THE BIRTH AND DEATH OF PARICUTIN VOLCANO IN MEXICO

By SHARAT K. ROY*
CHIEF CURATOR, DEPARTMENT OF GEOLOGY

"ONE that with a flash begins ends in smoke"—that is the life story of *El Monstruo*, the Tarascan Indian name for the volcano Parícutin. As volcanoes go, Parícutin died a premature death, but while it lived, it put on one of the greatest shows on earth. Bypassing infancy, it reached adolescence in a matter of hours. Its fiery bosom outswelled a maiden's prayer and rose to a height of 150 feet in less than a week. On the first anniversary of its birth, the cone attained an altitude of better than 1,000 feet and assumed a perfect geometric shape —one that Euclid might well have envied. From the vents of the cone, red-hot lava poured out at an average rate of 2,700 tons per minute and crept forward fanwise like a crevassed glacier aflame, leaving death and desolation in its wake. The temperature of the lava a mile from its vent registered 1994° Fahrenheit.

Every six seconds, occasionally at longer intervals, either in the dark of night or in the light of day, amidst billowy clouds of steam, gas, and dust, fountains of fire lit the sky; terrific blasts shook the peaceful countryside; dust columns borne aloft by the uprushing gases behaved like a thunder cloud; lightning and thunder added their din to the clatter of the blazing inferno; flaming arcs leaped out of the crater and bursting gas bubbles sent out fiery umbrellas; cherry-red chunks of lava, cinders, and ashes hurtled 3,000 to 4,000 feet into the air and fell crashing down the cone, gleaming incandescently. It was the most awe-inspiring display of nature's fireworks the land of the Aztecs has ever witnessed. Vesuvius in its heyday had nothing more spectacular to show. Stunned spectators stood motionless, even burst into cheers, unmindful of the fact that they were cheering a volcano.

VOLCANO IN ACTION

How Parícutin looked in the early days following its sudden eruption in a cornfield in 1943.

NOW ASLEEP OR DEAD?

Is Parícutin now dead? Except for a wisp of steam and gas spouting around the crater, it shows no other sign of life today. Perhaps, like its extinguished neighbors, it has gone to a sleep from which there is no awakening. Yet, it is impossible to predict the life-span of a volcano. Krakatoa, near Java, became disastrously active after a repose of two centuries, destroyed scores of towns and villages, and snuffed out the lives of 36,000 people. Vesuvius had been dormant so long that it was overgrown with thick vegetation, but in 1631 it became violently active and has been intermittently active ever since.

The name "volcano" comes from Vulcan, the Roman god of fire. The traditional concept of a volcano is that it is a cone-like hill or mountain with a crater at its summit, whence at times are ejected rocks, cinders, ashes, and lava. Actually, a volcano is a vent from which hot or molten material is ejected from the depths of the earth. The essential feature of a volcano is the conduit or volcanic pipe that connects the magma chambers of the interior with the exterior of the earth. This does not mean that the interior of the earth is molten. Seismic records (earthquake records registered on a seismograph) indicate that the outer shell of the earth behaves like a solid for about

PARICUTIN CRATER AS IT IS TODAY

An aerial view of the famous Mexican volcano, now dormant. The crater has two throats with a long ridge between them. Until recent months it was belching forth smoke, sparks, and thousands of tons of lava that ravished the countryside for miles around. In the volcano's present inactive state, it was possible for Chief Curator Sharat K. Roy to reach the rim after an arduous climb. Photograph is by courtesy of Dr. Carl Fries.

Dr. Sharat K. Roy, Chief Curator of Geology, returned in April from a two-month journey in Mexico during which he studied the now dormant Parícutin volcano and collected volcanic rocks. He also visited silver and other mines and collected specimens of ores and minerals.

1,800 miles. But there are magma chambers or reservoirs of molten rocks underlying certain regions known as volcanic belts or belts of fire. There are two such belts and Parícutin lies in one of them—the one that encircles the Pacific Ocean and extends along the Andes, Central America, Mexico, the United States, Canada, Alaska, the Aleutian chain, Kamchatka, Japan, the Philippines, and Java.

NEW VOLCANOES PROBABLE

The volcanic belts are lines of weakness characterized by fracturing, faulting, and folding in the earth's crust. They thus are favorable sites for volcanic activities. Volcanic forces, however, could be sufficiently powerful to make their own outlets and volcanoes may originate where no connection between them and a fracture line appears to exist. Such is the case in the Highwood Mountains in the great plain of central Montana where no evidence of a line of weakness could be determined. As a rule, though, new volcanoes break out only in volcanic areas. That there will be new volcanoes at the site of Parícutin is almost a certainty. Judging from the numerous extinct volcanoes surrounding Parícutin it can be safely assumed that underlying the region there is a magma chamber restlessly awaiting to break through.

The immense weight of the crust exerts a tremendous pressure on the gases dissolved in the magma. They are forever seeking an escape outlet. The chief magmatic gas is steam. The combustible gases are hydrogen, hydrocarbons, and various compounds of sulphur. The combustion of these gases, especially that of the hydrogen, produces the only true flames seen at an eruption. Other "flames" are merely incandescent lava fragments shot into the air. Parícutin never did emit sulphurous gases; chlorides, ammonium chloride in particular, formed abundantly. The gases, especially the super-heated steam, play the most dominant and active role in volcanic eruptions. It is these gases that cause the explosive puffs and send solid rocks, cinders, ashes, dust, and bombs flying from the crater. A volcano builds its cone from these fallen fiery objects, not from lava flowing out of the crater. The only lava that helps in the building up of a cone is that which is blown out. Ejected lava clots, exposed to the air, harden and fall, assuming various forms, usually with spirally twisted ends (bombs, lapilli, etc.). Exploded lava in the crater forms dust and ashes. Cinders are ejected lava-fragments from which gases have escaped. Volcanic dust, because of its light weight is carried away hundreds of miles by the prevailing winds. The dust from Parícutin is known to have drifted to Mexico City, a distance of 200 miles.

Where, then, did the lava that engulfed two villages—Parícutin and Parangaricutiro—and spread over acres and acres of fertile land issue from? From vents in Parícutin's sides, not from the crater. Will this stupendous outpouring create an empty tunnel within the earth from which it came? So far as is known, it will not. Magma reservoirs are constantly making readjustments of their lost contents. There might be some subsidence of the overlying area, but it would be hardly noticeable.

Lava is the name applied for magma (molten rock) issuing at the earth's surface. Both the liquid material and the rock formed from magma are called lava. Different types of volcanoes discharge different kinds of lavas. Even one and the same volcano may erupt a variety of lavas. In the main, however, there are two kinds of lavas that volcanoes eject—silicic or rhyolitic, and basic or basaltic. The silicic kind may contain as much as 75 per cent of silica; the basic about 50 per cent of the bulk composition. The lava of the former is viscous, even at a very high temperature (2000° Centigrade), and its contained gases escape with difficulty, giving rise to explosive eruptions; that of the latter is much more fluid and remains so down to much lower temperature (800° Centigrade). The gas thus escapes much more rapidly without explosive violence. There are, however, exceptions to this general rule. Parícutin is a point in the case. The lava of Parícutin is basaltic or basaltic-andesite. According to the general rule its lava should be fluid and it should be less explosive than it had been. The explanation for the exception is that even the much more fluid basaltic magma may become viscous by standing in the conduit and behave as viscous acidic lava, both in the manner of its flow and its explosive character.

A PEACEFUL VILLAGE BEFORE THE LAVA FLOWED

The tiny community of Parangaricutiro, which was wiped out and buried, as was also its sister village of Parícutin from which the volcano receives its name.

EXCEPT FOR A STEEPLE TOP, VILLAGE HAS VANISHED

The flow of lava has completely engulfed the little settlement of Parangaricutiro. All of the inhabitants were forced to evacuate. No trace of their homes remains.

Parícutin was born in a cornfield on February 20, 1943. Dionisio Pulido, a Tarascan Indian from the nearby village, Parícutin, state of Michoacan, Mexico, and his boy were the only eye-witnesses of the momentous occasion. The elder Dionisio was plowing for corn when he heard a low rumble and saw a spiral of smoke (steam) behind his furrow. The initial explosions shook the fertile fields and ejected fragmental materials, clouds of dust, gas, and ashes. From these ejected projectiles Parícutin built a 1,500-foot-high cone. At the beginning, the cone gained height rapidly, but as its base broadened more and more material was needed and altitude was gained slowly.

FIERY LAVA TERRIFIES

Lava first issued from the vents at the base of the cone as an incandescent viscous liquid, but, as it advanced, it became coated with a crust that broke off at cascades exposing a molten glowing interior. The moving of the tumbling, jostling mass of fiery lava is a fearful sight. The individual flows were from 12 to 20 feet thick, but the total thickness of all the superposed flows adjacent to the volcano ranged from 300 to 450 feet. In the nine years of Parícutin's activities it has discharged nearly 700 million

cubic feet of lava encompassing some 16 square miles.

The lava was not alone destructive—the ash killed most of the trees, particularly the resinous pines, within a radius of several miles from the volcano. This ended the tapping for turpentine and livelihood for hundreds of people who have seldom enjoyed three square meals a day. With the destruction of vegetation, the animal life disappeared also. Birds that fed on seeds took to wings for happier grounds; small animals —deer and rabbits—migrated to fertile fields and with them, for obvious reasons, went the coyotes.

Good sometimes comes of evil. So will it come for the thousands living by the simple faith of Indians. Volcanic ash, on decomposition, makes good soil. Dionisio may not plough the lava fields of Parícutin for corn again, but the Dionisios to come may, and perhaps they will reap a far richer harvest than ever before.

Uruapan, the nearest town to Parícutin, famed for its lacquer work, may be reached from Mexico City by automobile, plane, bus, or train. The road to Parícutin is bad, dangerously so. Part of it is traveled by automobile over bridges constructed of two planks that are little wider than the tires, and part of it on horseback. At the journey's end you are at the edge of the lava flow. Here you must decide if you care to have a look at the crater. You have but two choices: walk across the lava—three and one-half miles as the crow flies—or go around it (a distance of twelve miles). Do not cut across if you are not surefooted or if you happen to tip the scale heavily. Go around it, and the chances are you will get there. Return by nightfall. It is hardly the place to be wandering around in the dark.

Battle of the Sexes . . .

THEIR DIET DIFFERENCES MAKE THEM DIFFERENT

By AUSTIN L. RAND
CURATOR OF BIRDS

I USED TO THINK that the battle of the sexes so ably portrayed by James Thurber in his drawings and in his prose was artificial, a man-made and woman-made thing, a product of civilization, certainly. Thurber, of course, only deals with one species of animal—humans. But recently I've come to see the competition between the sexes as widespread and of far-reaching consequences. It is probably as old in the animal world as sex iteslf.

In a booklet with the severe title *Secondary Sexual Characters and Ecological Competition*, published by the Museum, I've outlined the possibility of competition for food between the sexes being a factor in evolution and responsible in part for characteristics of structure and traits that distinguish the sexes.

In circles that discuss evolution the idea is current that food-competition is important between species. It may even be stated as a rule: two species with the same food habits cannot live in the same place. Competition drives one out unless the other has different food habits. Differences in food habits seem especially evident when you look at closely related species, and these differences are brought about in a variety of ways. One very common way is a difference in habitat. The long-eared owl hunts in the woods and its cousin, the short-eared owl, hunts in the meadows; the song sparrow favors drier shrubbery while its cousin, the swamp sparrow, lives in wetter shrubbery.

THE SIZE FACTOR

Another way is a difference in size. The downy and hairy woodpeckers of our woodlots are very similar except that one is larger and adapted to take larger prey while the other is smaller and adapted for smaller food items. Sometimes species feed differently. The Baltimore oriole picks flowers and pecks through their sides while the orchard oriole probes into flowers as they hang on the branches.

The same factors may be at work within a species. When a pair of birds "sets up housekeeping" and starts "raising a family" they can no longer drift about looking for easy living and places where food is plentiful. Their wanderings are restricted by having a fixed point, the nest, as their center of interest. The two individuals must draw on the food supply from an area about the nest. If their food habits were the same, competition would be extreme and, if food were scarce, perhaps critical.

We know how different in appearance the sexes may be—how different is the appearance of the rooster and the hen of our domestic fowl, the drake and the duck of the mallard, or the red male and the green female of the scarlet tanager. These sexual differences have been mostly correlated with display and mating. But logically there should be differences between the sexes in feeding behavior and food adaptations. The basic idea is contained in the old nursery rhyme:

> "Jack Spratt could eat no fat,
> His wife could eat no lean,
> So betwixt them both, you see,
> They licked the platter clean."

To the two birds of a mated pair, limited to a single area, it would be a decided advantage to have different food preferences or adaptations for food-getting. And we find that there are cases of this. The most striking is that of the huia of New Zealand, about which I've written in a recent BULLETIN (June, 1952). Both sexes have similar food preferences—both like especially wood-inhabiting insects—but they get their food in different ways. The male has a short, straight, stout bill for digging out the wood-boring grubs, woodpecker-fashion. The female has a long, slender, curved bill for probing into holes for them, creeper-fashion. The female may get grubs in wood too hard for the male to chisel.

DIET VARIATION BY SEX

It is possible that further study may bring to light additional cases of sex differences that are of advantage to the species in enabling the sexes to eat different things. The larger size of female hawks probably fits them to take larger prey than their smaller mates are able to take, and the smaller size of certain female songbirds probably fits them to take smaller prey than their larger mates can take. The larger bill of the male hornbill, the smaller bill of the female, the straight bill of the male western grebe, and the upturned bill of the female perhaps give each sex slightly different advantages in getting food.

Selection could have its effect in the populations, the forms with the greater difference in feeding habits of the sexes being the more successful in raising and leaving progeny. Thus, slowly, differences between the sexes would accumulate. However, it must be kept in mind that this sort of evolution would be limited. The drifting apart of the sexes would be checked by the necessity for their coming together periodically, for at least a short period, at nesting time.

HERPETOLOGIST RETURNS FROM WEST COAST

On February 4 Clifford H. Pope, Curator of Amphibians and Reptiles, left Chicago with a double purpose: to make a reptile and amphibian reconnaissance of the northern part of the western coast of Mexico and to study the habitats of the salamanders of our own West Coast. The lower parts of northwestern Mexico are too dry for salamanders, whereas the humid coastal regions of Washington, Oregon, and California are ideal for them and harbor one of the distinctive faunas of the world.

Two and a half months of work and 11,000 miles of travel were required to complete the project. All but two or three of the twenty-two salamander habitats were visited. Success of this part of the venture depended largely on two weather conditions, temperature and rain. The field trip was favored by abundant rain but hindered to some extent by cool weather. The low temperature was not a serious handicap but merely prevented the collecting of large series, a minor object of the work. One of the two habitats missed lay beneath the snows of the High Sierras and presented a considerable dilemma because at the time of the year when it is available most of the other habitats have already become too dry. It might be remarked that herpetological collectors are forever confronted by similar weather dilemmas, Curator Pope comments.