashioning (cutting, polishing, carving), the caprices of style, and historical significance—including the patriotic appeal of American gems to American people. A gem becomes a jewel when placed in a setting appropriate to its use.

The properties of a gem are its chemical and physical characteristics. By them is it identified and named. Chemical tests are seldom performed on gems, for obvious reasons. Nevertheless, it is often worth knowing whether a given gem is a silicate (as most of them are), an oxide, a phosphate, sulfate, carbonate, halide, or native element (as is diamond).

More useful for purposes of identification is the geometry of

gem crystals. According to the arrangement (number, relative lengths, and angular relationships) of imaginary axes within the crystal, all crystals belong to one of the following six systems: isometric, tetragonal, hexagonal, orthorhombic, monoclinic, triclinic. Each has a different pattern of symmetry.

The physical (including the optical) properties of gems are most often used to identify them. Some simple equipment is helpful, although some of the problems require expensive apparatus. Field tests for most of the important gem minerals, needing only a few items found in the home, are given in the book *How to Know the Minerals and Rocks,* by Richard M. Pearl (McGraw-Hill Book Company, New York, 1955).

Color is one of the fundamental properties of gems. Combined with luster, which is the effect of surface reflection, color is the chief element of beauty, without which a substance can hardly hope to enter the ranks of the gems. Even in a colorless gem, such as diamond, some aspect of color is present, as in dispersion, or "fire," whereby light is broken up into its component colors, which are those of the spectrum. Luster is described as adamantine (diamondlike), vitreous (glassy), oily, pearly, etc. Luminescence (fluorescence, phosphorescence) is another optical property of interest, being the response of gems to invisible radiation, especially of ultraviolet light. Dichroism is the difference in color of the separate components of light that combine to make the color we see in a particular crystal direction in a gem. The extent to which light is bent when entering a gem is measured by its index of refraction and is a factor in the brilliance that can be obtained when the proper cutting is executed. A number of gems have distinctive optical properties, difficult to describe but of winning appeal. These include asterism, shown by starlike rays of light; chatoyancy, seen as a band of light on the surface of fibrous gems; and interference of light, giving a play of bright color.

Hardness, or resistance to scratching, is important to the durability of a gem. So is toughness, or resistance to breakage,

which is different from hardness. Cleavage is the way in which a gem mineral breaks in a definite direction; parting is a sort of pseudocleavage; and fracture is breakage without regularity, although it does present recognizable patterns, such as conchoidal (shell-like). Specific gravity is the relative weight of a gem, compared to water. Various minor physical properties help to distinguish gems from one another.

The major gems that are of especial American significance are described in this chapter. More about them can be read in the usual books on gems and gemology. The gems of less general importance are described in the particular chapter where they are discussed in this book.

Azurite is a mineral composed of hydrous copper carbonate, $Cu_3(CO_3)_2(OH)_2$. It crystallizes in the monoclinic system and occurs in crystals and rounded masses. The color is blue. Azurite effervesces in acid and can be scratched with a knife. The fracture is irregular.

Benitoite is a mineral composed of barium and titanium silicate, $BaTiSi_3O_9$. It crystallizes in the hexagonal system and occurs in small, flat, triangular crystals. The color is blue and the luster vitreous. The hardness is only moderate, and the fracture is shell-like (conchoidal) to irregular.

Beryl is a mineral composed of beryllium-aluminum silicate, $Be_3Al_2(SiO_3)_6$. It crystallizes in the hexagonal system and occurs in six-sided crystals, often very large. These are usually flat, but small crystals sometimes terminate in tapering faces. The typical home of beryl is in pegmatites, although the emerald variety and some common, commercial beryl are found in veins. Beryl can be identified by its frequent greenish hue, its vitreous luster, and its hardness (it will scratch glass).

Aquamarine is the blue or bluish-green variety of beryl, colored by iron. The crystals are sometimes large and are often

very clear. They frequently show lines or grooves (striations) in the long direction.

Emerald is the green variety of beryl, colored by chromium and modified by vanadium. Clear crystals are almost unknown, and flaws are regarded as inevitable. The chief occurrence is in veins.

Morganite is the pink variety of beryl, colored by lithium. The name includes rose- and peach-colored stones.

Goshenite is the colorless variety of beryl.

Coral is an organic deposit of calcite, $CaCO_3$, which the coral polyp, a small marine animal, extracts from the water and secretes as a framework upon which it lives. Coral effervesces in acid, can be scratched with a knife, and has the other properties of calcite. The usual gem coral is some shade of red or pink; black coral consists mostly of conchiolin, an organic substance.

Corundum is a mineral composed of aluminum oxide, Al_2O_3. It crystallizes in the hexagonal system and occurs in straight and barrel-shaped, six-sided crystals, sometimes flat and sometimes of considerable size. Corundum develops in metamorphic rocks and is often found in placer deposits. This mineral is rather heavy and extremely hard, and will scratch every other mineral except diamond. The luster is vitreous to nearly adamantine, and a bluish-gray color is often seen. The rhombohedral parting resembles cleavage.

Ruby is the red variety of corundum, colored by chromium. Iron modifies the hue and so also does the natural fluorescence.

Sapphire is corundum of any color except red—but this name usually means blue, the color being due to titanium and iron and possibly chromium.

Diamond is a mineral composed of native carbon, C. It crystallizes in the isometric system and occurs mostly in octahedral

and star-shaped, twinned crystals. The origin is in basic igneous rocks formed at high temperature and pressure, and placer deposits are a common secondary source. Color is usually absent, and the luster is adamantine. The hardness exceeds that of any other natural substance. An easy cleavage makes it possible to split diamonds without sawing through them.

FELDSPAR is a group of aluminum silicate minerals. They crystallize in the monoclinic and triclinic systems. Feldspar occurs in almost every kind of rock. The luster is glassy or, on the two good cleavage surfaces, pearly. The hardness is moderate, but feldspar will scratch glass.

Orthoclase is a monoclinic species of feldspar, $KAlSi_3O_8$. It includes most of the milky, gem variety called *moonstone.*

Microcline is a triclinic species of feldspar, $KAlSi_3O_8$. It includes the green variety called *amazonstone.*

GARNET is a group of silicate minerals. They crystallize in the isometric system and occur especially in dodecahedral and trapezohedral crystals. Garnet is found in igneous, metamorphic, and sedimentary rocks, depending upon the chemical composition of the particular garnet. The luster is vitreous, and the hardness is variable but sufficient to scratch glass. Some degree of parting and a fracture of no special character are often seen.

Pyrope is a subspecies of garnet composed of magnesium and aluminum, $Mg_3Al_2(SiO_4)_3$. The color is red. When combined with almandine, it includes the variety *rhodolite.*

Almandite is a subspecies of garnet composed of iron and aluminum, $Fe_3Al_2(SiO_4)_3$. The color is red. It is heavier than pyrope.

JADE can be either of two separate silicate minerals, nephrite or jadeite. They are similar in their range of colors (of which

green is most typical) and in their remarkable toughness, although the hardness is barely enough to scratch glass. Both are of metamorphic origin and are found in solid rock and as rolled boulders. The luster is vitreous.

Nephrite is a compact variety of either tremolite or actinolite, both members of the amphibole family. The composition is $Ca_2(Mg,Fe)_5(OH)_2(Si_4O_{11})_2$.

Jadeite is a member of the pyroxene family, $NaAl(SiO_3)_2$. It is heavier than nephrite.

Lapis lazuli is a rock of metamorphic origin. It consists of any of the following blue minerals belonging to the feldspathoid group: hauynite, lazurite, sodalite, and noselite. In addition are calcite, pyrite, and several dark-green minerals, which give the variegated color. The luster is vitreous, and the hardness is about equal to that of glass.

Malachite is a mineral composed of hydrous copper carbonate, $Cu_2CO_3(OH)_2$. It crystallizes in the monoclinic system and occurs in rounded masses. The color is green. Malachite effervesces in acid and can be scratched with a knife. The fracture is irregular.

Obsidian is a rock that consists of natural glass of variable chemical composition. The origin is igneous, the occurrence being in or near surface flows of lava. The color is black, deep brown, red, gray, or mottled red and black. The hardness is that of glass, and the shell-like (conchoidal) fracture is distinctive.

Olivine is a mineral composed of iron and magnesium silicate, $(Mg,Fe)_2SiO_4$. It crystallizes in the orthorhombic system and occurs in flat, elongated crystals having a series of lines (striations) on the surface. The origin is in basic igneous rocks, from

which rolled grains may be derived. It has a vitreous to oily luster. It is only moderately hard and will barely scratch glass; the fracture is shell-like (conchoidal). The gem variety is better known as *peridot*, colored green by iron and nickel.

OPAL is a mineral composed of hydrous silica, $SiO_2 \cdot nH_2O$. It is an aggregate of tiny crystals of cristobalite, containing varying percentages of water. It occurs as rounded crusts formed by deposition from solution. Opal is often a petrifying agent of wood. Its play of colors is due to interference of light. The luster is oily. The hardness is about the same as that of glass, and opal breaks with a shell-like (conchoidal) or an irregular fracture.

Black opal has a dark background, either black, blue, green, or gray.

White opal has a light background.

PEARL is a gem of organic origin, deposited in concentric layers within the mantle, which lies inside the shell of a bivalve mollusk. Pearls are composed of the mineral aragonite, $CaCO_3$, and conchiolin, an organic substance. The pearly luster is due to the effect of light on the overlapping plates. Pearls grow in both sea and fresh water.

QUARTZ is a mineral composed of silica, SiO_2. It crystallizes in the hexagonal system and forms as six-sided, elongated crystals showing fine lines (striations) in the long direction, and tapering to one or both ends. Quartz also forms as chalcedony, which does not occur in crystals. The many names of quartz and chalcedony result from the great diversity of colors and patterns. Quartz occurs in almost every kind of rock and geologic environment. The luster is vitreous. Quartz is a standard of hardness, and breaks with a shell-like (conchoidal) fracture.

Rock crystal is the colorless, transparent variety of quartz.

Amethyst is the violet to purple variety of quartz; the cause of the color, which occurs in patches, is still unknown.

Rose quartz is the pink variety of quartz. The color, which is subject to fading in light, may be due to titanium.

Agate is the banded variety of quartz. It occurs as a filling of cavities, in nodules of several kinds (including thunder-eggs), and as a replacing material in petrified wood and bone.

Moss agate shows a dendritic pattern resembling plants.

Jasper is the opaque variety of quartz, deeply colored in red, green, yellow, or brown, and in combinations of colors. It occurs like agate.

SPODUMENE is a mineral composed of lithium and aluminum silicate, $LiAl(SiO_3)_2$. It crystallizes in the monoclinic system and occurs in flat, elongated crystals showing parallel lines (striations) in the long direction. The origin is in pegmatite, in which spodumene sometimes grows to huge sizes. The luster is vitreous, the hardness is enough to scratch glass, and the nearly right-angled cleavage is very prominent.

Kunzite is the orchid-pink variety of spodumene, colored by lithium.

Hiddenite is the green variety of spodumene, colored by chromium.

STAUROLITE is a mineral composed of hydrous silicate of iron and aluminum, $Fe_2Al_9O_7(SiO_4)_4(OH)$. It crystallizes in the orthorhombic system and occurs in crystals (often twinned) and masses of metamorphic origin. The color is usually brown, and the luster depends upon the purity and freshness of the specimen. The hardness is substantial, and the fracture is irregular.

TOPAZ is a mineral composed of aluminum silicate with fluorine, $Al_2(F,OH)_2SiO_4$. It crystallizes in the orthorhombic system and occurs in elongated crystals, often lined (striated)

in the long direction, and coming to a point, usually at one end only. The typical origin is in pegmatite, from which it may be carried to placer deposits. Most topaz is colorless, but some is blue, green, brown, or yellow. The luster is vitreous. Topaz is hard but cleaves readily.

Tourmaline is a mineral composed of a complex, hydrous silicate. It crystallizes in the hexagonal system and occurs in triangular, elongated crystals, which are ruled (striated) in the long direction. Tourmaline is mostly of pegmatite origin. The color is variable, often seen in combinations, such as pink and green, blue, and colorless, etc. The luster is vitreous. The hardness is substantial; tourmaline breaks with an inconspicuous fracture.

Rubellite is the pink to red variety of tourmaline, colored by lithium.

Indicolite is the blue variety of tourmaline.

Achroite is the colorless variety of tourmaline.

Turquoise is a mineral composed of hydrous copper aluminum phosphate, $CuAl_6(PO_4)_4(OH)_8 \cdot 4H_2O$. It crystallizes in the triclinic system but occurs as nuggets, veins, and crusts. The origin is mostly in arid regions as a somewhat porous deposit in volcanic rock. The color ranges between blue and green; the brown markings are the iron-stained matrix. A waxy luster is present. The hardness is moderate, and turquoise breaks with an even fracture.

Variscite is a mineral composed of hydrous aluminum phosphate, $AlPO_4 \cdot 2H_2O$. It crystallizes in the orthorhombic system. The color is green to bluish green, due to chromium and iron. The luster is vitreous. The hardness is moderate, and the fracture is even.

CHAPTER 6

WHERE TO COLLECT GEMS

"Here a little, and there a little."
—*Isaiah* 28:10

Nearly everywhere in America does the opportunity present itself to collect gem stones in the rough. Specimens suitable for jewelry as well as for display on the table or mantel are to be found in every one of the 3,072 counties, including the parishes of Louisiana, as well as the 24 election districts of Alaska, the District of Columbia, and the undivided Yellowstone National Park. The *World Almanac* also enumerates 32 independent cities in Virginia and 1 each in Maryland and Missouri—somewhere within the limits of each of these cities, in somebody's backyard or in a sandbank or gravel pit, a worthy enough gem can be picked up. Perhaps it won't equal the Punch Jones diamond crystal of 34.46 carats' weight, which Punch found in April 1928 while pitching horseshoes with his father in a vacant lot in Peterstown, West Virginia, but it might suffice.

Road cuts, excavations, cliffs, the beach, and the desert are likely places in which to search for gem materials—wherever, indeed, rock is exposed or its eroded fragments have accumulated. One need only look sharply. Hills and mountains seem the natural home for minerals of the desired kind, and of course they are to be favorably regarded, but nearly every

type of terrain offers promise of something of worth. A detailed discussion of the places in which gem stones most abound is the illustrated book *Successful Mineral Collecting and Prospecting*, by Richard M. Pearl (McGraw-Hill Book Company, New York, 1961).

The magazines devoted to the mineral, gem, and lapidary hobby carry locality articles in each issue, often giving explicit directions for reaching them. Most of the hundreds of clubs organized for the promotion of the same hobby conduct field trips to good collecting spots. The geologic surveys and the mining bureaus in many of the individual states publish lists of gem and mineral localities, and there are available detailed guides to certain of the states. At intervals, the U. S. Geological Survey issues an indexed bibliography to articles and other literature that have been printed about the gems of all the states; these can be consulted in your public or school library.

Cabochon gems of American origin. Top: red jasper. Second row: turquoise, smithsonite, amazonstone. Third row: agate, Petosky stone. Bottom row: petrified wood, williamsite, carnelian.

CHAPTER 7

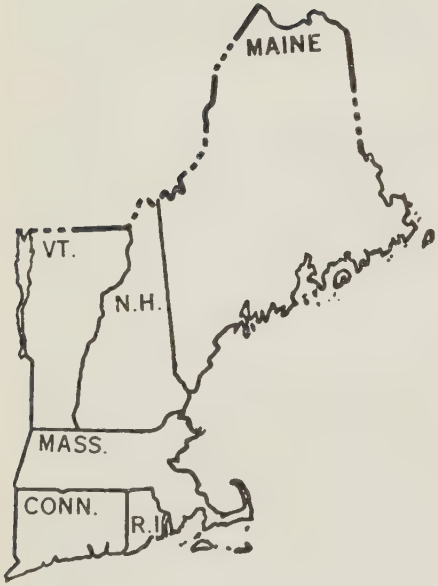
GEMS OF THE FIFTY STATES

"A country fairly bursting with wealth."
—WILLIAM COWPER BRANN:
Slave or Sovereign

Every one of the fifty states is a commercial producer of gems. During the most recent extended period for which figures are available (1953–1958), the U. S. Bureau of Mines has reported that ten states have been responsible for 87 percent of the total; in order, these are Oregon, California, Texas, Nevada, Arizona, Washington, Wyoming, Utah, Colorado, and Montana. Most of the rest came from other places in the Rocky and Appalachian Mountains. The domestic production of gem materials and mineral specimens in 1962 was estimated at $1,296,000.

Each of the fifty states also contains unworked deposits of gem minerals that await the amateur field collector. In order to encourage the search for them, the principal gem localities in this country are enumerated in this chapter, arranged for convenience according to the nine geographic divisions of the U. S. Bureau of the Census.

The accompanying regional maps list only those gems that are discussed in this book. Agate, jasper, petrified wood, and silicified dinosaur bone are found more widely throughout the West, pearls occur in many other streams, and all the fifty states have many minor gems that do not appear on these maps.



New England States

Connecticut
danburite
datolite
topaz

Maine
amethyst
rose quartz
topaz
tourmaline

Massachusetts
amethyst
datolite
goshenite
topaz

New Hampshire
amethyst
topaz

Rhode Island
agate
bowenite
jasper

Vermont
jasper
staurolite

New England States

Reflecting the solid foundation of granite and other hard and ancient rocks that underlie the glacier-strewn surface of the New England states, the gems of the northeastern corner of America are typically of pegmatite and metamorphic origin.

The tourmaline deposits in Maine are the most important producers of gems in New England; the names Mount Mica and Mount Apatite are world famous.

Middle Atlantic States

Next to New England the smallest of the geographic divisions of the United States, this region is more highly mineralized than its industrial nature might lead one to suppose. The gems may be simple, but they are widely distributed. The most conspicuous gem material is perhaps quartz, which has furnished the Herkimer and Cape May "diamonds" of New York and New Jersey, respectively.

New Jersey
datolite
rock crystal
ruby
sapphire

New York
diamond
Petosky stone
rock crystal
rose quartz

Pennsylvania
amazonstone
amethyst
aquamarine
pyrite
sapphire

Middle Atlantic States.

East North Central States

This part of the United States lies buried beneath the glacial moraines of the Ice Age. Within this mass of jumbled rock is a heterogeneous assortment of gem minerals brought from elsewhere—from the eastern provinces of Canada and the

northern tier of states, including the now-watery beds of the Great Lakes. This is doubtless the source of the diamonds described in Chapter 12. The agates and agatelike gem stones of the Lake Superior region and some of the catlinite are shared by this region. Michigan's datolite and alabaster are other gem materials of interest.

East North Central States.

Illinois
diamond
pearl

Indiana
diamond
pearl

Michigan
agate
alabaster
chlorastrolite
datolite
diamond
jasper
Petosky stone
thomsonite

Ohio
catlinite
diamond

Wisconsin
catlinite
diamond

West North Central States

This central part of North America is situated largely in the glacial zone of the United States. It includes some of the Lake Superior gems and some of the catlinite. The most abundant gem is quartz, of which the rose quartz of South Dakota deserves special mention. This state is also among the leaders in agate and petrified wood.

Iowa
Petosky stone

Kansas
agate
jasper

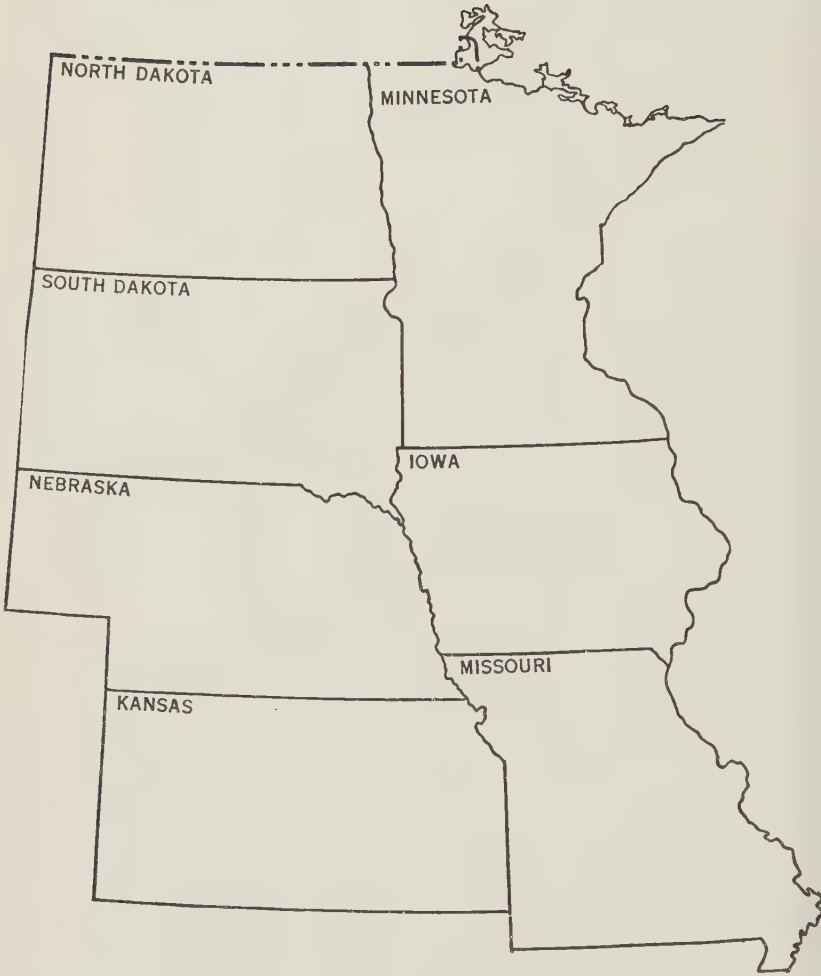
Minnesota
agate
binghamite
catlinite
chlorastrolite
jasper
thomsonite

Missouri
agate
jasper
pearl

Nebraska
agate
jasper

North Dakota
agate
jasper

South Dakota
agate
catlinite
jasper
rose quartz



West North Central States.

South Atlantic States

Stretching a long distance down the coast, this region yields gems ranging in nature from the amazonstone feldspar in the granite pegmatite of Virginia to the silicified coral of Florida. It includes rhodolite garnet in North Carolina and the hiddenite, emerald, and ruby in the same state. The curious staurolite twins are found in several of the Appalachian states, especially Virginia, North Carolina, and Georgia.

Florida
- silicified coral

Georgia
- amethyst
- aquamarine
- rose quartz
- ruby
- staurolite
- topaz

Maryland
- agate
- jasper
- williamsite

North Carolina
- amazonstone
- amethyst
- aquamarine
- emerald
- hiddenite
- rhodolite garnet
- ruby
- sapphire
- staurolite

South Carolina
- aquamarine
- emerald
- topaz

Virginia
- amazonstone
- amethyst
- diamond
- staurolite
- topaz

West Virginia
- diamond

South Atlantic States.

East South Central States

This region contains mining districts of great significance to the economy of the United States. It, however, affords relatively less in gems than in metals and the ordinary nonmetallic mineral resources with which nature has endowed it. The pearl fisheries of the Mississippi River, its tributaries, and other streams constitute a gem source of unusual interest.

East South Central States.

West South Central States

This region yields to no other in the United States in the contrasting nature of its gems. The original Spanish settlement of Texas has been ascribed to the discovery of fresh-water pearls in the Nueces River. Surely, the high temperature and pressure needed to form diamonds deep within the crust of the earth in Arkansas constitute a strikingly different environment from that in which a pearl mussel lives. The topaz and agate of Texas are among the best in the country, and the rock-crystal quartz of Arkansas ranks equally high.

West South Central States.

Arkansas
- diamond
- pearl
- rock crystal
- thomsonite

Louisiana
- agate
- jasper

Oklahoma
- agate
- jasper

Texas
- agate
- amethyst
- jasper
- rock crystal
- topaz

Mountain States

Extending over so huge and heterogeneous an area, the gems of the Rocky Mountain and other interior mountain states should surprise no one by their variety. Here are mountains, plateaus, and plains on a grand scale, each with its own geology and mineral products, including gems.

Montana's sapphire fields rank first or second among the most valuable gem deposits in America. The moss-agate beds are also important, and the amethyst is of high quality. Star garnet is of particular interest in Idaho. Wyoming is distinguished for its jade and moss agate. Nevada's opal is outstanding, and so is its turquoise. More gem obsidian comes from Utah than from any other state; so does nearly all the variscite. Colorado is noted for alabaster, amazonstone, amethyst, aquamarine, lapis lazuli, topaz, and turquoise. The agatized wood of Arizona is one of the most remarkable gem deposits anywhere, and this state also has fine amethyst, garnet and peridot, turquoise, azurite and malachite, and obsidian. New Mexico has peridot and garnet, as well as staurolite to compensate for the decline of what were once the major turquoise mines on the continent. Dinosaurian gems are found in a number of the Rocky Mountain states.

Arizona
- agate
- amethyst
- azurmalachite
- catlinite
- jasper
- peridot
- pyrope garnet
- shattuckite
- turquoise

Colorado
- agate
- alabaster
- amazonstone
- amethyst
- aquamarine
- jasper
- lapis lazuli
- obsidian
- rose quartz
- sapphire
- smoky quartz
- topaz
- turquoise

Idaho
- agate
- aquamarine
- jasper
- opal
- ruby
- sapphire
- sillimanite
- star garnet

Montana
- agate
- amethyst
- jasper
- moss agate
- ruby
- sapphire

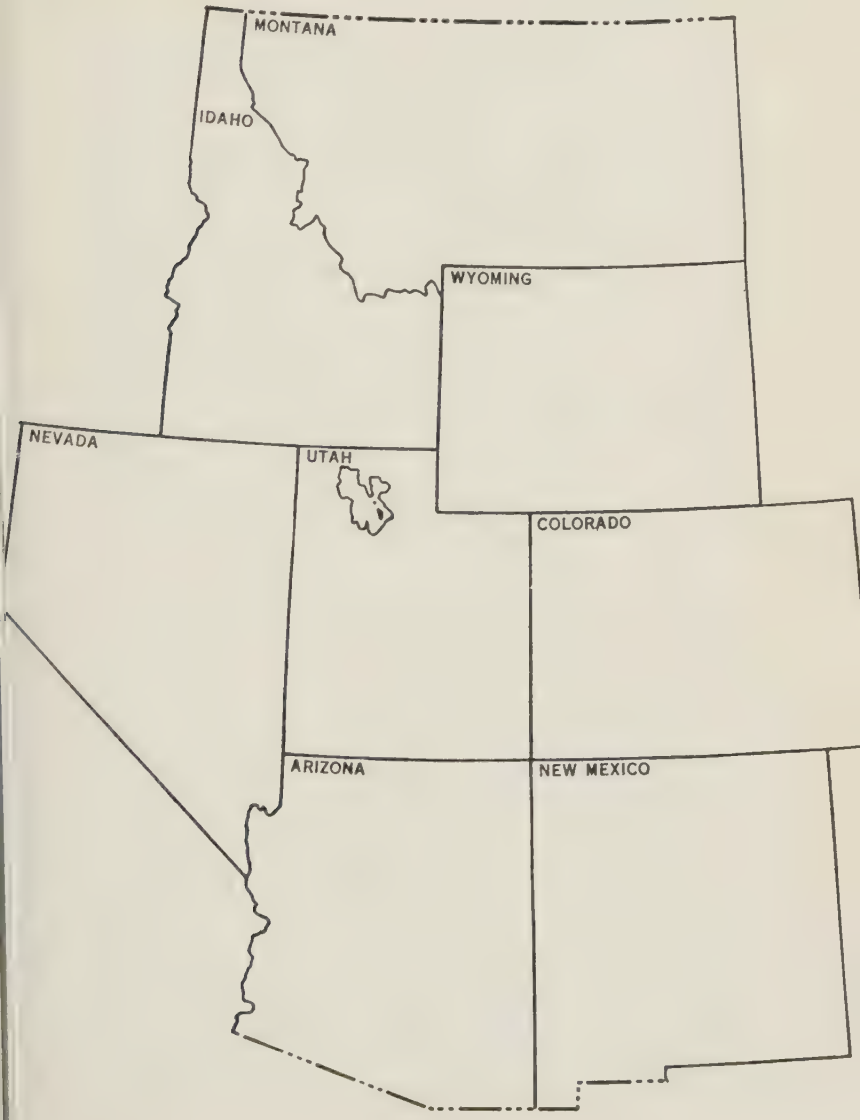
Nevada
- agate
- emerald
- jasper
- obsidian
- opal
- turquoise
- variscite

New Mexico
- agate
- aquamarine
- jasper
- obsidian
- opal
- peridot
- pyrope garnet
- staurolite
- turquoise

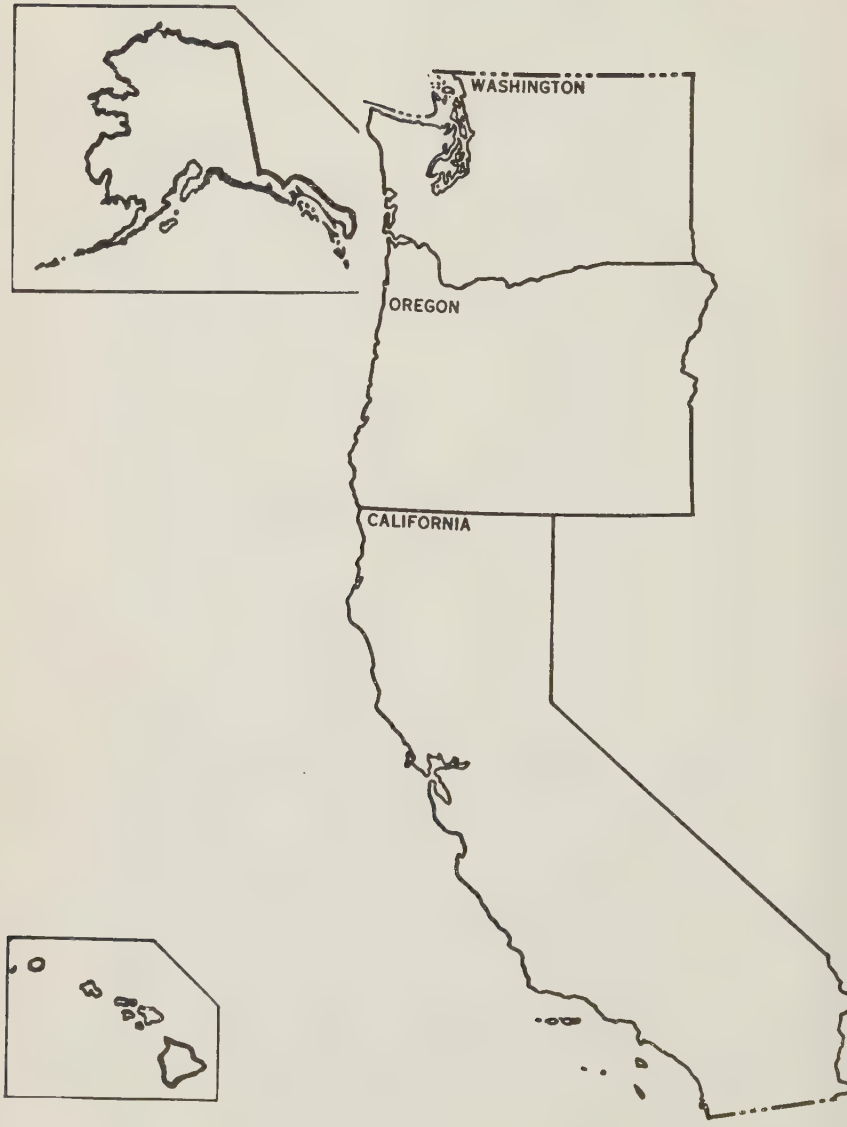
Utah
- agate
- jasper
- obsidian
- topaz
- variscite
- wardite

Wyoming
- agate
- aquamarine
- jasper
- moss agate
- nephrite jade

Mountain States.



Pacific States.



Alaska
- agate
- jasper
- nephrite jade
- rock crystal
- ruby

California
- agate
- aquamarine
- benitoite
- californite
- colemanite
- diamond
- howlite
- jadeite jade
- jasper
- kunzite
- lapis lazuli
- myrickite
- nephrite jade
- topaz
- tourmaline
- turquoise

Hawaii
- coral
- rock crystal

Oregon
- agate
- jasper
- obsidian
- opal

Washington
- agate
- jasper
- sapphire

Pacific States

The extraordinary diversity of geologic conditions in the three contiguous states that border the Pacific Coast is matched by the enormous variety of gem materials occurring in the rocks and on the surface. California leads all the other states of the nation in the number of kinds of gems and other minerals known to occur within its boundaries, and has long been the home of more gem collectors and amateur lapidaries; consequently, it is also the place of publication of more of the hobby magazines, the place of business of more dealers in equipment, and the base of operations of more clubs and societies in this field than any of the rest of the states. Oregon,

largely because of its prolific occurrences of agate, is the country's second biggest producer of commercial gem material.

The tourmaline in California, the world's most important source, is superb. So is the extraordinarily fine kunzite, the lilac-colored variety of spodumene. The jade of California, and the turquoise, are of especial interest. Howlite comes chiefly from California. Oregon is famed for its thundereggs and other agates. Washington has agates of many kinds.

Vastest of the states and one of the largest political units in the world, Alaska contains the ingredients that should make possible a tremendous variety of gems when it has been adequately explored. Now, however, the principal gem is jade, although others of value have indeed been found.

The uniform nature of the rock that constitutes the islands of Hawaii—all of it volcanic in origin—make unlikely any considerable range of mineral products. There are gems of interest, but the chief of these—the luxurious black coral—comes from the all-embracing sea.

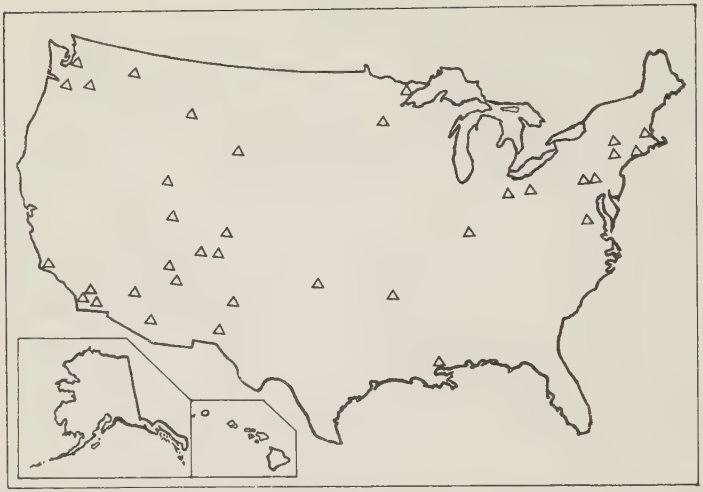
CHAPTER 8

GEM TRAILS BEFORE COLUMBUS

"Decked with diamonds and Indian stones."
—SHAKESPEARE:
King Henry VI

Columbus and the explorers who came after him—Spanish, English, French—sought in the New World not only a passage to the Indies and the wealth of the spice trade, not only trade routes and the conquest of a new land, but the gold, silver, and precious stones that first rumor whispered and then fact proved to be there in abundance. The possession of gems by Indian tribes, the open-pit mines from which they had come, and the natives' considerable knowledge of where they were to be found probably hastened the development of mining in America by many years.

But while gems and other minerals meant wealth to the invaders, they were an essential part of the Indian's life. He used them as weapons and utensils, in medicine and in religion, for currency and for ornamentation. Indians of the Western Hemisphere mined metal long before Columbus. Although elementary smelting was used in Mexico, Central America, and western South America, and the working of metals was highly advanced in certain places, the Indians of the United States treated native copper and gold merely as pebbles, pounding them into shape. They mined the red metal in open pits in the



Indian gem mines (excluding turquoise, obsidian, and catlinite mines).

Lake Superior copper region and recovered the yellow metal through placer mining in Georgia. Nevertheless, at the time of Columbus, the aborigines were still largely in the Stone Age.

Consequently, the Indian's knowledge of gem stones greatly exceeded his familiarity with metals. He developed extensive mines, quarries, and placer deposits, most of which were abandoned centuries ago. Some can still be observed, although many have completely disappeared or become difficult to locate. Others, containing minerals not valued by white men, were simply ignored. Sydney H. Ball named 84 gems used by Indians of both the Americas.

Of the 25 stones first used by early man, 16 have been found to be common to both the Eastern and Western Hemispheres. When Columbus rediscovered America, the minerals that were suitable for decoration and known to the Indians exceeded in number those known altogether to Europeans and Asians.

The most widespread evidence of early man in America is the Folsom culture, named for the discovery made in 1925 near Folsom, New Mexico. Here, crude stone implements were found with the bones of an extinct species of bison; later excavations resulted in the discovery of the arrowheads called Folsom points. Those discovered in New Mexico are of chalcedony, jasper, and obsidian. At the Lindenmeier site near Fort Collins, Colorado, they are of chalcedony, jasper, moss agate, lignite, quartz, hematite, and agatized wood.

It is believed that some 2,000 years ago, the American Indian used, in addition to those named above, the following gems: agate, alabaster, azurite, bloodstone, calcite, jadeite, jet, malachite, mica, nephrite, opal, pyrite, satin spar, selenite, serpentine, soapstone, and turquoise. By no later than A.D. 1000, amber, carnelian, catlinite, fluorite, garnet, marcasite, moonstone, and variscite had been added.

In the United States, the tribes with the greatest knowledge of decorative stones were the Pueblo Indians, the Mound Builders, and the Indians of the southeastern states. A greater variety of materials was required by their higher state of civilization. Of these, the Pueblo and the tribes occupying the southern Appalachians were the best miners; the Mound Builders depended primarily on trade for their gem supply.

Prospecting for minerals and ornamental stones was as much a part of the Indian's life as his search for food. Certain tribes were nomadic, wandering over hundreds of miles in a year's time. All tribes, whether hunting for game, fruit, berries, and roots—or on the warpath—kept a sharp lookout for the materials from which their weapons, utensils, and ornaments were made. It is probable that prospecting trips were made in search of gems, just as there were specific expeditions to work the mines.

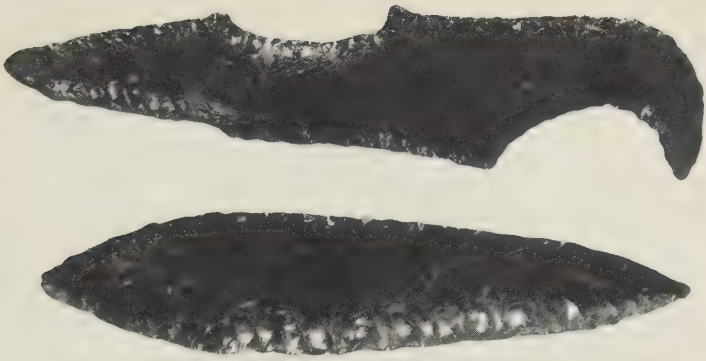
Geologists have found that most of the locations of American gem stones described in this book were first known to the

Indians. For example, the sources of soapstone in the eastern states, the numerous obsidian mines, and virtually all of the known turquoise deposits in the Southwest were worked by the natives before Columbus. The Indians showed many of their mineral sources to the whites, but some—such as certain of those of jadeite and nephrite jade—are hidden from us even today.

Although his knowledge of metals and their recovery was inferior to that of his European contemporaries, the Indian's knowledge of gem mining was equal to that of the skilled Europeans and Asiatics of the same day. He relied greatly upon river gravels, marine beaches, glacial moraines, and weathered outcrops for his gem sources, searching through the detritus and sorting out gem stones by hand. One example of tribal ingenuity in obtaining amber was evinced by Indians of the Aleutian Islands, who spread a walrus skin between two boats at the foot of a steep bank containing the amber. Loosening the earth so that it fell into the skin, they then sorted out the amber from the debris.

Long experience taught the Indian much about the hardness, texture, and mineralogic make-up of the rocks he used. The Pomo Indians of California, for example, had two names for obsidian—*bati xaga* for "arrow obsidian" and *dupa xaga* for "to cut obsidian." The former flaked well; the latter, being harder, broke with a clean edge more suitable for razors. This knowledge also enabled him to recognize the same material wherever he might find it. He learned, too, that weathered rock from surface outcrops or detrital boulders would shatter, and so he sought material for his arrowheads from stream gravel or by quarrying beneath the weathered surface to obtain fresh deposits.

Many tribes engaged in actual mining, using both open-cut quarrying and underground workings. Most of the mines were small compared with today's operations, but they compared



Aboriginal obsidian blades.

favorably in size and extent with European and Asian mines of 400 years ago. However, mines at Flint Ridge, Ohio; Magnet Cove, Arkansas; and Los Cerrillos, New Mexico, yielded hundreds of thousands of tons. A quarry of quartzite 125 miles north of Cheyenne, Wyoming, gives evidence of the removal of perhaps millions of tons of rock.

Mining tools were primitive—stone hammers and sledges, picks of deer or caribou horn, and gads fashioned from stone, horn, copper, or charred wood. A common method of breaking rock was by building a fire against it, then throwing water upon it. It is likely that the fracturing of rock in this way was first discovered while putting out a campfire, and quickly adapted to mining. Most of the workings, some of which can still be found today, were pits or open cuts along the length of the deposit. Some stoping was used, as were tunnels and galleries; and some mines, such as the Los Cerrillos turquoise mine, extended as much as 100 feet below the surface. A few others, like the salt mine at Camp Verde, Arizona, had workings on different levels.

The Indian miners fashioned hide or birchbark bags to haul out both the gem material and the waste rock. These were dragged out by rawhide ropes. Although as little waste rock as

possible was broken off, the ratio of waste to product was necessarily fairly large.

Flint nodules were sometimes mined by undercutting, and turquoise veinlets or nodules were removed as blocks of rock, which were then broken into smaller pieces to extract the gems. Indians mining gypsum from Mammoth Cave, Kentucky, cleared a space on the cave floor where the gypsum could be sorted from the limestone waste.

The Havasupai Indians, of Arizona, worked a paint mine on Diamond Creek. To reach the entrance of the mine on a cliff face, they made "chicken ladders" consisting of a tree with its branches lopped off to make footholds. Similar ladders have been found in Lake Superior and Mammoth Cave workings; and at Lake Superior, there is evidence of levers and wooden props. Primitive winzes were also used in deeper cuts, although ramps were perhaps more commonly employed to reach the bottom. When drainage was necessary, ditches or even cedar troughs were built. Wooden bowls were used to scoop out the water, but in the Lake Superior open-cut copper mines, paddle-like wooden shovels for mucking have been discovered.

Deeper mines and caverns, such as the selenite deposit at Gypsum Cave, Nevada, required torches to light the miners' work. In some mines, rock pillars were left to support the roof of the diggings; in others, granite boulders were used to support overhanging walls. Such mining could prove dangerous, and there are many tales and legends of cave-ins, rock falls, and similar disasters, all of which were brought about by the breaking of a taboo or some other unsanctioned act.

Gems and minerals, and the places where they were found, were sacred to the Indians, and were believed guarded by spirits and by birds of prey or great snakes. Some spots, in fact, were not used or even approached because of dread of the spirits. Others could not be shown to the white man for fear of offending the spirits and bringing punishment upon the

tribe. Stories are told of members being cast out of the tribe for such violations. Votive offerings were made and religious ceremonies used to placate the spirits before mining could begin again.

The Pit River Indians of California considered Sugar Hill, where obsidian was obtained, as sacred ground. Oregon obsidian arrow makers could not drink water while making their arrows, and if a blade broke during the making, it was thrown away because the spirits were against the maker. If the arrow maker showed anger, his punishment would be doubled, and so he sang a hymn of praise as he began work on another point.

There were legends, too, concerning the origin of many gems and other minerals. Point Barrow Eskimo, seeing sparks fly from pyrite, declared that it had fallen from the sky. The Mohawk believed that the flint pebbles thrown up by the waves on the shore of Lake Champlain were tossed by little people living under the lake, and so they threw offerings of tobacco into the water. The same tribe regarded the shiny, clear crystals of quartz, called by us Herkimer "diamonds", as the congealed tears of a loving mother, shed upon the return of her wayward son.

Indians living near Glass Butte, Oregon, told how the tribe, troubled by vicious yellow jackets, set fire to the mountain and, when it had burned for several days, a shower fell, followed by a beautiful rainbow. The rainbow shone all day and then disappeared into the far side of the mountain. Venturing up the slopes, the Indians found that part of the mountain had melted, making mounds of glass for their arrows and spear points. Where the rainbow had been, there was now beautiful, multicolored rainbow obsidian; this they used only for sacred purposes.

The Potawatomi Indians declared that the flint pebbles found scattered over the ground marked the place where

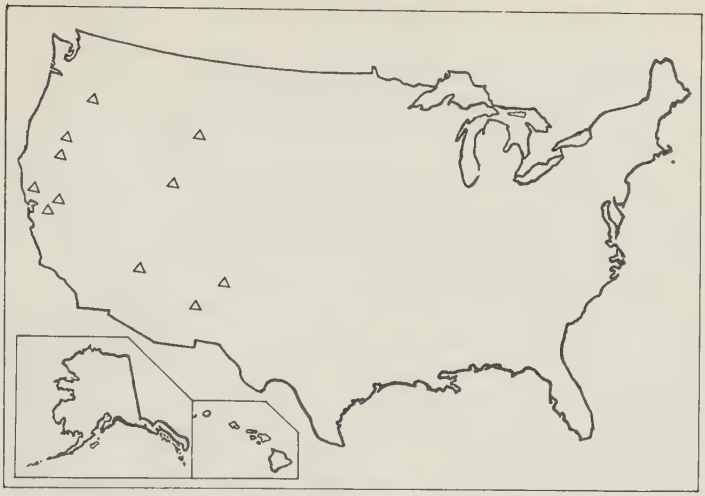
Nonaboojoo, friend of the human race, fought an evil spirit. The petrified wood found on mesas near the Grand Canyon was known to the Indians as the arrows of Shin-ar-ump. One of the most delightful of such stories accounts for the brittle fragments of obsidian on Mount Kanaktai, north of San Francisco Bay. According to the Pomo Indians, the Obsidian Man, caught in a bush and struggling to free himself, fell and broke into thousands of pieces.

Various gems were used in religious ceremonies and as fetishes and charms, in medicine, or as offerings to the gods. Quartz crystals were used as fetishes by the Eskimos, and the Yuma Indians believed that they brought good luck. The Pueblo and Navaho Indians used turquoise both as fetishes and as offerings to the gods, as the Apache did malachite. The Natchez and Pima made charms of rock crystal. Navaho medicine men used rock crystal to diagnose disease by looking at starlight reflected in the stone to see the cause of their patients' illness. The Pueblo and Cherokee used quartz crystal for divination, and the Cherokee also used hematite for this purpose.

Some gem minerals were used to gain health. Green stones were especially treasured by Yuma medicine men. Knives and lancets of obsidian or rock crystal were used for scarification and bloodletting by the California Indians. Washoe and Yakut infants were dusted with powdered steatite much as modern babies are with talcum.

California's Pomo Indians strung blocks of obsidian above their deer traps. A struggling deer caused the stones to clack together, notifying the trapper of a catch. Indians in Wisconsin crushed rock crystal as an abrasive. The Hidatsa of North Dakota used sharply pointed fragments to cut their pictographs into the rock.

Perhaps such practical uses were far in the majority, for gems and ornamental stones were a very real part of everyday



Indian obsidian mines.

tribal life. Altogether, the most common uses of stones were as weapons, utensils, and pigments. Hard stones having a conchoidal fracture were abundantly used for arrowheads, spear points, knives, and razors. Soapstone has been used since earliest times by the Eskimo for lamps. Numerous tribes throughout North America used soapstone cooking utensils, since this material readily absorbs and retains heat. Soapstone and also serpentine were heated and used to straighten the shafts of arrows. Indians in California used Santa Catalina steatite, which is softer and more micaceous than soapstone, for their cooking pots, reserving the closer grained, darker rock for ornaments, pipes, and the weights of digging sticks. Pyrite and quartz were often used by the Eskimo to produce fire.

Pigments for paints, dyes, tanning, whitewash, and body and face paint were widely used by all tribes. The Pawnee and Mandan heated selenite to make a powder with which they

whitened their buckskins during the tanning process. The Pueblo Indians mixed powdered alabaster and other gypsum with water and used it as whitewash. The Omaha used calcined gypsum powder to clean, whiten, and dry the sinews that bound feathers to their arrows. The Navaho crushed turquoise to paint various ceremonial objects, and rocks were crushed to make the colors for their sand paintings. Hematite, azurite, and malachite—widely used in pendants—were frequently crushed for pigments. Malachite and azurite—green and blue, respectively—were the favorite colors of the Pueblo Indians.

Some pueblos of the Southwest were adorned with turquoise, and logs of agatized wood were used as the building stone for an occasional pueblo in Arizona.

Certain gem stones were used for barter and as a medium of exchange. Turquoise beads were so used among the Pueblo, Navaho, and Yaqui. Particularly notable was the use of large obsidian blades as currency in California. These varied in value according to their size and color, red obsidian being of greater value because of its rarity. Blades of ordinary size were valued by length—about a dollar an inch in modern terms, some authorities say—and blades 30 inches or more were highly prized.

The mines usually belonged to the miner or group of miners working them, a loose, general control being exercised by the tribe in whose territory they occurred. According to custom, working parties from other tribes could come in and take what they needed for their own use. Some such workings were sacred ground and open to all; such were certain of the catlinite deposits described in Chapter 48. After the proper votive offerings, the obsidian and the magnesite quarries of north-central California were operated by all Indians in the area. Flint Ridge, Ohio, was another region of neutral ground. When hostile tribes met at such places, a truce was in effect, although

each group camped separately and went about its own business. Such a custom probably arose from the belief that to quarrel or kill would bring down the wrath of the spirits.

There was a certain amount of tribal rivalry and even of individual monopoly, however. The Modoc and Pit River Indians battled over control of the obsidian deposits near Glass Mountain, California; and it is recorded that one old Natchez man shaped and sold black marble pipes, while refusing to disclose the source of his supply.

Although the gems common to the area in which a tribe lived were, naturally, those most frequently used by it, there was a surprising amount of barter among tribes, extending over as much as 1,000 miles. Some groups made special journeys to acquire their needs. For example, various tribes gathered at the catlinite quarries in Minnesota, and the Eskimo journeyed as much as 400 miles in search of soapstone and flint. Other tribes were nomadic, traveling hundreds of miles in a year, during which time gems and minerals were sought and mined, and trading with other tribes was carried on. In 1680, a war party of Iroquois attacked tribes west of the Mississippi, a distance of more than 1,000 miles from New York, while other Iroquois braves made war on tribes near Lake Superior and in South Carolina. In the 1800s, the Chippewa declared that they sometimes went as far as Virginia to exchange Lake Superior copper. Some tribes, though perhaps not in the United States, had a merchant class that engaged in trading various items, including gems, throughout their territory.

By barter, a gem stone or other mineral might change from hand to hand until it had traversed a continent. Minnesota pipestone traveled to New York and Georgia, and New Mexican turquoise was found in Mexico City and the Mayan cities. There is evidence that, in the 1700s, Indians of the Northwest were in possession of Spanish goods from New Mexico. The Mound Builders—a nation of great traders—had obsidian, prob-

ably from Yellowstone Park, some 1,500 miles distant, soapstone and mica from the Appalachians, and copper from Lake Superior. Another tribe that did a great deal of trading was the Nez Percé.

Alaskan Indians and Eskimos were avid traders. Alaskan nephrite has been found in the ruins on St. Lawrence Island, in the Bering Sea. Considerable trade was carried on between the natives of Alaska and the northeastern tip of Siberia. American soapstone, nephrite, and pectolite went to Siberia, and Asiatic turquoise and amber have been found in Aleutian graves.

Trading began shortly after the tribes first made stone artifacts, and it progressed steadily until it was well developed in both North and South America by the beginning of the Christian era. It was often the custom for the chiefs to have precedence in the bartering, and when they began to bid, lesser members of the tribe refrained from trading. At certain intervals, arrow makers of the Georgia mountains set off for the coast to barter their wares. Sioux Indians arrived at the Hidatsa village "when the corn was ripe," and from the time they came in sight of the village until they left, a truce was in order. Out of sight of the village, they might attack or be attacked, according to tribal custom.

Traditionally, however, traders were given safe passage because of the goods they carried, and the news they brought. Cabeza de Vaca, the famous Spanish explorer who wandered through the American Southwest in 1534–1536, could never have made his journey except for the fact that he gathered and exchanged trade goods along the way.

In addition to the rather well accepted gem materials described in the rest of this book, and an occasional one of especial significance, such as catlinite, the American Indian used for ornamental purposes a great many minerals that we today would not admit to the exclusive ranks of the gems.

Even coal was so adapted; we, however, find jet, which is nothing more than a compact variety of lignite coal, a suitable substance for dignified jewelry. Lignite and cannel coal were used by many tribes for pendants and other ornaments. The Creation Legend of the Navaho had cannel coal adorning the northland.

In California, the Pomo Indians took magnesite from White Buttes and Sulphur Bank and made it into beads. Baking turned it buff or salmon color, when it was used as money. Magnesite used by the Pueblo Indians may have come from California.

Fluorite was a common ornamental stone among the Indians of Missouri, Illinois, Tennessee, Kentucky, Indiana, and California, as well as in the pueblo country.

A fossil resin closely resembling amber has been found in mounds built by the Mound Builders in Ohio. A similar bead was recovered from an Indian grave in Virginia, where some amber is occasionally found on the coast. Amber is placed on the graves of rich Koniaga of Kodiak Island, Alaska, among whom it is a rare and expensive article of commerce, used for ear ornaments, in perforated lips, and as pendants.

Particular attention should be given to the extensive array of gems belonging to the quartz group. These were popular among all the Indian tribes of North America. Besides those discussed elsewhere in this book, mention ought to be made of rock crystal and jasper.

The chief source of quartz was glacial, river, and marine gravels, but some mining of quartz veins was done, and quartz was quarried in the Piedmont region of the southeastern United States and elsewhere in the country.

Early chronicles of English and French colonists and explorers tell of "crystal arrowheads" and gifts of crystal. Rock crystal and arrowheads made of it are common in Indian graves in Arkansas, where the Hot Springs collecting area was well

known to tribes of the region. Rock crystal had numerous religious and medicinal uses, and a whole series of legends grew up around it. The Hopi Indians used rock crystal in their religious ceremonies and to foretell the future. The Zuñi placed crystals on their shrines, and other pueblos used it to reflect sunlight into their kivas and into medicine bowls. The Pueblo, and the Pima Indians as well, used rock crystal to diagnose disease. It was a charm among the Yuma tribes. The Chippewa believed that it would protect them from the thunderbird, since the crystal was thought to be the egg of the thunderbird. To a Cherokee medicine man, rock crystal was his most prized possession, for it was once embedded in the head of the Horned Serpent and could cure the sick and foretell death and danger in battle. Alaskan Eskimo prize amulets of rock crystal, which they believe to be ice frozen so solid that it has turned to stone, a belief similar to that of the ancient Greeks, from whom we get the very word *crystal*, meaning "icy cold."

A number of jasper quarries, some 14 feet deep, were worked by Indians in Pennsylvania. A tree found in the bottom of one pit places the time of excavation before 1680. Fire and water and stone hammers were used to mine jasper, other chalcedony, and flint, in Pennsylvania, and at Flint Ridge, Ohio. Quartz crystals as much as 2 inches across and ranging in color from clear to almost black were found in cavities in the flint in Ohio. The pits ranged up to 80 feet in diameter.

CHAPTER 9

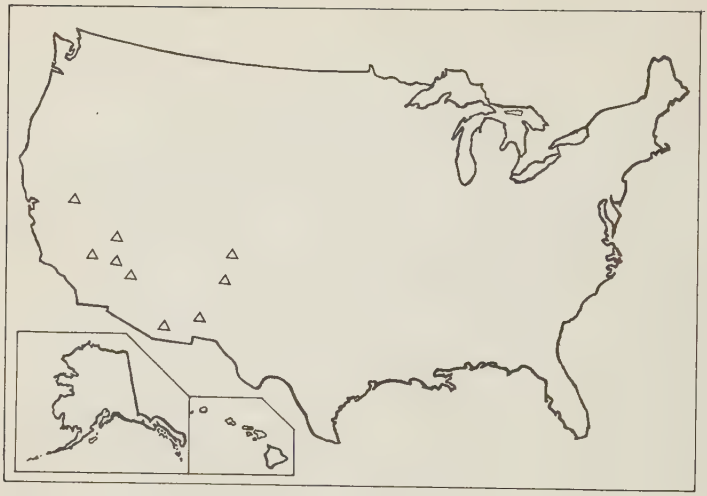
RED MAN AND BLUE GEM

"Wild warriors of the turquoise hills."
THOMAS MOORE:
Lalla Rookh

For nearly 2,000 years, the precious blue stone known as turquoise has been mined and traded, cut and polished, worshipped and coveted by all the tribes of our American Southwest. It remains today as beautiful and prized as it was long before Columbus, long before the French and Spanish and English explorers discovered the continent, and will likely remain popular as long as turquoise endures.

The beautiful blue or green gem that is turquoise received its name from the French, who called it "Turkish stone," because it was supposed to have been introduced into Europe by way of Turkey. Or else the famed Persian locality of Nishapur was thought to be in Turkey. The Spanish version of the name is *turquesa.* The mineral occurs in few places in the world, and these are almost exclusively desert-like areas. There are deposits in Asia, the Sinai Peninsula, and in Egypt, but the American Southwest is one of the finest sources of the gem, and here its history has been a long and fascinating one.

Tribes of Central America, Mexico, and our own Southwest prized turquoise long before Columbus, the Pueblo Indians mining the gem as early as the fifth century A.D. Extensive use



Indian turquoise mines.

of the gem in beads and pendants at Pueblo Bonito, in New Mexico, dates from about A.D. 900 to 1100.

At the time of the Spanish Conquest, there were three distinct groups of aborigines occupying the Central American, Mexican, and Southwestern regions. These were the Maya, Quiché, and related peoples of Central America; the Nahuan tribes, or Aztecs, in the mountains of Mexico; and the Zuñi, Hopi, and other Pueblo tribes living in New Mexico, Arizona, and northern Mexico. With the end of the Aztec and Mayan cultures, the use of turquoise disappeared in Mexico and Central America; but in the United States, turquoise is as important to the Indians of today as it was to their ancestors centuries ago.

While turquoise has been found in nominal quantities in a few other states—especially Virginia, where the only crystals have ever been found—the chief deposits now producing commercially occur in Arizona, Nevada, Colorado, California, and New Mexico.

Arizona turquoise is now coming in as a byproduct of this state's vast copper-mining operations, especially at Morenci. Former mines include those near Courtland, in Cochise County; the Mineral Park district, in Mohave County; and the Castle Dome mine, in the Miami district, Gila County. The Mineral Park deposits were the most important, extending along the western side of the Cerbat Range, in the vicinity of Ithaca Peak and Aztec Mountain. Small pits filled with rubbish and several tunnels nearly 20 feet long have been seen on the south side of Aztec Mountain, and ancient stone implements were discovered in the workings.

In Nevada, the gem is found in Esmeralda and Nye Counties, and some sources are also in Lincoln and Lyon Counties. An ancient village site and stone tools were discovered near the turquoise workings 18 miles east of Vanderbilt, California, in Nye County, Nevada. There is also evidence of prehistoric mining in Lincoln County, at the foot of Sugar Loaf Peak.

Colorado turquoise is mined principally near Manassa, in Conejos County, and near Villagrove, in Saguache County. It has also been found near Turquoise Lake, 7 miles from Leadville, and at Creede and Cripple Creek. Remains of stone hammers, pieces of deer horn, and other artifacts have been uncovered at the Manassa workings.

In 1897, T. C. Bassett discovered and named the Stone Hammer mine for the two aboriginal artifacts he found in a deposit of turquoise near Yucca Grove, in San Bernardino County, California, near the Nevada state line. A series of newspaper stories about the mine led to an investigation of the area by archaeologist Dr. Gustav Eisen, who found several ancient excavations, cave dwellings, and stone tools. Saucer-like pits 15 to 30 feet across and half as deep are distributed over an area 15 miles long and 4 miles wide. Numerous stone tools and turquoise fragments were scattered among the old workings, but even more interesting are the caverns and rock carvings in the canyon. Windblown sand fills most of the

Zuñi Olla women wearing turquoise jewelry.

caverns to a depth of several feet, but the blackened ceilings and crudely sculptured walls indicate that the natives who worked the mines lived there for a long time. In the sand were found rude pottery fragments, incised but not painted, and many carefully made and polished tools of hard basalt or trap rock. These included hammers, adzes, and axes, some quite large and most grooved for a handle. Many show wear, while others are in perfect condition. Some of the cavern openings are partially closed by rough walls of trap rock, apparently piled up as a protection against weather and wild animals.

Over the centuries, New Mexico has produced more turquoise than any other state, its value totaling millions of dollars.

There are four main regions where the gem is found: the Cerrillos Hills, of Santa Fe County; the Burro Mountains and the Little Hachita Mountains, of Grant County; and the Jarilla Hills, of Otero County. Old trenches containing pottery fragments and stone hammers have also been found in Sierra County, near Paschal.

Turquoise deposits of the Little Hachita Mountains are centered in an elevation known locally as Turquoise Mountain. Here, early tribes excavated for the gem, and the workings were rediscovered by white men in the late 1880s as they searched for gold. Various other mines in the area show evidence of earlier prospecting by Indians. Similar operations abandoned hundreds of years ago have been discovered in the Jarilla Hills, in Otero County. These were all shallow in extent and stopped wherever hard rock blocked the vein.

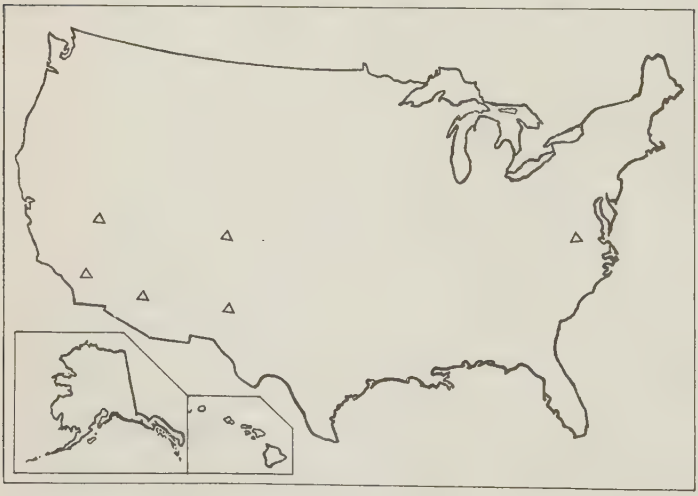
Diggings and heaps of debris containing stone implements and coiled pottery mark the site of the ancient turquoise mines in the Burro Mountains, in Grant County. It is believed that the mines were also worked under Spanish rule. In the 1890s, the Azure mine yielded between $2 million and $4 million in top-quality gems, including the famous Elizabeth pocket, which produced more high-grade turquoise than any single deposit on record in modern times.

But the most important deposits of turquoise in the United States are those in the Cerrillos mining district of Santa Fe County, New Mexico, about 20 miles south-southwest of Santa Fe. There is evidence that the mines of Los Cerrillos were being worked by Indians more than 1,000 years ago, and American mining companies operated in the district until the early 1900s. Both the production and the history of the area mark it as outstanding in the annals of turquoise. The Tewa Indian name for it means "the place where turquoise is dug."

There are two main locations 3 miles apart—on Turquoise Hill and at Mount Chalchihuitl, the latter being the site of "the

most extensive prehistoric mining operations known on the American continent," according to Joseph E. Pogue. The whole north side of the hill has been quarried out, and excavations are estimated at nearly 200 feet deep and 300 feet wide. Dumps on the slopes of the excavation occupy some 20 acres, and trees growing out of the debris are believed to be 600 years old. Perhaps 100,000 tons of rock have been removed from the diggings, an incredible amount of mining to have been done by primitive men without machinery of any kind. Many stone hammers and similar implements have been found in the slopes, one weighing 20 pounds and still attached to its oak handle by a withe.

Although the Zuñi legend of the migration of the Turquoise Man and the Salt Woman suggests that, even before the discovery of Los Cerrillos, turquoise was obtained from some mine farther to the north, perhaps Manassa, Colorado, the

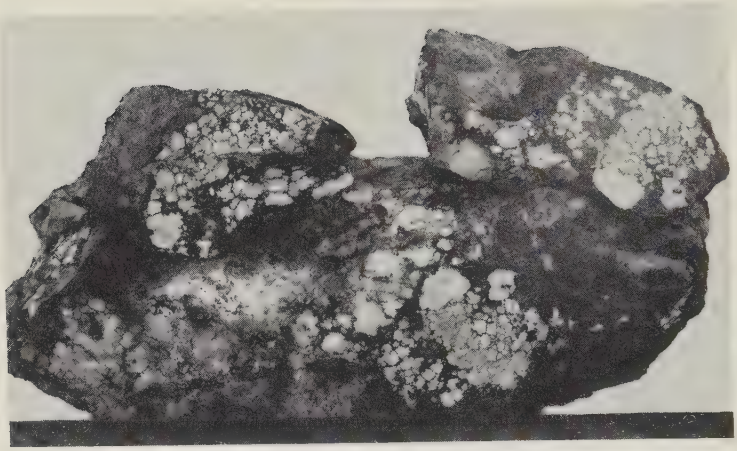


Distribution map for turquoise.

excavations at Los Cerrillos are of great antiquity. It is believed that the greater portion of the mining was done before the Spaniards came, and that this was the source of much of the turquoise in pre-Spanish times, not only in the Southwest but in Mexico as well. Judging by the country rock attached to some of the Pueblo Bonito pendants, they came from the mines at Los Cerrillos. In 1540, the Indians at the head of the Gulf of California told Captain Fernando Alarchon that the Pueblos dug turquoise "out of a rock of stone."

During the sixteenth century, the Tano guarded the mines and used the turquoise extensively in trade. Juan de Oñate established the first successful Spanish colony in New Mexico toward the close of that century, and the colonists soon discovered both metals and turquoises or "chalchihuites" in the area. One legend has it that the Indians were forced to labor in the mines against their will; and when a large section of the workings caved in from undermining, they rose up against the Spanish and drove them out of New Mexico. Some authorities believe that there was no mining undertaken by the Spanish until after 1725, and that the earlier uprising had nothing to do with enforced labor in the mines. According to the first version, when the Spaniards reestablished their colonies in New Mexico in 1700, they had to agree that mining would not be resumed. In any case, the record of a chalchihuitl, or turquoise, grant dated 1763 has been found in the archives at Santa Fe.

Turquoise occurs in thin veinlets and small nodules and is never found in quantity at depths exceeding 100 feet. The aboriginal miners used open pits or cuts, short drifts following the vein away from the main cut, and sometimes stopes and winzes. Some workings at Los Cerrillos extend below 100 feet. Fire and water were sometimes used to break the rock, and the ore was then removed in blocks, which were carefully broken into small pieces to extract the gem. As in all Indian



Rough turquoise in matrix, Esmeralda County, Nevada.

activities, certain taboos had to be observed. The miner who engaged in some irreligious act, mined certain proscribed areas, or dared to give turquoise to his sweetheart was sure to be punished. One legend tells of miners being entombed in the New Mexico mines because they were robbing pillars. Some connection may be supposed between these taboos and the causes of the uprising of the Indian miners against the Spanish.

There are numerous references to mining and the use of turquoise throughout the Southwest, Mexico, and Central America by the old Spanish chroniclers. Much of this evidence is obviously accurate; however, some of the descriptions of "blue and green stones" and references to chalchihuitl—which many scholars believe was an Aztec term for jade rather than turquoise—make for some doubt as to its complete reliability. On the other hand, numerous objects containing turquoise still exist in various collections. Mineralogists have identified the turquoise, and the objects themselves so closely fit the descriptions of the old writers, that we can for the most part accept their narrations as truth.

Even today, there is some doubt as to the meaning of chalchihuitl in respect to the Southwest in contrast to Mexico and Central America. The Navaho and Pueblo Indians still call turquoise by this term, they are quite definite about it, and it refers only to turquoise. In the chronicles of the Spanish, however, there is doubt as to whether all of the references to chalchihuitl designated turquoise or included jade and other minerals as well. Many authorities believe that the term included all green stones, while still others feel that chalchihuitl in Mexico and Central America was definitely jade.

It is probable that the first European to see turquoise in the New World was Juan de Grijalva, discoverer of Yucatan, who is recorded as having bartered with the natives for three gilded wooden masks inlaid with turquoise mosaic. Later, he obtained four turquoise-encrusted ear pendants at San Juan de Ulloa. In 1519, Hernando Cortes landed at San Juan de Ulloa, where he was met by Indians bedecked in jewels, including labrets, or lip rings, of gold and "turkesse-stones which weighed so much that their lips hung over their chinnes leaving their teeth bare." Montezuma, ruler of the Aztecs, gave Cortes many gifts of gold and precious stones, including, according to Bernardino de Sahagun, a mask encrusted with turquoises, a crozier of turquoise mosaic, a miter and a staff also covered with turquoises, and large earrings of chalchihuitl. Not long after, nevertheless, the Spaniards seized Montezuma and soon overthrew the Aztec Empire.

Rumors began to reach the conquerors of riches to the north of Mexico, and they were irresistibly drawn to that unknown region. Álvar Núñez Cabeza de Vaca set out with three companions in 1535 on a journey of exploration, which took them from eastern Texas to Sonora, on the coast of the Pacific, and later led to the discovery of New Mexico. He was given turquoise by various tribes, and when he inquired where they had obtained the gems, they said the stones came from the north,

where they were obtained in exchange for parrot plumes. In 1538, a Franciscan friar, probably Fray Juan de la Asuncion, was told by the Indians of northern Mexico that they received turquoise as day laborers' pay from the pueblos to the north. Fray Marcos de Niza was told the same story the following year. Since the ruins of Pueblo Bonito contain Toltec pottery sherds, it seems evident that trade between the Southwest and Mexico dates back more than 1,200 years. Turquoise sources in Mexico being inadequate to the great supply of the stone known to have been used by the Aztecs and their predecessors, the Toltecs, it is likely that the greater part of the supply came from Arizona and New Mexico, plus local sources now exhausted or not yet discovered.

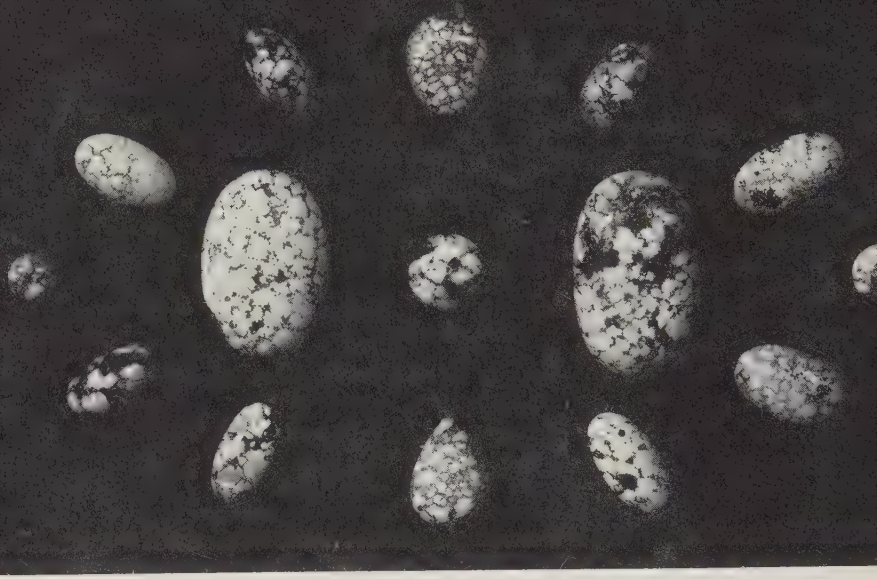
In 1539, Fray Marcos de Niza and a Negro companion, Estéban, headed northward into New Mexico in search of the fabled "Seven Cities of Cibola." These were, in actuality, a group of pueblos, now in ruins, situated at about the present Pueblo of Zuñi. De Niza found the Indians along the way using turquoise both for ornaments and for exchange. They gave him presents of turquoise and ox hides. He was especially impressed by the many turquoises worn by the Sobaipuri of the Rio San Pedro, in southern Arizona. At a village near Cibola, the Indians wore turquoises hung from their ears and nostrils, and they told the friar that there were many such gems in Cibola and in Marata, Acus, and Tontonteac. The latter three have been identified as Makyata (near Zuñi), Acoma, and the Tusayan, or Hopi, province northwest of Zuñi.

Estéban had been sent ahead to Cibola, where he was killed by the Indians, possibly because of too great an enthusiasm in collecting turquoises. Arriving in Cibola, de Niza was greatly excited by the emeralds and other jewels, particularly the turquoises, "wherewith they adorn the walls of the porches of their houses, and their apparel and vessels; and they use them

instead of money all through the country." Following this account, Coronado set out to conquer Cibola. He reported that Fray Marcos' account was somewhat exaggerated, but he, too, commented upon the quality and varied uses of turquoise, including its use in worship. Having occupied Cibola, Coronado sent a force to conquer Tusayan, site of the present Hopi pueblos, and when these tribes sued for peace, they sent him gifts that included turquoise.

Trade in turquoise was widespread both in Spanish and pre-Spanish times, extending from the West Indies and Yucatan on the south to Ontario on the north, and from California to Mississippi and Arkansas. Hernando de Soto's men, arriving in the province of Guasco (eastern Arkansas) saw "Turkie stones—which the Indian signified by signes that they had from the West." Some 100 turquoise beads and a small pendant were found with the skeleton of a child in a mound in Coahoma County, Mississippi. In 1599, Vicente de Saldivar Mendoza came upon a band of Apache, near the Canadian River, close to the present Texas–New Mexico border, who said that they had been trading for turquoise with the Picuris and Taos Pueblos. Other Apache were said to trade with the Pueblo of Pecos for turquoise during the years 1630 to 1680. The Yaqui used the gem as money, and the Seri of Sonora exchanged iridescent shells from the Gulf of California for Zuñi turquoises. The Opata traded parrot skins and plumes for the stone.

Pueblo Bonito, in Chaco Canyon, in northwestern New Mexico, has yielded to the archaeologist thousands of turquoise objects. George H. Pepper, exploring the ruins in 1896, found 30,000 beads and pendants in one room alone, and nearly 6,000 beads in a single burial. He felt that this room was perhaps the burial place for high priests and other important officials of the community. Among his findings were elaborate mosaics



Turquoise cabochons showing matrix patterns. These are from Mohave County, Arizona.

containing thousands of pieces of turquoise, eight duck-like birds carved from decomposed turquoise, carved tadpoles and frogs, pendants, discoidal beads, stone and bone carvings inlaid with turquoise, and a jet frog or toad with large eyes of turquoise.

Only a chief among the Yavapai of central Arizona could wear turquoise bracelets. In most tribes, however, it was apparently a sign of wealth as well as distinction. The Patki people who lived near present-day Winslow, Arizona, wore shell, bone, and turquoise ornaments, the women having ear pendants of lignite or bone set with turquoise, or of pure turquoise, and both men and women wearing armlets, wrĭstlets, and rings of shell set with the gem. A food vessel from the Sikyatki ruins in the Tusayan province bears the painted head of a woman wearing square ear pendants of turquoise mosaic like those worn by Hopi women today. Among the Zuñi, neck-

laces—worn only on ceremonial occasions—have been handed down from father to elder son for generations.

Ancient mosaics of elaborately pieced turquoise, while most highly developed in Mexico, have also been found in ruins of the Southwest. Fetishes and votive offerings often were made of or included turquoise. The Navaho crushed the stone to paint certain ceremonial objects. The Tewa set the headrests of their cradles with turquoise, and a Zuñi cradle in the U. S. National Museum has a small turquoise set beneath the heart of the child. Zuñi women ground corn, mixed it with white shell and powdered turquoise, and offered it as food to the gods.

Once the gem was taken from the mines, it was cut and polished, usually into discoidal and cylindrical beads or pendants of oblong, triangular, or keystone shape. Cutting was done on sandstone, perhaps with the addition of water and fine sand; and perforations for stringing were made with a crude bow-drill, usually tipped with a piece of quartz or flint. The finished piece was rarely symmetric or highly polished. The Pueblo Indians sometimes heightened the color of the stones by placing them in tallow or grease.

Color is perhaps the most important quality of turquoise for the Indian. Blue and green have always held special significance for primitive peoples around the world. Blue was the Druids' sacred color. To the ancient Chinese, blue symbolized heaven, the Egyptian god Amun was painted blue, and the Hindu god Vishnu was represented by the color. In ancient Mexico, blue was the color of supreme authority. To the Indians of the Southwest, blue represented one of the points of the compass (varying with different tribes), or heaven itself, while green was symbolic of earth.

The Pima Indians believed that the loss of a turquoise was due to magic. To prevent the loser from suffering some mysterious ailment, he had to call in a medicine man to give him another turquoise, a piece of slate, or a crystal to drink in

water. The Zuñi declared that the perfect blue turquoise is male; that of imperfect coloring, female. The upper world was represented by the sun, the eagle, and the turquoise, while the rattlesnake, water, and the toad represented the lower world. Blue was the color of heaven and of the west. Among their many fetishes was the blue Coyote of the West, fashioned of compact, white limestone and having large turquoise eyes.

Still another fetish, which originated with the Navaho but was also used by the Zuñi, was a sheep of purplish-pink fluorite with eyes of inlaid turquoise. It guaranteed a shepherd many flocks free from disease, wild animals, and accidental death. In a legend concerning the origin of the Zuñi Salt Lake, Hli'akwa, or Turquoise, journeyed to the southwest, where he made his home on a high mountain protected by many angry, white and black bears. Even into modern times, Zuñi making pilgrimages there to collect turquoise appeased the angry bears with sacrifices of plumes and sacred meal. In the story of a young man and his eagle, the eagle carried him into the sky world where it took him to the Mountain of Turquoises, "so blue that the light shining on it paints the sky blue."

This resembles the Pueblo Indian myth that the gem is the stone that stole its color from the sky. The Kere of the Santo Domingo Pueblo have a fetish of gypsum in the form of a prairie dog with eyes of turquoise, which the medicine man uses in invoking the rain god. The gem is also regarded as a good-luck charm. The Apache, too, believed that it could bring rain, and no Apache medicine man could function without his turquoise emblem of authority.

Turquoise is a symbol of good fortune for the Hopi, also, and in the traditional story of the early wanderings of the tribe, it is said that the people met with many difficulties, including a great overflow of water. The chiefs made two balls of powdered turquoise and shell, which they sent as an offering to the evil water serpent, whereupon the ground became dry.

In the Hopi Snake Myth, a chief's son, wondering what had become of all the water in the Grand Canyon, went to investigate. After many adventures, he encountered the goddess, owner of hard substances—the Harúing Wuhti—who gave him a sack of beads, among them turquoises. He was told not to open the sack until he reached home. Each morning of his journey, he found that the sack became heavier, until it was filled; and on the last night of his journey, he could resist no longer and opened the sack to gloat over his treasure. On the following morning, all the beads except the original ones had disappeared, and this is why the Hopi have so few beads.

The nomadic Navaho first learned to use turquoise through their contacts with the Pueblo Indians, and no tribe exceeds them, even to the present day, in their veneration of the gem. They regard it as a good-luck charm, and there are many Navaho myths concerning it. By praying to the rain god and throwing an offering of turquoise into a river, the Navaho believed that he could bring rain. Many stones were offered to the wind spirit, to appease his anger so that the wind would stop and rain might come; for when the wind is blowing, it is searching for turquoises. Carvings in the shape of horses were carried by those who wished to own many horses. Numerous instances of the magic of turquoise are found in the Navaho Origin Legend. For example, the First Man and First Woman made the sun and the moon. For the sun, they made a flat, round stone like a dish and set turquoises around its edges. Another version of the same story says that the sun was lifted into the sky on four poles of turquoise and two of white shell beads held by twelve men at each of the four cardinal points. Even the heart of the earth is composed of turquoise, say the Navaho.

Another Navaho legend deals with the gambling god, Noholipi, He Won Wins Men, whose talisman was a huge piece of turquoise. Because of this, Navaho gamblers require a fine

piece of turquoise to help them win. Originally, according to one myth, the buffalo had horns of turquoise, but two boys offered the buffalo all the jet they had in exchange for his turquoise horns, and that is why the buffalo until this day has horns of jet.

The gem is used in the Night Chant and also in the Mountain Chant, both Navaho rituals. In the latter, a ceremony of both religious and social meaning, four large sand paintings incorporating the cardinal points are drawn. The figures to the south are symbolized by blue, and in one picture the gods are shown wearing ear pendants, bracelets, and amulets of turquoise and coral. During the ceremony, sacrifices to the gods are performed, and a blue ornamented stick and five turquoises are buried.

Many of these legends and beliefs carry over into the present day. Zuñi Indians still revere fetishes of animals carved from turquoise; a Hopi miner will not wear turquoise with a matrix while he works, for fear that the stones he quarries will shatter along its lines; and a piece of turquoise is often tied to the patient's hair during the Navaho curing ceremony. The ears of a newborn Navaho child must be pierced for his turquoise earrings within two hours of his birth. Seldom is a well-to-do Pueblo Indian seen without turquoise necklaces and ear pendants, especially during important ceremonies.

Among the Pueblo, the Hopi and the Zuñi tribes prize turquoise most highly. A single strand of beads has been said to be worth several horses. The mosaic ear pendants of the Hopi are very beautiful, consisting of thin slabs of turquoise polished and fastened with piñon gum to a flat, wooden base. Both Hopi and Zuñi men wear loop earrings on ceremonial occasions. During the Hopi Snake Dance, each antelope priest wears shell and turquoise necklaces. Each tribe of the Tewa consists of a Sun People and an Ice People, and the Galaxy and Turquoise fraternities of the Ice People at San Ildefonso meet in

the Turquoise Kiva, or ceremonial room. The Kere of Santo Domingo wear turquoise beads strung on silver wire. The Navaho are seldom seen without their necklaces and ear pendants of turquoise, and Navaho silversmiths are noted for their settings of the gem.

Combining turquoise and silver is a fairly recent innovation. The craft was first learned from the Mexican plateros, or silversmiths, but the first setting of turquoise into silver by the Navaho did not occur until around 1880. In 1890, the Fred Harvey Company bought silver jewelry from the traders, principally items that had been pawned and not redeemed by the Indians, and sold them to the tourists on the Santa Fe railroad. When these proved too heavy to be really popular with the passengers, the company began to farm out silver and pre-cut, flat turquoise to Navaho silversmiths for fashioning into lightweight jewelry.

The practice is continued today, with traders providing the turquoise and the silver, and the smiths working under contract for the finished work. The rough stone is shipped in from mines in Arizona, Colorado, and Nevada by the 50- or 100-pound sack. Most of these stones these days are polished by professional lapidaries, and the silversmith mounts them according to the commission of the trader, who may actually design the piece. The Zuñi, too, have become jewelry workers in modern times, as have the Hopi. A specialized area of turquoise jewelry is that of the Santo Domingo, who drill and match turquoises into bead necklaces greatly prized by the Navaho. The Santo Domingo can be seen on the streets of Gallup, New Mexico, "The Indian Capital," carrying strands of the beads over their arms for trading to the thousands of Zuñi and Navaho who come there each weekend.

CHAPTER 10

MONTANA'S ELECTRIC-BLUE SAPPHIRES

"The lights burn blue."
JOHN HAY:
The Stirrup Cup

Since their discovery in 1865, the sapphires of Montana have brought a sum estimated as high as $5,000,000 and valued today at about $25,000,000. Those of cornflower blue, the outstanding color at Yogo Gulch, are especially choice, and other desirable hues from here and elsewhere in the state run from nearly ruby red through the range of virtually every hue in which corundum comes.

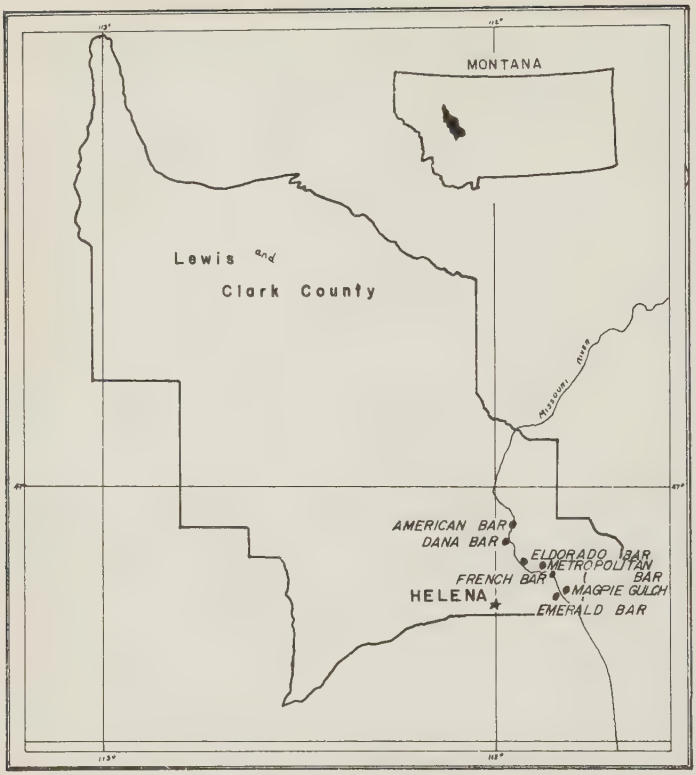
The only drawback to the Yogo sapphire has been the small size of the flat crystals, few of them exceeding several carats in weight; most of the rest have ended as industrial material, especially watch bearings, because they were too small to cut. The largest crystal, found in 1910, weighed 19 carats. The cornflower-blue color is marked by a curious, metallic luster, and has been referred to as electric blue. When cut, the gems are especially bright by artificial light, retaining their richness at night, which Oriental sapphires in general do not.

Yogo Gulch is near the Judith River, in northeastern Montana. The sapphires are found in a dark, fine-grained dike of igneous rock, which is exposed at the surface for almost 5 miles. This dike—the geologic age of which is later than the

Pennsylvanian Period, probably Tertiary—was formerly pitted with a string of gopher and badger holes and could be followed across country by watching for the holes and the mounds of earth next to each. The principal mining was done by an English firm, the New Mine Sapphire Syndicate, and the output shipped mostly to Switzerland for cutting and to London for marketing, so that not many were ever sold in the United States.

The gravel beds along the Missouri River, lying as terraces above this stream in north-central Montana, have also yielded sapphires of pale blue and blue green, often tinged with gray, and sometimes other hues. They are typically rough and pitted, and many have been rounded. These gravel deposits go under the name of bars—Eldorado Bar, French Bar, Metropolitan Bar, American Bar, Emerald Bar, Dana Bar—and were important sources of placer gold in early Montana history. Gem garnet and other minerals occur with the corundum and gold. Dredging has been an effective means of recovery, which has taken

Distribution map for blue sapphire.



Sapphire placers in Montana.

place near Helena, the capital, and for a considerable stretch in both directions.

Rock Creek (in Granite County), Dry Cottonwood Creek (in Deer Lodge County), and a few other streams and ravines in Montana have also given up sapphire, less well known than that from the Yogo and Missouri River localities.

Blue sapphire has also been produced in unimportant quantities in other states, including Washington, New Jersey, North Carolina, Idaho, Colorado, and Pennsylvania.

CHAPTER 11

THE CRATER OF DIAMONDS

"The only things harder than diamonds
are women who collect them."

—RICHARD ARMOUR:
Armour's Almanac

The only authentic diamond mine in North America is now a tourist attraction. Situated in Pike County, Arkansas, near Murfreesboro, it attracts thousands of visitors annually. They come for the opportunity of searching the ground for genuine diamond crystals, which they may keep, paying only a royalty on stones larger than 5 carats. From here have come tens of thousands of diamonds, most of which were small and either of industrial quality or quite useless.

The Crater of Diamonds (in the Prairie Creek area) and another area of diamond-bearing rock not far away bear a close resemblance to the diamond pipes of South Africa. Both Africa and Arkansas contain bodies of the dark, explosive-volcanic rock called peridotite breccia, produced during the Cretaceous Period by internal shattering of violent proportions. This rock was known in Arkansas as early as 1842 and described geologically in 1889. The first diamond was found in 1906 by a farmer, John Wesley Huddleston.

The only drawback to the Arkansas diamonds seems to be the extremely low yield, combined with the greater expense of

The Crater of Diamonds near Murfreesboro, Arkansas.

mining in the United States than in Africa or South America. Extensive tests by the U. S. Bureau of Mines and by Glenn L. Martin failed to indicate commercial possibilities, but the appeal to tourists was a stroke of genius.

The nearby Arkansas Diamond mine has a washing and concentrating plant in operation but a meager output. The famous Searcy diamond, found in 1925 or 1926 as a crystal of

Arkansas diamonds from the only American mine.

27.31 carats, also came from Arkansas (White County) but as an isolated specimen entirely outside the Murfreesboro area. This superb diamond is owned by Tiffany and Company, of New York City, which bought it from Mrs. Pellie Howell, who had found it as a young girl and kept it until it could be properly identified.

Compared with other deposits of the world, the Crater of Diamonds has a larger proportion of stones that are white, brilliant, and flawless. Some of the yellow crystals are likewise of exceptional quality. Others are brown. An occasional blue or pink tinge has been seen, and some crystals appear frosted or etched. Among the fine gems that have been recovered are the 40.23-carat Uncle Sam diamond, the 15.33-carat Star of Arkansas diamond, and the 6.43-carat Garry Moore diamond.

Distribution map for diamonds.

CHAPTER 12

DIAMONDS THE GLACIERS BROUGHT

"Less often sought than found."
—LORD BYRON: *On My Thirty-sixth Year*

A rock or mineral torn from bedrock by a glacier, carried by the ice away from its place of origin, and finally deposited in a spot altogether foreign is termed an "erratic." The vast continental ice sheets of North America, coming down from Canada to about the present course of the Ohio and Missouri Rivers, bore with them fragments of the country across which they moved. These give clues to the successive paths of the glaciers during the Pleistocene Epoch—the Ice Age. Pieces of native copper, for example, found today strewn across the glaciated interior of the United States from southern Iowa to northeastern Ohio, indicate movement across the Keweenaw Peninsula of northern Michigan, because only here and in the surrounding Lake Superior region is native copper found in its native home.

Diamond crystals, though small, are likewise glacial erratics in the states of the Great Lakes. Dozens have been picked up, or removed while panning for placer gold. The first—the Eagle diamond—was discovered in 1876 in Wisconsin, and the

largest to date, the 21.25-carat Kohlsville, or Theresa, diamond, also came from Wisconsin. So have a number of others.

Numerous diamonds have been found in Indiana since 1878. A diamond weighing 6 carats came from Ohio in 1897, one weighing 10.88 carats came from Michigan in 1894 or 1895, and finds of uncertain authenticity have been reported from Illinois, Kentucky, and New York.

Real American diamonds—excluding such materials as "Herkimer diamonds" and other misnomers, as discussed in Chapter 3, have also come from a broad, nonglaciated belt in the Appalachian states, from eastern California, and from a few miscellaneous places widely scattered throughout the nation. The most important of these treasures are the Dewey diamond from Virginia and the Punch Jones diamond from West Virginia. The Dewey was found in 1885 at Manchester, Virginia, while an excavation was being dug; it weighed 23.75 carats. The Punch Jones—weight 34.46 carats—was picked up in 1928 in Peterstown, West Virginia, while Punch and his father were playing horseshoes. Diamond crystals are not extremely rare in California, being found in sand and gravel and taken mostly from placer operations. They have all been small.

CHAPTER 13

TREES OF CORAL

"The magic of the sea."
—LONGFELLOW:
My Lost Youth

Ako Akoa Eleele, America's newest gem, comes from America's newest state. Small "trees" of rich, black coral—an animal that grows to look like a plant—are being recovered by divers off the islands of Kauai, Lanai, and Maui, and between Maui and Molokini Islands. The discovery was made accidentally in 1958 by Jack Ackerman, one of a trio of skin divers who were laying fish traps at depths of 200 feet and more in the tropical waters between Lanai and Maui. At once graceful and eerie, the forests of stunted trees spread out before them like so many miniature Bonsai trees. Some, however, grow to a height of 20 feet. For years previously, pieces that had been washed ashore were picked up on Hawaiian beaches, but their source was not known.

At this depth, the coral presents conspicuous perils to those who would bring it to the surface. These include sharks, underwater currents of surprising strength, and the danger of the depth itself. Since the original find, the coral has been seen at depths ranging from 120 to 300 feet.

The stalks of antipatharian coral, *Antipathes grandis*—the

Black coral, Hawaii.

biologic study was made by Jon Lindbergh, son of the noted aviator—are tough and rather flexible, so that they must be hacked from the submerged volcanic-rock cliffs—the only place they grow—with hammer and chisel. The branches can be broken by bending them, for—unlike the precious red and pink coral of the Mediterranean, Malayan, and Japanese seas—black coral consists of organic matter called conchiolin. The

One of the Maui Divers of Hawaii collecting black coral from tropical waters.

color is actually red but so dark that it appears entirely black, except at the very tips of the branches. The base from which the tree develops is, however, white. This lustrous Hawaiian black coral—washed free of its gelatinous covering, cut, or carved, and polished—has now entered the jewelry trade, especially in Honolulu, as a much-prized gem.

CHAPTER 14

THE RAINBOW GEM

"The chemistry of it is more like
a medieval doctor's prescription than
the making of a respectable mineral."
—JOHN RUSKIN:
The Ethics of the Dust

Tourmaline, the rainbow gem, occurs in the United States most satisfyingly in the two most distantly removed states of the conterminous area, Maine and California. From pegmatite in both coastal states has come a prodigious amount of fine-quality crystals. The deposits in Maine were brought to light first, in the year 1820, although those in California, beginning about 1872, have been much the more prolific.

Gem tourmaline also comes on occasion from Colorado, New Mexico, and New York.

The elongated, peculiarly triangularly shaped crystals from both states show the range of hues that has given tourmaline its popular name, the rainbow gem. Clear and colorless specimens are found, and some that are opaque and black; but those that have made their mark in the world of gems are of the tints and shades, from red to violet, that recall the rainbow itself. Tourmaline from Maine is characterized by a predominance of green and blue tones, while California yields especially the pink variety known as rubellite, the color of which is due to the presence of lithium. Combinations of colors, including watermelon tourmaline—a rind of green, a heart of red, and white between—are especially popular.

Maine tourmaline is associated with the name of Elijah S. Hamlin, brother of Hannibal Hamlin, who served as vice president of the United States during the first Lincoln administration. He and a friend, Ezekiel Holmes, came upon crystals lying loose in the soil on Mount Mica, in Oxford County, but they had to wait until the winter's snow had melted before they could begin systematic recovery in 1822. This became the most important gem-mining operation in the northeastern section of our country. Hamlin told all about it in his book, *The History of Mount Mica*, published in 1895. Besides Mount Mica, Maine tourmaline of especial value has come from Mount Apatite and the Berry Quarry, both in Androscoggin County. Most of the recent production has come from the Harvard mine, near Greenwood, and from areas near Newry, both in Oxford County.

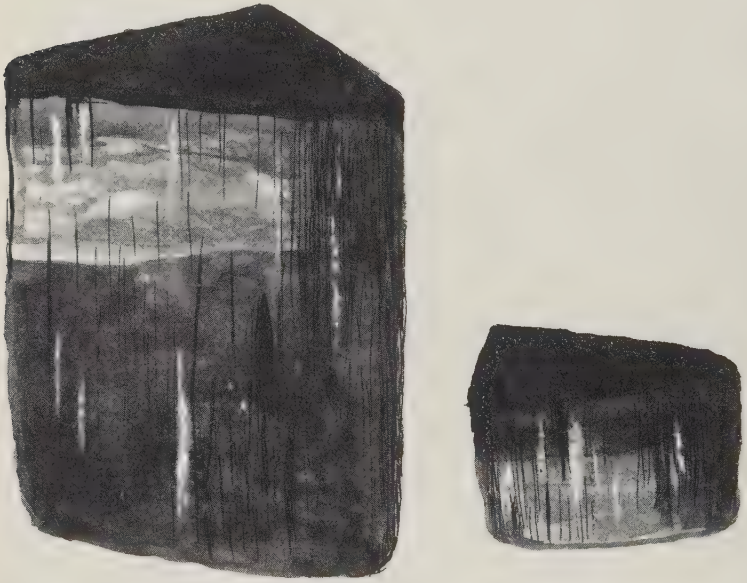
The deposits in California, perhaps first noted by Henry

Distribution map for tourmaline.

Tourmaline crystals from New York.

Hamilton in 1872, are situated chiefly in San Diego and Riverside Counties, in rocks of Jurassic-Cretaceous age. Among the numerous individual mines, the Himalaya, at Mesa Grande, is the best known, having produced more tourmaline than all the other mines in California combined. Crystals have been found in aboriginal graves near here, and Indians rediscovered several of the deposits that had been known to them in earlier times. For a number of years prior to the First World War—until the fall of the Chinese dynasty in 1912—a substantial

quantity of pink tourmaline of less than the best quality was shipped to the Orient for cutting and carving. The Pala district, first known in 1892, is the next most productive area, embracing a cluster of pegmatite mines on three adjacent hills. Gem spodumene (see Chapter 27) also comes from Pala. The Rincon district lies between the other two. Many are the stories of surprising success and disappointing failure in the operation of these deposits in the Peninsular Ranges, and one can expect more surprises in this remarkable treasure house of nature.



Tourmaline crystals, Mesa Grande, California.

Tourmaline on quartz, Mesa Grande, San Diego County, California. Faceted gems of tourmaline at bottom, displayed in U. S. National Museum.

CHAPTER 15

TEXAS TOPAZ

"Colored with the heaven's own blue."
—WILLIAM CULLEN BRYANT:
To the Fringed Gentian

Topaz is one of the favorite gems of connoisseurs—often large enough as crystals to be impressive as specimens alone; limpid and delicately hued when cut. The finest topazes known in North America are perhaps the blue crystals from Mason County, Texas. The largest American specimen of gem quality is certainly the 1,296-gram (45.7-ounce) crystal from here that is now in the U. S. National Museum. Others weighing more than a pound have also been found. One such Texas-size crystal was estimated as suitable for fashioning into a flawless, 500-carat gem, and an actual stone has been cut to 333.5 carats.

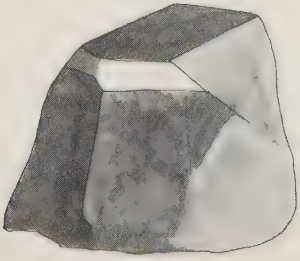
The topaz was first found in 1904 by R. L. Parker and has been recovered mostly by sporadic collecting. The origin of the topaz is in pegmatite, in which rock it is associated with gem quartz and other minerals. Erosion of the pegmatite carries the minerals into stream beds. The heavy topaz settles to the bottom of the river gravel, lodging in rock crevices and behind boulders or other natural obstructions. The chief localities are near the communities of Streeter, Katemcy, and Grit.

Although the colorless topaz outnumbers the blue by about ten to one, the latter crystals—ranging from bluish green to

Distribution map for topaz.

pale blue to sky blue—hold the reputation. Those taken from placer deposits are frosted and stream worn.

Equally fine and nearly as large topaz of similar blue tints comes from Colorado, particularly the craggy cliffs of Glen Cove, on Pikes Peak, and at Devils Head, which is not too far away (see Chapter 31). The much larger topaz crystals from Maine are seldom gemmy; neither are most of those from New Hampshire, nor the large masses of topaz in South Carolina. Some good topaz has been acquired from deposits in California, Utah, Georgia, Connecticut, and Virginia.



Topaz crystal from Texas.

CHAPTER 16

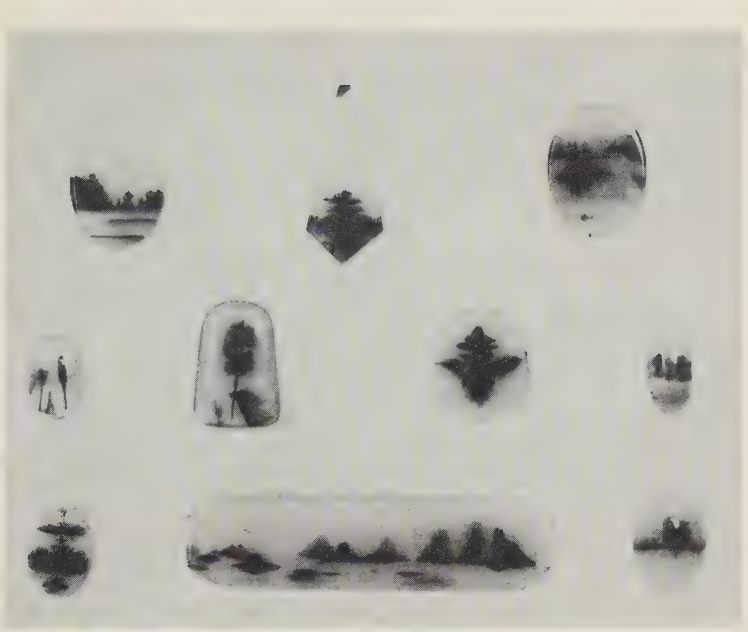
SCENERY IN STONE

"Each scene, a different dish."
—GEORGE FARQUHAR:
The Inconstant

Varied aspects of the wonderful scenery of nature are preserved forever in moss agate. In permanent tones of green, red, and black are etched enchanting views of land and water, of islands and lakes, of forests and flocks of birds flying from them—the pictures are sharp or misty, and as individual as the specimens that show them. But they are not due to moss or petrified organisms of any kind.

Just as Jack Frost grows crystals of ice on the broad surface of a window pane, so do the forces of crystallization diffuse themselves over the face of a mineral or rock. This takes place either as impurities crystallize during the deposition of the chalcedony quartz, or else by a later penetration of foreign matter along cracks. The same dendritic pattern is familiarly seen between the layers of bedded rock, such as limestone, where it presents a treelike figure having considerable appeal as an ornamental stone.

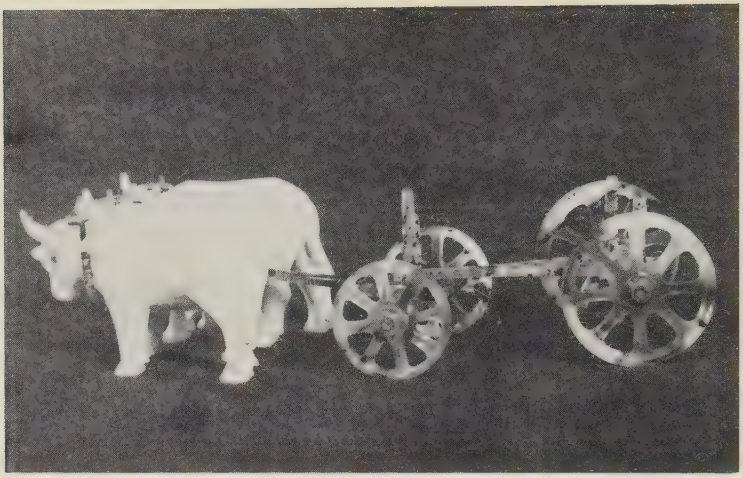
In the variety of chalcedony known as moss agate—also as landscape, or scenic, agate and as mocha stone—the design is made by several minerals. The green is typically chlorite (a



Montana moss agate, showing landscapes.

silicate), the red is iron oxide, and the black is pyrolusite, which is manganese oxide.

Although moss agate and its rather distinct variant, plume agate, are found widely throughout the United States, especially in the West, and were used by the Indians of many places, the best-known examples come from Montana and Wyoming. Along and adjacent to the Yellowstone River, in Montana—northeast from Billings to the Missouri River—occur gray and white nodules of moss agate, which yield beautiful gems when sliced open, cut, and polished. The fanciful pictures are mostly black, although some contain vague spots of brown or orange. Examples are known that show easily recognized animals and other objects—even portrait resemblances to famous people, and some have been held at high prices, quite unjustified by the actual value of the stones.



Model of the Oregon Trail covered wagon, made from moss agate and alabaster.

The Sweetwater agate of Wyoming features black, radiating hairs and tiny knots of mosslike markings. This agate is found as small nodules of various shapes, which lie scattered upon the ground in Fremont County, especially north of the Sweetwater River. The strong, yellowish-green fluorescence of the Sweetwater agate under ultraviolet light is due to the presence of uranium.

CHAPTER 17

MINES OF THE ANTS

"A small insect which was scraping about on the surface."

—WILLIAM DEAN HOWELLS:
Letter to Charles Eliot Norton

Ants are the miners of the insect world. For reasons unknown—perhaps because certain minerals are bright and occur in distinct grains—anthills often supply a concentration of small pebbles of gem minerals, together with those of quartz and other common materials of the earth's surface and soil. The Great Diamond Hoax of Western history (see Chapter 18) began with the report of diamonds that could be "picked up on the anthills."

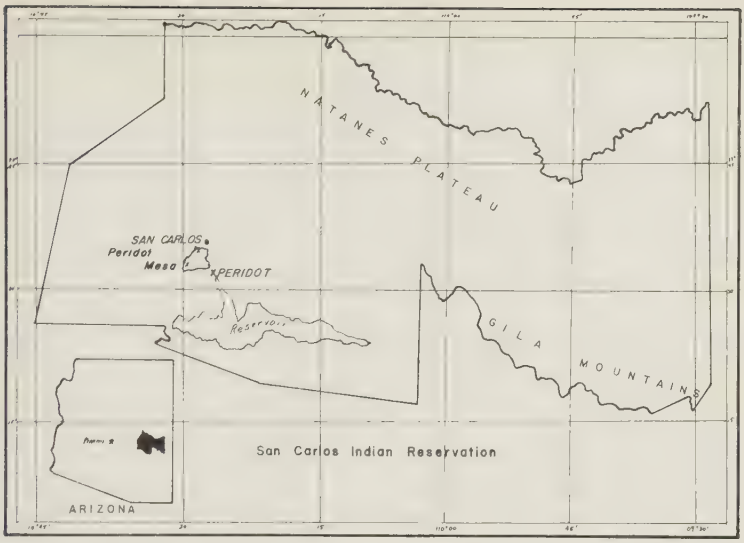
The numerous anthills of the Southwestern deserts, notably on the Indian reservations, are a curious source of two interesting gems—garnet and olivine. As much as 60 percent of some of the hymenopterous mounds consists of olivine. The garnet is the magnesium-aluminum subspecies called pyrope; and the olivine is the variety known as peridot and locally referred to as Job's tears. Both are found in rather constant colors—the garnet, its usual dark red, and the olivine, its typical yellowish green. The latter readily tends to weather brownish, being chemically unstable in the atmosphere, dry though the climate is here.

Even though this unusual type of deposit is authentic, the same two gems are actually more abundant in their original home—the solid, rocky crust—and in the stream beds and other secondary accumulations derived from them without insect aid.

Garnet was known to the Pueblo Indians. Fray Gerónimo de Zárate Salmerón, who wrote of his missionary work in New Mexico from 1618 to 1626, mentioned the garnet mines in the pueblo of Picuris, in Taos County, New Mexico.

The more productive places for garnet are in the Four Corners region, where the four states of Arizona, New Mexico, Utah, and Colorado come together. Indians of the region do most of the collecting of the rounded and fragmented specimens. In Apache County, Arizona, are the unusually interesting localities of Buell Park, 10 miles north of Fort Defiance, and Garnet Ridge, just south of the state line. In both places are found both garnet and olivine.

Distribution map for pyrope garnet and peridot.



Peridot deposits on San Carlos Indian Reservation, Arizona.

The chief peridot locality in the United States, however, lies on the San Carlos Indian Reservation, in Gila County, east-central Arizona. Periodot Mesa, properly named, contains the mineral in the form of individual grains and aggregates called bombs, or segregations, enclosed in basalt and cinders erupted from a volcanic cone. The native residents of the reservation hold collecting rights, and they supply material to the market on a sporadic basis. The largest stone cut from this peridot weighed 25.75 carats, but the average runs from 1 to 3 carats.

Kilbourne Hole, in Dona Ana County, New Mexico (near El Paso, Texas) is another source of gem-quality peridot, which likewise occurs in nodular aggregates called bombs, composed of angular fragments.

CHAPTER 18

THE GREAT DIAMOND HOAX

> "There's no getting away
> from a treasure that once
> fastens upon your mind."
> —JOSEPH CONRAD:
> *Nostromo*

The "salting" of mines is an old American pastime. Never has it reached such heights of mischief as in the notorious episode of the "Arizona diamond fields"—the Great Diamond Hoax, or the Diamond Mine Swindle. Although it is related only vaguely to any legitimate mining of gems in the United States, this story occupies a firm place in Western Americana. It has now become so familiar as a result of the attention paid to it by magazines and television that only a brief summary, in order to fix the names, dates, and places, is given here.

Capitalized at $10,000,000, the New York and San Francisco Mining and Commercial Company was incorporated in July 1872 for the purpose of working the Western diamond fields alleged to have been discovered deep in hostile Indian country the year before by Philip Arnold and John Slack. Tantalized by the solid evidence of a sack of diamonds in the hands of these two honest-looking miners, a prominent San Francisco banker, William C. Ralston, employed Henry Janin, the most

reputable mining engineer of the time, and organized a company that included on its board of directors a former governor of California and General George B. McClellan, after having first sent another general, David D. Colton, to inspect the site. Led in blindfolded, he found the diamonds, all right, and also rubies, sapphires, emeralds, amethysts, spinels, and garnets—incredible for a natural association of gems; but caution was silenced by knowledge of the recent finds of diamonds in vast amounts in South Africa.

The ground was next visited by a party of six, which included Janin, General George S. Dodge, and the two discoverers. Alleged at first to be in Arizona (or New Mexico) and south-central Colorado, the diamond field was finally found to be in the northwestern corner of Colorado, close to both Wyoming and Utah. Here had been mapped such places as Diamond Flat, Ruby Gulch, and Sapphire Hollow. The swindle was exposed in November 1872 by the geologist Clarence King, in company with Samuel Franklin Emmons, an equally well known geologist, and a topographer named Wilson. Ralston lost a quarter of a million dollars, but it could have been worse.

CHAPTER 19

THE ROSE-RED GARNET

"I find earth not gray but rosy."
—ROBERT BROWNING:
At the "Mermaid"

The first discovery of a new variety of garnet—appropriately called rhodolite because of its attractive rose color—was made some time before 1893 in Cowee Creek, Macon County, North Carolina. Although garnet of the same appearance and properties has since been found in Ceylon, the American locality is the one usually thought of as the only source of this delightfully named gem. Rhodolite is intermediate between two of the recognized subspecies of garnets—pyrope (see Chapter 17) and almandite (see Chapter 21), consisting of two parts of pyrope to one part of almandite.

Traced from Cowee Creek—where also the only rubies of any importance have ever been found in the United States (see Chapter 20)—to Masons Branch, a nearby stream, and to Mason Mountain, the rhodolite was finally found in solid, metamorphic rock. The specimens in this dike are mixed with quartz and are lacking in crystal form, and those in the stream are irregularly shaped and closely pitted. The largest cut gem weighs a little more than 13 carats.

CHAPTER 20

RUBY OF COWEE CREEK

"They're red and they're rare."
—PATRICK REGINALD CHALMERS:
The Red Dogs

Carat for carat, quality for quality, ruby is the most costly of all the gems. The explanation lies, simply enough, in the relationship between supply and demand, for here is a gem that is both rare and highly favored by those who can afford it. Certain other gems are even rarer—of some, only a few specimens are known altogether—but neither is there any regular market for them and therefore no occasion for obtaining a large price.

It is disappointing, therefore, to record that only a few rubies of any consequence have been recoverd from the United States. These are attributable to North Carolina, especially to Macon County, and here more specifically to the Cowee Creek district. The crystals of ruby are mostly small, although an occasional one up to 25 carats or more has been found. A ruby bead was recovered years ago from a Cherokee grave. Several companies have undertaken to work the deposits since 1895 but with little commercial success, and the area is today accessible to visitors who wish to pay a small fee for the oppor-

Distribution map for ruby.

tunity of trying their luck. In the same gravel of Cowee Creek where these rubies are found, the first rhodolite garnets (described in Chapter 19) were discovered.

A few feeble indications of ruby have been reported from scattered places in Georgia (near where Indian pictographs occur), Idaho, New Jersey, and Alaska. A few corundum crystals that could be considered ruby have come from the sapphire deposits of Montana (see Chapter 10).

CHAPTER 21

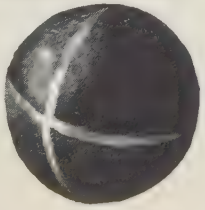
STAR OF IDAHO

"A bright particular star."
—SHAKESPEARE: *All's Well that Ends Well*

Idaho, the Gem State, affords us one of the truly distinctive, though not exclusively, American gems—star garnet. When cut into polished spheres, a succession of six, four-rayed stars—white against a dark-red (brownish or purplish) background—appears as the specimen is turned. Stars having three rays are also possible, according to the crystal orientation of the cut stone.

This garnet is the species named almandite. It occurs in rocks of metamorphic origin and in stream deposits derived from them. The asterism is caused by the presence, in the interior of the crystals, of a great many tiny needles of rutile, which diffract the light in such a way as to produce the star effect. The crystals are rough and striated dodecahedrons, modified by trapezohedrons, as is typical of so many garnets.

Emerald Creek, near Fernwood, in Benewah County, is an outstanding locality, particularly its East Fork, and there are several other places in Idaho where star garnet is found.



Star garnet sphere from Idaho.

CHAPTER 22

NORTH AMERICA'S HIGHEST GEM DEPOSIT

"Objects in an airy height."
—MATTHEW PRIOR: *To the Hon. Charles Montague*

The highest gem locality in America, and nearly the highest mineral deposit in the world—exceeded only by the mines of glorious sapphire in Kashmir—yields lovely aquamarine of a bright-blue color. From an altitude of 14,000 feet, on the upper slopes of Mount Antero and neighboring White Mountain—connected with it by a broad ridge—have been taken numbers of aquamarine crystals, an occasional one reaching 8 inches in length. These peaks are in the Sawatch Range and lie somewhat east of the Continental Divide, which follows the range for most of its 75 miles' length. The broad valley of the Arkansas River lies just to the east and far below.

For decades after the "official" discovery of aquamarine by Nathaniel D. Wanemaker in 1884 or 1885, Antero was one of the more isolated collecting localities in this country. It was a long, hard climb—not dangerous but always strenuous, even when supplies and equipment were transported on pack animals. The glaciated topography is rugged in the extreme. Frequent, severe electrical and hail storms hamper operations; and the steep, talus-covered slopes of the mountains are conducive

Distribution map for aquamarine.

to rock slides. Access is only during the short summer. Here, on the south side of the mountain, Wanemaker lived for years in a small, stone cabin in a glacier-gouged amphitheater about 800 feet beneath the summit. The roofless ruins of the old cabin still stand, entirely surrounded by barren rock, the only timber 1,500 feet below, the only water from a small pond that dries up before the end of summer.

Yet, it must have been a satisfying place. The thrill of the spectacular scenery—unique among American mineral localities—and the beauty of the flowers and wild life made up for the hardships. So, too, did the value of the gems, which probably attracted one or more men before Wanemaker, for local rumors say that Tim Ivey, Jasper Pettigrew, and John Mohr collected crystals in earlier years, as seems likely. Others have followed them, but extracting gems on Antero was always considered an achievement.

Then, in 1956, a mining company decided that Mount Antero

was a likely enough deposit of beryllium metal—for aquamarine is a gem variety of beryl, a mineral composed of beryllium aluminum silicate, $Be_3Al_2(SiO_3)_6$. They built a road practically to the top and hired an unfriendly, armed guard to discourage all comers, mountain climbers as well as mineral enthusiasts. They drilled holes and blasted rock and trucked ore. Thus, they destroyed the isolation of the area and its romantic appeal, although they have probably provided future collectors with much easier access, once the commercial mining activity ceases.

The mineral-bearing rock occurs mostly in a body of white granite of Tertiary age, which underlies a large part of 14,249-foot Mount Antero and 13,900-foot White Mountain and also appears nearly a mile west of these peaks. Some of the same deposits are found in a gray rock called quartz monzonite, which surrounds the granite. The beryl is in pegmatite and veins, one of which—the California vein—lies at the foot of symmetric Mount Baldwin, 2 miles away. The gemmy crystals of aquamarine have grown in large cavities in the upper 500 feet of the granite.

With the beryl are two other beryllium minerals—phenakite, much of it gem quality, and bertrandite, some of it in heart-shaped, twinned crystals, among the finest in the world. Rock crystal, smoky quartz, microcline feldspar, fluorite, and topaz are other interesting minerals in this remarkable place.

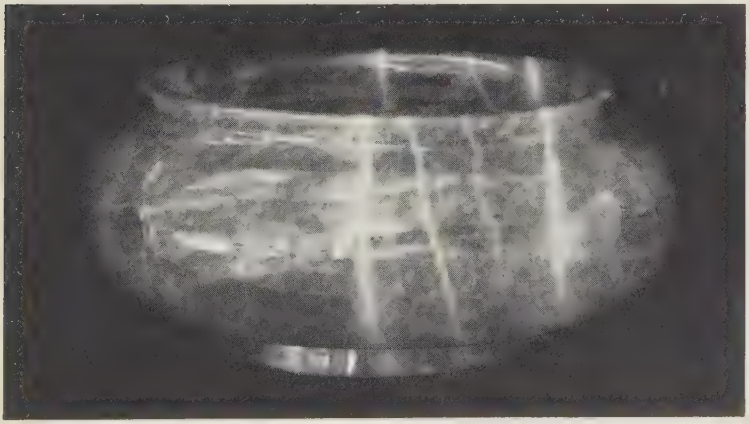
Aquamarine has also been collected or mined in other states, including California, most of those in New England, Pennsylvania, the Carolinas and Georgia, New Mexico, Idaho, Wyoming, and Alabama.

CHAPTER 23

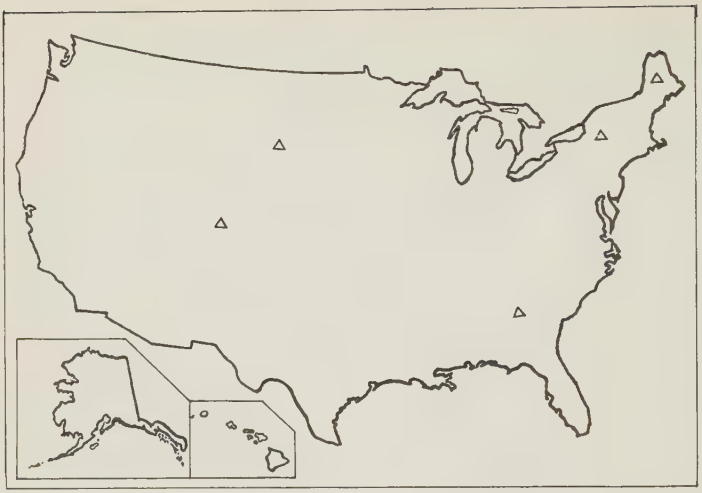
SCOTT'S ROSE QUARTZ

"The very pink of perfection."
—OLIVER GOLDSMITH:
She Stoops to Conquer

Custer City, renamed after the famous Indian fighter who lost, was settled in 1875 as the first town in the Black Hills, South Dakota, and its streets were laid out by Samuel Scott, a mining engineer. In 1881, he obtained ownership of a pegmatite body rising from the floor of a gulch 6 miles southeast of Custer, and



Large bowl, made of rose quartz from Scott's mine, Custer, South Dakota.



Distribution map for rose quartz.

on this deposit a quarry was opened that has yielded the best-known rose quartz in the United States. This was described by Scott as "fine specimens . . . of deep rose-red and pink colors," in his book, *Map of the Black Hills of South Dakota and Wyoming. With Full Descriptions of Mineral Resources, Etc.*

The finest material from here was sent for years to Germany and China for carving into ornamental objects and cutting into bead necklaces and other jewelry. The common grades of rose quartz—of lighter color and stained by iron oxide—were marketed as tombstones, for rock gardens, and in various forms of building construction.

Other sources of good rose quartz are in New York, Maine, Colorado, and Georgia. The Indians along the Atlantic coast and in South Dakota used this gem.

CHAPTER 24

AMERICAN AMETHYST

"Amethyst mountains, peaked with snow."
—ALFRED NOYES:
The Realm of Gold

Although amethyst—the most valuable variety of quartz—is not found in any significant amount in the United States, some extremely choice gems have come from a few scattered localities. Four Peaks (Arizona), Jefferson County (Montana), and Redfeather Lakes (Colorado) would, if more extensive, rank with the important amethyst deposits of the world, for the quality of their best product is superb.

The Four Peaks are in the Mazatzal Mountains of Gila County, Arizona, 10 miles west of Roosevelt Dam. Between peaks Number 3 and Number 4, at an altitude of 6,900 feet, are found the crystals of amethyst, which occur in veins and cavities in quartzite, both fixed and loose, and are characterized by a pronounced depth of color, some of which turns green when heated.

The Jefferson County, Montana, locality is the Pohndorf mine, once operated by the late August G. Pohndorf, the well-known jeweler and mineral dealer of Denver, who owned it jointly with his adopted son when they lived in Butte. The amethyst crystals have been taken from a large pocket in pegmatite and are noted for their clarity as well as color.

Scepter amethyst crystal, Redfeather Lakes, Colorado.

The former Pennoyer mine is situated at Redfeather Lakes, in Larimer County, Colorado. It yielded highly attractive amethyst from pockets in veins of quartz in granite. The most interesting crystals are of the scepter type, in which a slender stem extends from the thicker development at the top.

Amethyst is collected in Texas, and here and there in a number of other states, especially New Hampshire, North Carolina, Georgia, Maine, Virginia, and Pennsylvania. This gem was used by Indian tribes in the southeastern and southwestern United States and the upper Mississippi Valley.

Distribution map for amethyst.

CHAPTER 25

VIRGIN VALLEY OPAL

"We walked into an opal like a sunset-coloured cloud."
—ALFRED NOYES:
Forty Singing Seamen

One of the few really significant sources in the world for the gem that many connoisseurs regard as superior to all the rest lies in the high, desert country of northern Nevada. Here, black opal of flashing magnificence occurs in seams and irregular masses in volcanic rock, as well as in the form of opalized wood.

From this part of Humboldt County came the noted Roebling opal, now in the U. S. National Museum. Weighing 18.6 ounces, it is a section of a petrified limb, showing a rich-red interior. Red is the dominant color of Virgin Valley opal, although orange and yellow are also common, and green and purple are other choice hues frequently seen. Besides the wood that has been replaced by both precious and common (non-gem) opal, there are sometimes found pine cones and spruce cones similarly opalized.

Nevada opal has a pronounced tendency to dry and crack, more so than most other opal of equal beauty. The risk involved has lowered the commercial value of this best of American opal. Nevertheless, some of the material from the interior of the limbs has remained intact for many years.

The earliest discovery has been ascribed to both a cowboy

Distribution map for opal.

and a mining engineer and dated 1905 or 1906. Active mining extended from 1908 to about 1920 and was renewed in 1949. The Roebling specimen was found about 1917, and two masses of precious opal, each weighing more than 6 pounds, have been taken out since 1951. Some of the opal is moderately radioactive, owing at times to the presence of visible carnotite.

Good gem opal has also been recovered from a locality south of Yerington, Nevada, and from Idaho. Other gem opal—much of it in the form of opalized wood—has come from a number of the Western states, notably New Mexico and those bordering the Pacific coast.

CHAPTER 26

THE APPEARANCE OF A SAPPHIRE STONE

"Blue, darkly, deeply, beautifully blue."
—ROBERT SOUTHEY:
Madoc in Wales

The gem rock we call lapis lazuli—"blue stone"—was the sapphire of the ancients, as referred to in the Bible. *Exodus* mentions "a paved work of a sapphire stone," and *Ezekiel* alludes to "the appearance of a sapphire stone," and both meant lapis. Sprinkled with pyrite and streaked with white calcite, this mixture of minerals resembles, according to Pliny, the "star-bedecked night sky."

Scarcely any lapis lazuli in the world—even that from Badakhshan, so much prized—excels in beauty the scarce material that has been taken from the rugged slopes of North Italian Mountain, in Gunnison County, Colorado. At an altitude of 12,500 feet, the metamorphic rock, a marble of Cretaceous age, contains a vein consisting of stringers of lapis having a very fine-grained texture. This deposit was discovered in 1939 by Carl Anderson, who took away 100 pounds of gem-quality stone from his first 15 feet of mining.

Another occurrence of the same rock is in Cascade Canyon, in the San Bernardino Mountains, north of Upland, San Bernardino County, California.

CHAPTER 27

GEM SPODUMENE

"Oh, call it by some better name."
—THOMAS MOORE:
Ballads and Songs

The only two separately named gem varieties of the mineral spodumene both bear the names of Americans. These are kunzite, after George Frederick Kunz, and hiddenite, for William E. Hidden. Kunz was a professional mineralogist and a widely known gem expert with Tiffany and Company, of New York. Hidden was in charge of the emerald mine in North Carolina in which the first emerald-green spodumene was discovered.

Spodumene occurs almost exclusively in the very coarse and variably grained, granitic rock called pegmatite. Among minerals, spodumene is remarkable for the enormous size of its crystals, the world's largest—in the Etta mine, near Keystone, South Dakota—having reached 47 feet in length and 90 tons in weight. The first gem material, transparent and yellow but not distinctively named, was found about 1877 in Brazil. Then, in 1880, the green gem variety, hiddenite, was recognized as such in Alexander County, North Carolina; and in 1902, kunzite, which is pink to lilac in color, was identified in San Diego County, California, its first discovery having been made earlier by Frederick M. Sickler.

The kunzite locality of most renown, producer of the largest and finest specimens of this gem, is Hiriart Hill, in the Pala district of California. Some crystal fragments obtained here in recent years from the cavities in pegmatite, which are Jurassic-Cretaceous in age, approach deep amethyst in color. Like other gem spodumene, kunzite typically shows prominent grooves on the sides of the crystal remnants. Associated with some of the kunzite in California are tourmaline and other minerals (see Chapter 14), as well as other colors of spodumene, in colorless, yellowish, and pale-green varieties.

Crystals of hiddenite from pegmatite pockets in North Carolina are less than 2.5 inches long and are shaped like a short sword. The green hue grades into yellowish green. The largest cut gem weighs 9.29 carats and is in the American Museum of Natural History, the gift of J. Pierpont Morgan.

CHAPTER 28

THE FAIRY CROSS

"Do you believe in fairies?"
—J. M. BARRIE:
Peter Pan

The people of the southern Appalachians are familiar with the numerous mineral crosses that are found in the soil and rock of their countryside. These they call fairy crosses or fairy stones, about which some charming legends are told. The authenticity of such stories is uncertain; it seems likely that they have some remote folk connections brought from Brittany, in France, but have been passed along chiefly as tourist bait. Among other uses, it is known that the crosses were worn during the period 1751 to 1790 as baptismal amulets in Basel, Switzerland, where they were called "Lapis Crusifer."

These curious crosses are twinned crystals of the mineral staurolite, so named from its frequent tendency to assume this shape. Only a small proportion of the twins penetrate each other at the desired perpendicular angle, to form Latin or Greek crosses; the rest intersect at oblique angles. Except the pearl, staurolite is perhaps the only gem normally worn in its natural condition, requiring at most that it be scraped clean of its matrix and drilled for hanging on a chain.

Though not in the least rare, crosses of staurolite are usually crudely formed and are intergrown with the associated minerals. Hence, the clean and sharply defined ones are in demand.

Fairy stones of twinned staurolite crystals.

To increase the supply, the local residents manufacture the more popular, right-angled varieties in quantity by carving them from a soft, native rock. Roadside stands throughout the Appalachians sell large numbers of both the natural crystals and the artifacts.

The chief American deposits of staurolite crosses are in southern Virginia, western North Carolina, northern Georgia, and northern New Mexico. Patrick County, Virginia, and Fannin County, Georgia, are the best-known sources. Fairy-stone State Park commemorates the occurrence in Virginia. The crystals are found in the solid, metamorphic rock in which they have formed, in the soil derived from the bedrock, and in the stream gravel into which they have been washed.

Distribution map for fairy cross (staurolite).

CHAPTER 29

GREEN BOLTS FROM CAROLINA

"Like wet grass in the shadow
of great trees after a summer rain."
—O. O. MC INTYRE

It was the finding of crystals of emerald in the only place of any importance that this superb gem has yet been known in the United States that led to the original discovery of hiddenite, the green variety of spodumene (see Chapter 27). The source of both gem stones is Hiddenite, in Alexander County, North Carolina.

The emerald crystals were referred to locally as "green bolts" and had been picked up here by 1875 or earlier. When reached by excavating into the ground, a vein was exposed that contained both emerald and hiddenite. The largest crystals of emerald from here was 8.5 inches long; it was later stolen from the American Museum of Natural History. These emeralds have been more valued as crystals than as cut stones.

In addition to this original site, emerald has been found in North Carolina near Shelby, in Cleveland County, and on Big Crabtree Mountain, in Alexander County.

South Carolina and Nevada have reported very minor occurrences of emerald.

CHAPTER 30

CALIFORNIA'S BENITOITE

"With living sapphires."
—MILTON:
Paradise Lost

Conflicting stories tell of the discovery of benitoite in 1906 or 1907 on the west side of the Diablo Range, about 25 miles north of Coalinga, in San Benito County, California. At first, it was thought to be sapphire, for its color is a fine blue. The hardness is less than sapphire, however. Benitoite occurs (associated with black neptunite) as small, triangular crystals in veins of white natrolite in metamorphic rock. It was identified as a new mineral, a silicate of barium and titanium, $BaTiSi_3O_9$,

Benitoite, the blue California gem.

by Dr. George D. Louderback, of the University of California. It was, furthermore, shown to represent a class of crystal symmetry previously considered mathematically possible but unknown in nature. It still remains the only natural member of this crystal class.

Another remarkable feature of this gem lies in the colors of the two rays of light that combine to form the characteristic blue that is seen by the eye. This property of dichroism shows in a simple optical instrument called a dichroscope, revealing twin hues of blue and colorless; it was perhaps the original clue to the fact that the first cut stones were not sapphire. Some benitoite, however, is colorless. Benitoite fluoresces under short-wave ultraviolet light.

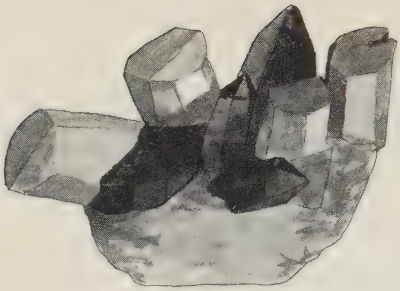
CHAPTER 31

PIKES PEAK AMAZONSTONE

"Among our ancient mountains,
And from our lovely vales."
—GEORGE LINLEY: *God Bless the Prince of Wales*

The first time that Russia was bested by the United States in open mineral competition seems to have been in 1876 at the Centennial Exposition in Philadelphia. A good deal of amazonstone, the green variety of microcline feldspar, had been shipped from the Ural Mountains for sale at the fair. To the surprise of the European exhibitors, newly found specimens from Colorado were brought in for display in such amount and quality as to drive the Russian material from the market.

The Pikes Peak region—in El Paso, Teller, and Douglas Counties—remains the most productive source in the world for this attractive gem. The discoveries of recent years equal any of the old-time ones, which have been made at least since the earliest published mention, in 1876, by Ovando J. Hollister in his fascinating book, *The Mines of Colorado.* The Pike's Peak or Bust gold rush did not focus on the famous mountain near Colorado Springs and Manitou Springs, but was directed toward the country west of Denver. The well-known name has, however, been written on the labels of specimens found up to 40 miles from the peak itself. The individual localities have also been referred to by their own names—Crystal Peak, Crystal



Amazonstone and smoky quartz crystals from Colorado.

Park, and Devils Head, among others. The deposits that are associated with the Pikes Peak granite are, however, much alike.

Amazonstone occurs in bright green and blue, and in blends of the two colors, often diluted with gray. It is opaque, and so its appeal is entirely one of color and luster. Readily enough mistaken for jade, it has been sold as "Colorado jade" and "Pikes Peak jade." It is doubtless the most characteristically Colorado gem.

Amazonstone—named for the Amazon River, where it has never been seen—is found as crystals in cavities, or pockets, in pegmatite in the reddish Pikes Peak granite. The principal associates include such gems and other minerals as smoky quartz, rock crystal, albite feldspar, muscovite and biotite mica, topaz (see Chapter 15), phenakite, fluorite, goethite, and hematite.

Devils Head probably offers better collecting possibilities than any other Colorado locality. From the area immediately surrounding this jagged-looking, rather isolated mountain of 9,348 feet has already come much fine amazonstone, some of the largest crystals of smoky quartz in Colorado, abundant rock crystal, and the largest well-formed and well-preserved topaz crystal ever found in North America.

Even choicer quality amazonstone comes from the Crystal Peak area, near Florissant and Lake George. The old homestead of Albert B. Whitmore, known as the Gem Mines, was the famed center of the specimen mining in this part of the

Pikes Peak region. Whitmore came to the region in 1874, mined at Cripple Creek, maintained a mineral store there, lived almost as a hermit on his homestead for thirty-five years, and died in 1938 at the age of eighty-nine after being beaten by vandals at his lonely cabin. A tourist concession has at times since then offered tours and collecting opportunities for a fee.

Crystal Park, where John Hay did some of his best writing, has furnished a large part of the amazonstone for which Colorado is credited. It lies at the base of Cameron Cone, closer to Pikes Peak than either of the other two areas. Most of the collecting here has been done by residents of Colorado Springs and Manitou Springs.

Amazonstone of the finest gem quality occurs near Amelia, Virginia, but in irregular masses rather than crystals. Pennsylvania and North Carolina have also yielded some amazonstone.

Distribution map for amazonstone.

CHAPTER 32

THUNDEREGGS

"New names for mystery."
—JOAQUIN MILLER: *The Tale of the Tall Alcalde*

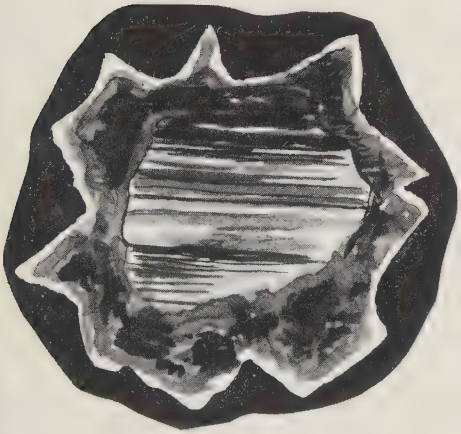
Taken from the nests of thunderbirds and thrown from the craters of the Cascade Range volcanoes Mount Hood and Mount Jefferson, by the angry gods during a battle, the thundereggs of Oregon represent a distinctive type of gemstone occurrence. By geologists, they are termed "spherulitic geodes." Within each of these nodules, so rough and bumpy on the outside, is a typically star-shaped growth of chalcedony quartz. This is often present in parallel bands of onyx—blue and white, or in combinations of other colors. Needlelike inclusions and swirling patterns of moss agate are also common.

The thundereggs have formed and are found in the volcanic rock called rhyolite, adjacent to a dark zone of the variety that is known, because of its pearly luster, as perlite. They readily weather from the original rock, which is of Oligocene or Miocene age. An occasional one is several feet across, but most measure several inches instead.

How did the thundereggs form? Several explanations have been offered besides the supernatural one. They may be due to the shrinkage of a mud filling of a cavity in the rock, which

was then permeated by solutions of silica. Or they may be deposits of silica filled by later penetrations of the same material.

The main localities in Oregon are distributed at random through the barren, central part of the state, especially in Jefferson, Crook, and Harney Counties. The Priday Ranch, 18 miles northeast of Madras, is a particularly well known place for thundereggs, as well as for plume agate and petrified wood. The Prineville-Crook County Chamber of Commerce maintains mining claims in this general area, where the public can dig for these and other specimens free.



Oregon thunderegg.

CHAPTER 33

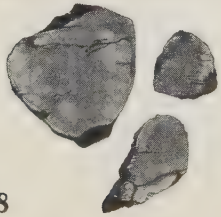
DUAL PERSONALITY

"There's a pair of us."
— EMILY DICKINSON:
Life

Datolite leads a double life. This mineral appears as an occasional gem in the form of transparent crystals having a pale tint of yellowish green, and it occurs in opaque nodules that resemble unglazed porcelain and can be cut into simple, rounded stones. This second type of datolite is known only in the United States, where it is found in the Lake Superior copper district of Michigan. The inside of the rough nodules is usually white, attractively speckled with tiny inclusions of native copper, but mottlings of other colors are also seen.

The copper mines from which massive datolite has come are on the Keeweenaw Peninsula and Isle Royale, now a national park but once the active site of prehistoric Indian mining.

Datolite of the clear, crystalline type comes from Massachusetts, Connecticut, and New Jersey. The mineral is a basic silicate of calcium and boron, $CaB(SiO_4)(OH)$.



Michigan datolite.

CHAPTER 34

WHEN APACHE WOMEN WEPT

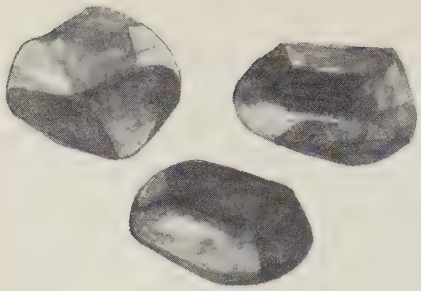
"Dark with torment and with tears."
—EMILY BRONTË:
Sleep Not

Named for the Indian legend that they are the petrified tears of Apache women mourning after the slaughter of their men in battle, the rounded lumps of natural glass known as obsidian are a familiar gem material in the American Southwest. These Apache "tears," when cut into transparent, smoky stones, are rather attractive, although they have little value beyond the cost of the lapidary work.

The nodules of obsidian have formed as inclusions within perlite, a volcanic rock, so called from its pearly luster. The proper, technical name for them is merekanite. They date from the Tertiary and Quaternary Periods of geologic time. When loosened by erosion, they gather in the soil and wash into stream beds, together with other alluvial fragments.

The most prolific sources of Apache tears are in Arizona, especially near Superior, in Pinal County, where perlite is mined as a raw material for the construction industry. The Vulture Mountains and the vicinity of Aguila, both in Maricopa County, are among the other sources in the state.

Nevada, Colorado, and New Mexico also furnish Apache tears in quantity. Massive obsidian, which may be found in



Apache tears from Arizona.

colors besides the usual black, is a rock that has often been used for gems but especially for artifacts, for which purpose it ranks as one of the most important substances known to early man. Spear points, arrowheads, razors, and knives of obsidian were used throughout the United States, except along the Atlantic seaboard.

Obsidian Cliff, in Yellowstone National Park, other areas of the Yellowstone and Snake River Valleys, and locations in Utah, New Mexico, Arizona, and Nevada were prime sources of obsidian. The Obsidian Cliff locality was apparently worked

Distribution map for obsidian.

Obsidian cliff, Yellowstone National Park. One of the most important Indian stone quarries.

as neutral ground. Rough blocks of obsidian have been found buried as if for safekeeping in shell heaps in the area around San Francisco Bay. The Pueblo Indians of New Mexico and Arizona had sufficient supplies nearby, both from shattered outcrops and from quarries. The Mound Builders of the Midwest apparently imported blocks of obsidian. Ceremonial knives 18 inches long and 6 inches wide were used by the Hopewell, Ohio, tribes, and it is believed by some that they may even have sent expeditions to Yellowstone to get the obsidian they needed.

California and Utah are today our leading producers of obsidian for the amateur lapidary. It comes in the varieties called rainbow, snowflake, golden sheen, black, and white.

CHAPTER 35

NODULES OF VARISCITE

"Variscite is found in noodles in Utah."
—FRESHMAN PAPER

The closest resemblance to turquoise among the natural gem materials is borne by variscite, a rich green to greenish-blue mineral having considerable popularity in America, though only limited use as a gem because of its softness.

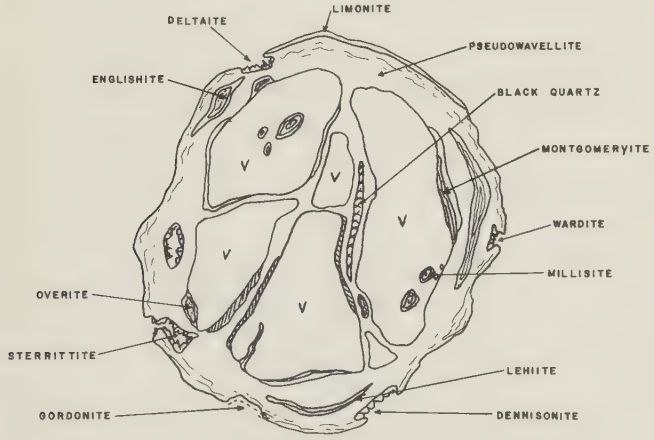
Named after Variscia, the ancient name of the district of Vogtland, in Saxony, it has been found so prominently in the state of Utah that some of its synonyms include utahlite and chlor-utahlite, as well as lucinite, named after the place called Lucin. The ancient pueblo people of Utah used the mineral, and their artifacts and rock inscriptions are common near the deposits.

Variscite occurs in nodules, some of which are as large as 1 foot in diameter, but most of them run under half that size. These were first discovered in 1893 in Clay Canyon, near Fairfield, in Utah County, where they occur in the "Great Blue" limestone of Mississippian age. Another locality is near Lucin, in Box Elder County, first worked in 1902 as a gold-mining claim. A third locality is Amatrice Hill, near Tooele, in Tooele County.

The mineral also fills veins and other openings in surround-

ing rock, and occasionally it appears as tiny, transparent crystals in hollows in the nodules. The variscite in the nodules and other masses is typically a bright yellowish green, but the color tends to be spotted and streaked, and it shows a considerable range from white to deep bluish green. Like that of turquoise, the luster is earthy to waxy.

The percolation of phosphate-bearing ground water through rocks, such as shale, having a high aluminum content, caused the deposition of the variscite, which is a hydrous aluminum phosphate. Surrounding the nodular variscite are bands of yellow, white, and gray, these being some of 12 other phosphate minerals altered from the variscite, 9 of which were first described from Clay Canyon. One of the minerals is wardite, which has an American name (see Chapter 3) and is occasionally cut as a gem. Later minerals were deposited in cavities of the earlier ones. This combination of various minerals en-



Nodule of Utah variscite (V) *and associated minerals.*

couraged an early dealer to put together the words "American matrix" and come up with amatrice, a name sometimes still seen today.

The patterns of delicate, lacy veining are really the most attractive feature of variscite, hence the more frequent appearance of sawed and polished slabs in mineral cabinets, where they are readily recognized, than of cut gems in jewelry.

Nevada—in Esmeralda and Mineral Counties—is another source of commercially useful variscite. These two states thus contain virtually all the world's known supply of cuttable material.

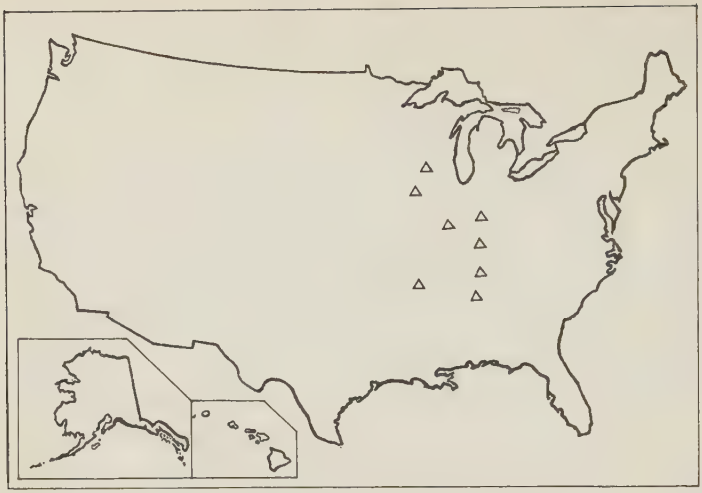
CHAPTER 36

RIVER PEARLS

"Beneath the watery floor."
—MILTON:
Lycidas

The picture of an Oriental diver making ready to descend into the shark-infested, tropical waters of the Persian Gulf for pearl-bearing oysters is a familiar one. So too is that of the female Japanese divers, or *amas,* who tend faithfully to the crop of cultured pearls and bring them to the surface in baskets. Not much thought is given, however, to the abundance of pearls obtained each year from the rivers of the world. Fresh-water pearls have been secured in Scotland for 2,000 years, and streams in other countries have also supplied many fine gems of this sort.

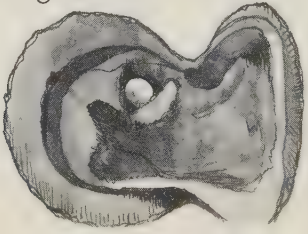
In the United States, interest began in 1856, when Tiffany and Company paid $2,500 for a single pearl discovered in New Jersey. Fresh-water pearls are now fished principally in the Mississippi River and its tributaries, especially the Tennessee, Wabash, Ohio, White, and Cumberland, and in the Alabama River. Some recoveries have been well-publicized because of the returns they have brought. The pearls, however—even though often very lovely—are a small byproduct (running about 10 percent) of the iridescent or silvery shells that are harvested from the streams for the making of mother-of-pearl buttons, knife handles, and other objects. The main produc-



Distribution map for river pearls.

tion currently comes from the states of Alabama, Tennessee, Indiana, Kentucky, Illinois, and Arkansas.

The animal responsible for the little gem of unique origin is a bottom-dwelling mollusk belonging to the family Unionidae. It lives between two shells, or valves, the shape and size of which vary according to the particular species, of which several hundred are known. These mollusks are spoken of as mussels (which they are) and clams (which they are not). Nor are they oysters. They are taken from the stream bed chiefly by the crowfoot method, which uses pronged wire hooks attached to a line that is fastened to an iron bar; the animal closes upon the hook when it enters the open shell. Also employed is the simple method of hogging—merely picking the shells out of the water at night when the mussels come up to feed. Diving and other means are also used.



Pearl in mollusk, found in Mississippi River.

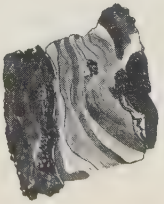
CHAPTER 37

THE GREEN AND THE BLUE

"This pretty pair."
—ANON.:
The Children
in the Wood

Equally rich in hue, green malachite and blue azurite contrast with each other as strikingly as two colors can. Both of these copper carbonate minerals—but especially the gloriously banded malachite from the Congo, the Ural Mountains, and Arizona—are used as gems. Much more frequently than it appears alone, however, azurite is likely to enter the gem market in association with malachite, the combination being given the name azurmalachite.

Over the years, the upper levels of copper mines in Arizona have supplied valuable amounts of these related minerals. Bisbee, in Cochise County, and Clifton-Morenci, in Greenlee County, rank high among the world's localities. According to early Spanish accounts, the Indians of the Southwest were abundantly supplied with malachite and azurite. The Apache attached a small bead of malachite to his rifle to make it shoot straight.



Azurmalachite from Arizona.

CHAPTER 38

THE SHORE OF GITCHE GUMEE

"By the shore of Gitche Gumee,
By the shining Big-Sea-Water."
—LONGFELLOW:
The Song of Hiawatha

An agatelike gem from the Lake Superior region is thomsonite, an orthorhombic, silicate mineral belonging to the zeolite group. The pattern is one of concentric, eyelike design; a single specimen may show many small eyes, each of which is an aggregate of closely packed fibers arranged in a radial fashion. The colors are varied, being mottled in white and shades and tints of red, yellow, and green.

Lintonite, named for Laura A. Linton, who determined its chemical composition, is a special variety of thomsonite, having a translucent, olive-green hue. The formula of thomsonite is $(Ca,Na)_6Al_8(Al,Si)_2Si_{10}O_{40} \cdot 12H_2O$.

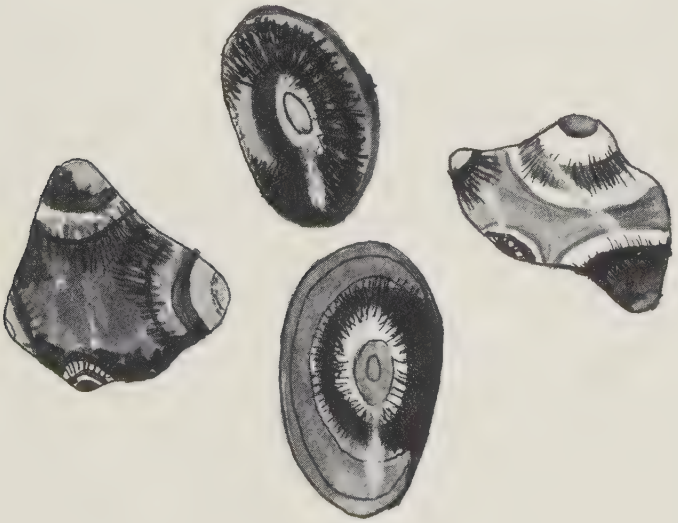
Pebbles of thomsonite are abundant along the shore of Minnesota, especially at Thomsonite Beach, southwest of Grand Marais, in Cook County. In Michigan, they are common on the beaches of Isle Royale, which has a Thomsonite Beach of its own, and on the pebble beaches north of Ahmeek, in Keweenaw County.

Green star stone is the meaning of the name chlorastrolite,

given in 1847 to an attractive gem popularly known as greenstone. It comes solely from the Upper Peninsula of Michigan, particularly in Isle Royale National Park, where it occurs in gas cavities in Pre-Cambrian lava and as small, rolled pebbles that have weathered out of the solid rock. The best localities are along the beaches on Smithwick and Mott Islands and along the south shore of Siskiwit Lake.

The distinctive feature of chlorastrolite is its green and white, mosaic pattern, consisting of fibrous aggregates, which give it a segmented look, often referred to as turtleback. Chlorastrolite is a synonym for pumpellyite, a silicate mineral having the formula $Ca_4(Al,Fe,Mg)_6Si_6O_{23}(OH)_3 \cdot 2H_2O$.

Agates of chalcedony quartz are also found on the shores of the shining Big-Sea-Water. These are of many colors, especially red, brown, white, and colorless.



Lake Superior thomsonite, found in Minnesota.

CHAPTER 39

TICK CANYON HOWLITE

"'E was white, clear white, inside."
—RUDYARD KIPLING:
Gunga Din

Appearing rather frequently in the work of amateur lapidaries as an ornamental material, the white, borate mineral called howlite has lately been used, when suitably dyed, as a good substitute for turquoise. It thus becomes an American gem of some consequence on two counts—for itself and especially as a disguised replacement for a gem much better known than it is.

The natural whiteness of howlite is marked in places by a thin veining in black or dark brown. The mineral occurs in nodules resembling cauliflower, which may grow to 1 foot in diameter. Howlite is soft enough to be carved readily and does not take a high polish. It is a hydrous borosilicate having the formula $H_5Ca_2B_5SiO_{14}$.

Tick Canyon, near Saugus, in Los Angeles County, California, is the principal source of howlite. In the Sterling borax mine, the nodules are found in gray clay and shale. Colemanite, another borax mineral, is, however, the main product.

CHAPTER 40

DINOSAURIAN GEMS

"Behold the mighty dinosaur."
—BERT LESTON TAYLOR:
Stegosaurus

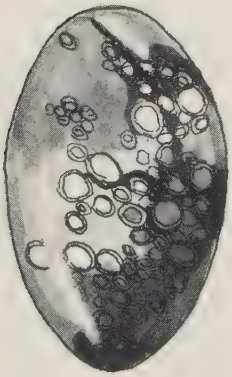
Gems that date from the Age of Reptiles and preserve in colorful stone the actual bones of the greatest of those monsters, the dinosaurs, form a novel American ornamental material. Red carnelian, jasper, agate, and related varieties of chalcedony quartz constitute the mineral matter that has filled and replaced the cells, while retaining in minute detail the organic structure. Huge segments of the skeletons of all the dinosaurs "famous in prehistoric lore" are found thus petrified and widely distributed throughout the West.

The Morrison formation in Colorado, Wyoming, and other Western states is the principal source of the dinosaur remains. Its variegated rocks were laid down during the Jurassic Period, when dinosaurs thrived so mightily in this corner of the world. They walked on low ground and moved slowly through shallow water, as they surveyed the medieval landscape of the world.

The Morrison formation is especially well displayed in and near Dinosaur National Monument, in northwestern Colorado, and Colorado National Monument, in the west-central part of the state. From both places have been taken some of the best known of these vastly interesting reptiles. Three other classic

localities, opened during the earliest years of the Western dinosaur discoveries—in the 1870s—are Como (or Como Bluff), Wyoming, Garden Park, near Canon City, Colorado, and Morrison, near Denver. These are type localities for some of the most ponderous beasts that ever trod the globe: *Atlantosaurus, Allosaurus, Brontosaurus, Diplodocus*, and relatives of theirs, whose bones, now turned to gemmy silica, you may wear one hundred million years later in costume jewelry. According to Robert Webster, this material is being carved in West Germany for such items as small tortoises, which look more realistic because of the natural markings of the fossil bones.

An intimate associate of many such agatized dinosaur bones is uranium, which has an affinity for organic carbon. Many of the former localities for silicified bone in the Colorado Plateau province became the sites of uranium mines during the boom of the 1950s. Petrified wood is likewise closely related to uranium deposition, and probably for the same reason. The hearts of many petrified logs are rich in the canary-yellow mineral known as carnotite; other radioactive minerals, notably pitchblende, also occur this way.



Agatized dinosaur bone, cut as cabochon.

CHAPTER 41

JADE IN WYOMING

"The stone of heaven."
—CHINESE

Over an area covering thousands of square miles in south-central Wyoming has been found an abundance of jade, "the stone of heaven." Ranging from black to gray to grayish green to brownish green to bright green, this is nephrite jade, the more common and less valuable of the two distinct kinds of jade—but true jade, nevertheless. Large quantities have been shipped to the Orient for cutting, and fantastic prices have been asked—and sometimes paid—for the rough material.

The jade is found in ledges of metamorphic rock and in boulders torn loose and strewn across the Wyoming sagebrush desert. The loose material, called float, was discovered first, apparently in the early 1930s. Prospecting on a large scale began in 1936, and finds as large as 4 or 5 tons have been reported. In 1944, the jade was found *in situ* ("in place"). Among the successful collectors, the names of Allan Branham and Bert A. Rhoads stand out prominently.

Nephrite jade, it is true, also comes from Alaska (see Chapter 42), and (together with jadeite jade) from California (see Chapter 43), and a little from Oregon. Nephrite is also found in British Columbia and even further north in western Canada. And both nephrite and jadeite have been associated with some

of the most significant artifacts of the Incas and Aztecs. Nevertheless, the Wyoming deposits have been the principal jade resources in the Western Hemisphere.

When buried in soil, the boulders of jade often show the effects of weathering or the growth of lichens. Those exposed at the surface may be polished in sandblast fashion by the wind, which is not a rare visitor to this part of the country. A "rind" of alteration products conceals the quality of many specimens, and the purchase of rough jade for cutting is financially hazardous. The most uniform texture generally goes with the darker, less valuable colors.

Donal Hord's Thunder, *carved from Wyoming nephrite jade. It is in the permanent collection of the Fine Arts Society of San Diego.*

CHAPTER 42

THE MOUNTAIN OF JADE

"Jade is the essence of field and stream."
—CHINESE

The first modern discovery of jade in its original rock in North America was made in Alaska in 1885 by Lieutenant George M. Stoney. Excited by jade implements in the hands of Eskimos who lived along the Arctic coast, he got up an exploring party that was, in 1884, able to reach a jade mountain, 140 miles up the Kobuk River, about 60 miles north of the Arctic Circle. True nephrite jade was not found until his next trip, the following year, when he spent the winter in a cabin near what is now called Cosmos Creek.

The jade is nephrite, as in Wyoming (see Chapter 41). It occurs in serpentine with asbestos, which has been mined here commercially. The deposits are in the low, rounded Jade Mountains, or Cosmos Hills, one of which is Jade Mountain itself. Boulders of jade derived from this source are taken in almost any size from nearby Jade Creek and the beds of other streams, which likewise flow into the Kobuk River; they are of better quality than the jade in the solid rock. Similar deposits are known, and others suspected, from the same kind of rock extending throughout an area about 40 miles long, rather parallel to the Kobuk River. Besides at Jade Mountain, nephrite is also mined more or less regularly at Dahl Creek and

Eskimo jade adz with caribou-horn handle, Kotzebue Sound, Alaska.

Shungnak River—the name means jade—where the claims are held by Eskimos of Shungnak Village. Transportation in this part of Alaska is almost entirely by "bush" plane.

The color of the jade is mostly deep green, often streaked yellowish green or greenish black. Other jade is gray, honey colored, white, or black. Near-surface staining is due to chemical alteration. Inclusions of black magnetite and other black spots are common.

A native lapidary industry has been established at Shungnak Village, and the jade is being exported on a worldwide scale as jewelry, book ends, and other objects. Reports of new discoveries in southeastern Alaska have appeared recently.

CHAPTER 43

SKIN DIVING FOR JADE

"Escaped from the deep sea."
—DANTE:
Divine Comedy

The growing popularity of the gem-collecting hobby and that of the moist art of skin diving have combined in California to bring about the recovery of large boulders of nephrite jade from a place in Monterey County now known as Jade Cove. This is a quarter of a mile south of Plaskett Point. Jade occurs here in the solid rock and also as a beach deposit on narrow Jade Beach, which is a state park. The jade, which was first identified as nephrite in 1939, is the same kind as occurs in Wyoming (see Chapter 41) and Alaska (see Chapter 42). It is characterized by a silvery sheen on a greenish-gray background.

The off-shore specimens have also been "mined" from pontoon rafts moored to small boats. A cave known locally as the Jade Room has been found in one of the two rocks that protrude above the water. Boulders of jade as large as 3,000 pounds have been reported.

Besides this occurrence of jade—interesting for its mode of extraction—California yields nephrite from other places along the coast of Monterey County and in Marin County, Tulare

County, and elsewhere. Jadeite comes from San Benito County and is known in miscellaneous finds in several other counties. Rare crystals of jade have come from near Cloverdale, in Sonomo County. No one has done more to popularize American jade than did James Lewis Kraft, the cheese maker, who collected, cut, and widely publicized it.

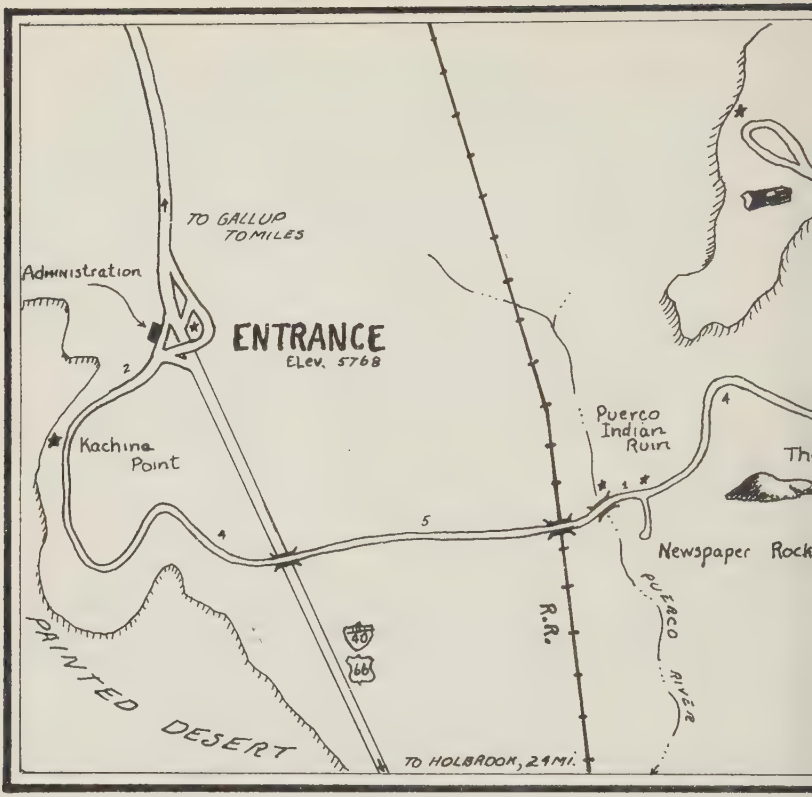
CHAPTER 44

THE BONES OF YEITSO

"I'll show you peetrified trees a-growing . . . with peetrified birds on 'em a-singing peetrified songs."
—JIM BRIDGER

The colorful, gem-laden trunks of the prehistoric pine trees that lie strewn fantastically across the Painted Desert of northern Arizona, abandoned by the ancient floods that once bore them down from the distant hills, constitute surely one of the great gem deposits of the world. Those that are protected within the boundaries of Petrified Forest National Park are fortunately not available for cutting; but material of the same sort occurs in the surrounding regions, and agatized wood from within the present preserve was for years fashioned into the book ends, paper weights, and other objects that are such familiar articles of commerce. Larger pieces have been shaped into table tops and other useful and ornamental things.

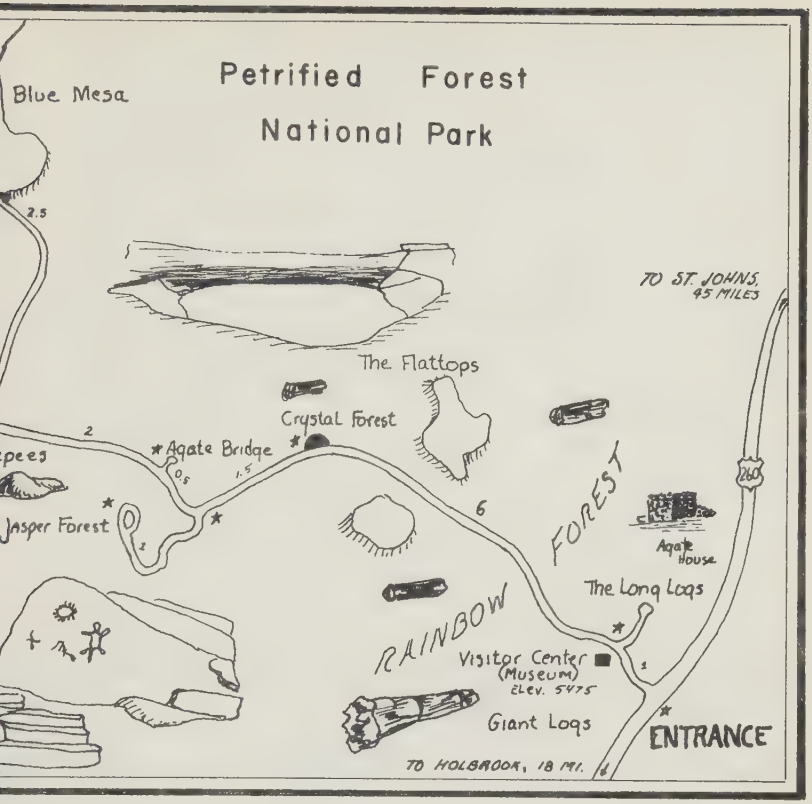
According to the Navahos, these stone logs are the bones of a terrible monster called Yeitso, who was finally destroyed in this place by the Sun God. The Paiutes preferred instead to regard them as the broken weapons of the Wolf God, Shinarav, who left them on the field of battle. Within the monument can be seen the ruins of houses—such as the partially restored Agate House—built from these fallen trees by the Indians of a former



Petrified Forest National Park, Arizona.

day. They traded the material as far as the interior of Mexico and the Great Plains.

The araucaria pines and nearly 40 other species of vegetation, now turned to gemmy silica, are embedded in shale and sandstone of the Chinle formation, laid down during the Triassic Period of earth history. This was the first of the three geologic periods in which dinosaurs were the dominant animals of the globe. The trees included many as large as 6.5 feet in diameter and 200 feet in length, though now broken into sections 2 to 20 feet long, evidently the result of the rhythmic vibrations of



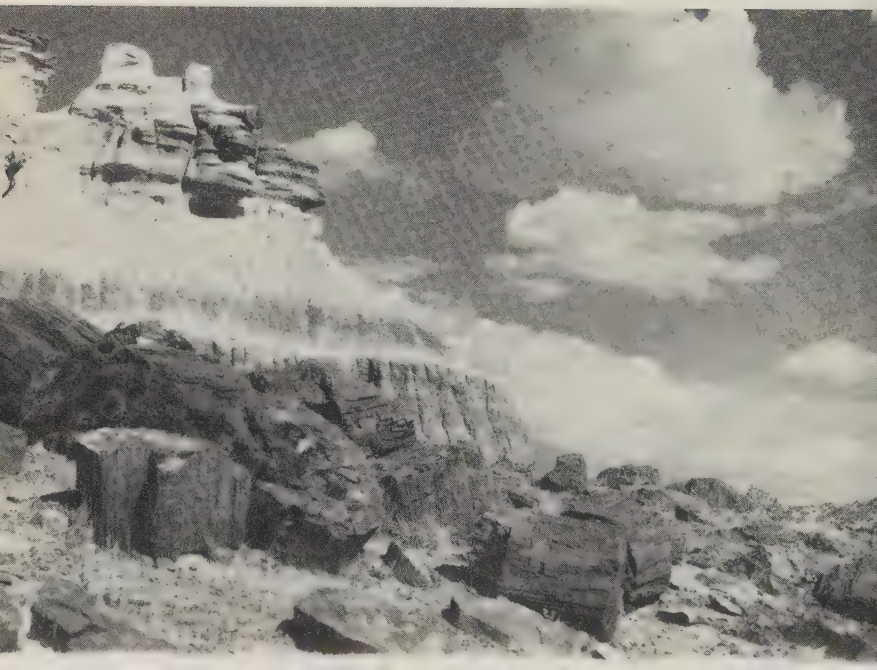
earthquakes and later settling. Stripped of their branches, even of most of their bark, these trees were buried under at least 3,000 feet of mud and clay (much of it of volcanic origin), sand, and silt. The woody cells were filled with and replaced by mineral matter in the form of chalcedony quartz—agate, jasper, and onyx, and some opal. Crystals of quartz, including amethyst and smoky quartz, line many cavities in the petrified wood and fill some of them, especially in the Crystal Forest section of the park.

The richness of the colors is unsurpassed in any other petri-

fied wood, and nowhere else is there so much silicified wood so finely colored. The traveler has timed his visit well who arrives soon after a rain has washed away the surface dust and brought out the magnificent hues in much the way they are revealed by the lapidary process. Red, purple, yellow, blue, black, and white appear in patches and swirls.

The extraordinary wonder of nature that is the petrified forest was first described in 1851 by Lieutenant Lorenzo Sitgreaves, who explored this section of the Southwest for the U. S. Army. The beauty of the material and the presence of the unique Indian dwellings and such splendid features as famed Agate Bridge—100 feet of agatized rainbows spanning a 40-foot ravine—led to the establishment of a national monument by Theodore Roosevelt in 1906. The reserve has been enlarged since then and was made a national park in 1962.

Gemmy logs in Petrified Forest National Park.



Polished section of petrified tree, 12 inches across, Petrified Forest National Park.

There are five separate "forests"—named, north to south, Black Forest (not accessible to visitors), Blue Mesa, Jasper Forest, Crystal Forest, and Rainbow Forest.

Petrified wood occurs almost everywhere throughout the West and in many other states as well, including Maryland, Pennsylvania, Virginia, North Carolina, and Mississippi. Indian artifacts of it have been found in Florida, Arkansas, Texas, and the upper Mississippi Valley. In 1961, South Dakota was the leading producer of commercial material, followed by Arizona, Wyoming, Utah, Nebraska, and Nevada.

CHAPTER 45

BY THE SEA

"Each softly lucent as a rounded moon."
—JAMES RUSSELL LOWELL:
In a Copy of Omar Khayyám

One of the most frequent stones that the gemologist is asked to identify is the beach "moonstone." Nearly everyone who has enjoyed the pleasures of the seashore has picked up one or more of the translucent pebbles that go under this name. In every case, they prove to be chalcedony quartz rather than the true moonstone, which is feldspar and has a lovely sheen that sweeps across the surface in a subdued flush of light—the bluer it is, the choicer the gem. Seldom are the beach specimens able to compete with gem feldspar, but some are pretty enough to justify being polished.

These "moonstones" occur from Maine to Alaska, being most numerous along the Pacific coast. In former years, when people spent weeks or months at the same seaside resort, local jewelers often had a small but steady business in the cutting, polishing, and mounting of such pebbles as vacation souvenirs. It was often suspected—not without reason—that many an unlikely looking find was tactfully substituted for by a stone of better quality, already shaped at low cost abroad. Everyone concerned was pleased at the transformation.

Bandon Beach, a typical Oregon beach where agates and "moonstones" may be found.

CHAPTER 46

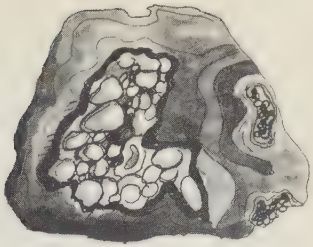
SILICIFIED CORAL FROM FLORIDA

"The bosom of the sea."
—SHAKESPEARE:
King Henry VI

Corals that once thrived in Tampa Bay and other waters now constituting the state of Florida—the last part of the United States to rise from the ocean and become dry-land North America—have been filled and replaced by silica in the form of opal and gemmy chalcedony. The hollow growths contain rounded linings of various pleasing shades, mostly black, gray, and brown.

The best-known occurrence of this silicified coral is at Bal-

Ballast Point, Tampa. Source of Florida silicified coral.



Silicified coral from Ballast Point, Florida.

last Point, which extends into Hillsborough Bay, an arm of Tampa Bay. Collecting is done at lowest tide, when the unprepossessing material, encrusted with organic debris, is dredged up from the bottom. Some of the pieces show a late development of tiny quartz crystals. The Florida silicified coral is generally used in its natural shape after being polished.

Silicified coral was used by the American Indian in New York, the upper Mississippi Valley, and the pueblo country, as well as in the southeastern states.

Map of Tampa, showing Ballast Point.

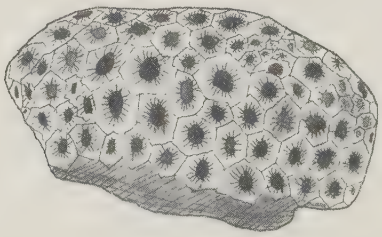
CHAPTER 47

PETOSKY STONE

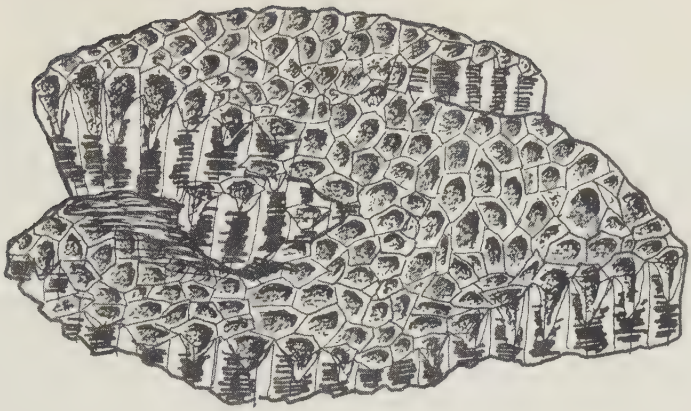
"These fossils—who are they?"
—BERT LESTON TAYLOR:
So Shall It Be

Whereas coral in Florida (see Chapter 46) has turned to silica, coral in Michigan has retained its chemical composition as calcium carbonate ($CaCO_3$). It is, because of its larger size, better suited to lapidary treatment than the Tampa Bay material. Coming especially from Petosky, it was given the name Petosky agate many years ago, but it is not true agate, which is chalcedony quartz. The source extends across the northern tier of counties in the Lower Peninsula of Michigan, which was covered with warm, clear ocean water during much of the Paleozoic Era. The counties represented are Alpena, Presque Isle, Cheboygan, Emmet, and Charlevoix.

The fossil coral reveals the hexagonal, colonial structure of



Petosky stone from Michigan.



Honeycomb coral from Michigan.

the extinct tetracoral called *Hexagonaria,* of the Devonian Period, which is the age of the Traverse limestone. Another coral—especially abundant in the Alpena area—is *Favosites,* the tabulate Honeycomb coral of the Silurian Period, the "age of corals." Other Paleozoic organisms from here are likewise used for polishing. These include cup, or horn, corals and the coral-like stromatoporoid.

Similar fossils are collected for lapidary purposes in New York and Iowa.

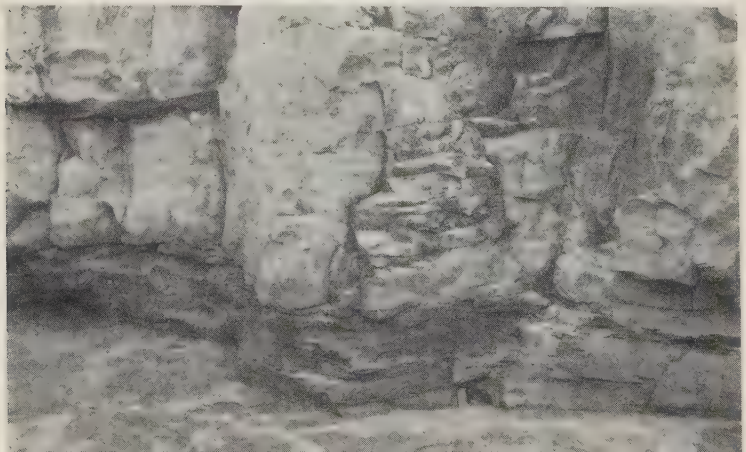
CHAPTER 48

INDIAN PIPESTONE

"All the warriors
Broke the red stone of the quarry,
Smoothed and formed it into Peace-Pipes."
—LONGFELLOW:
The Song of Hiawatha

Although the soft, red rock from which the American Indian carved his most typical ceremonial pipes seems scarcely a gem, it doubtless is as deserving of being classed as a natural ornamental material as is meerschaum, which is used for the same sort of object and is given attention in most of the standard books on gems. Meerschaum (or sepiolite) also occurs in the United States (in Utah, California, Arizona, New Mexico)

Catlinite layer between strata of Sioux quartzite.



George Catlin's famous sketch of the pipestone quarry on the Coteau des Prairies.

but lacks the historic significance of pipestone. The Cherokee Indians of the Great Smoky Mountains make pipes of soapstone to sell to visitors, as once did the Narragansett of Rhode Island, whose product was famed in Colonial days for its "rarity, strength, handsomenesse and coolnesse."

This smooth clay, colored by hematite, is also called catlinite in honor of George Catlin (1796–1872), the lawyer-turned-artist, who was a painter of the Indian before the primitive life was altered forever by the white man's civilization.

The quarry that Catlin visited and painted, after some attempt at discouragement on the part of some of the Sioux, is now preserved in southwestern Minnesota as Pipestone National Monument. Nevertheless, reliable Indian accounts place the most important catlinite deposit near Rice Lake, in northwestern Wisconsin. This place probably furnished the material to all the tribes of the Great Lakes region. The Chippewa kept the locality a secret and used the pipestone for trading. The whereabouts of the site was lost when the warriors who knew it were killed in a battle with the Sioux. Cornell University later acquired the property and sold it to loggers.

According to Catlin, the bowls of the pipes are, many of them, "designed and carved with much taste and skill, with figures and groups in *alto relievo*, standing or reclining upon them." Besides these familiar, long-stemmed calumets, or peace

Distribution map for catlinite.

The quarry line of ancient pits at Pipestone National Monument, Minnesota.

pipes, miscellaneous articles of other designs are carved from catlinite.

The same rock is also found near Devils Lake, Wisconsin; at Sioux Falls, South Dakota; in Scioto County, Ohio; and in Arizona—the material from Jerome being found in artifacts of the Pueblo II culture stage of Utah, dating between A.D. 200 and 800.

Photograph of Washú-na-koo-ra, head chief of the Mandan, holding catlinite pipe.

CHAPTER 49

ALABASTER CITIES

"There came unto him a woman having an alabaster box of very precious ointment."
—MATTHEW 26:7

The Greek word *alabastros* meant a vase used to contain ointments. The stone used in classic times for this purpose, and for a large variety of boxes, jars, jewel cases, vessels, and other objects was not the kind we know today as alabaster. Instead, it was translucent marble, composed of the mineral calcite, which is calcium carbonate, $CaCO_3$; it is known to us as onyx marble or "Mexican onyx." Today's alabaster, on the other hand, is compact gypsum, an entirely different mineral, being hydrous calcium sulfate, $CaSO_4 \cdot 2H_2O$. Even softer than marble, this gypsum can be readily carved into all sorts of ornamental things.

As the word is generally assumed to mean something white and pure—as in Katherine Lee Bates' "alabaster cities gleam"—alabaster is popularly thought of as a snow-white substance. Yet, the most widely sold American alabaster, from Colorado, is recognized by its pink and brown mottling. Michigan alabaster is also marketed, and the best of it is a pretty pink. From other states, however, comes white and gray alabaster; New Mexico also yields yellowish material.

Wherever the Rawlston member of the Morrison formation

appears on the surface, outcrops of alabaster may be expected in Colorado—southward along the Front Range and then swinging eastward in a great arc. Owl Canyon, in Larimer County, has been a leading source. Red Rock quarry, south of La Junta, in Otero County, is another commercial deposit.

In Michigan, the best alabaster comes from the vicinity of Alabaster and National City in Iosco County. The strata are the Michigan formation of Mississippian age.

The American Indians used alabaster of the onyx-marble kind, in the northeastern states, Georgia, the Mississippi Valley, the Rocky Mountains, and California. Wyandotte Cave, in Crawford County, Indiana, has an interesting history of aboriginal alabaster mining, which was carried on from the surface with deer antlers used as picks. The natives also penetrated the cave for a mile to break off pieces of stalactites, using torches to see their way.

CHAPTER 50

CABINETS OF GEMS

"A cabinet of gems, containing whatever curiosities were deemed most rare and costly."

—SIR EDWARD BULWER LYTTON:
The Last Days of Pompeii

Based on examination of the treasuries of European cathedrals, G. Evelyn Hutchinson proposes, in *The Enchanted Voyage and Other Studies*,* the interesting possibility that modern natural-history collections grew out of relic-collecting in the late Middle Ages. Whether this be the entire story or not, we are grateful that fine exhibits of gems have been made a part of many of the museums of science in the United States, as well as of museums of art, in which such gem materials as carved Chinese jade are featured. The science museums emphasize the geologic and mineralogic side of gems, showing both rough and cut specimens. Even those exhibits that seek to emphasize only fashioned gems are likely to show with them a few crystals to illustrate the way in which they occur in nature.

The best display of American and other gems in the United States is that of the U. S. National Museum of the Smithsonian Institution, in Washington, D. C. The Hope diamond, though the most famous, is just one of the many magnificent items that

* Yale University Press, 1962.

can be seen here. Ranking next to it in importance is the American Museum of Natural History, in New York. The Chicago Museum of Natural History has a wonderful gem room. The Mineralogical Museum of Harvard University, the Cleveland Natural History Museum, and the Philadelphia Academy of Natural Sciences also exhibit collections of outstanding quality. Numerous diversified collections of gems, some of which feature craft of amateur lapidaries, are open to the public in communities from California to the Atlantic coast.

One of the best ways to observe gems, both rough and finished, apart from established museums of the kind referred to above, is to attend the shows being put on all over the nation by rockhound and lapidary clubs and the federations into which they have become affiliated, as described in Chapter 2.

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Richard M. Pearl, Professor of Geology at Colorado College, is co-founder of American Federation of Mineralogical Societies. He has organized *American Gem Trails* to supplement and complement two of his previous books for McGraw-Hill: *How to Know the Minerals and Rocks*, a simplified field guide, and *Successful Mineral Collecting and Prospecting*, a survey of the mineral hobby and business. He is also author of *Guide to Geologic Literature*.

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