Making Magic

by Peter Gorman
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Deep in the Peruvian Amazon, the Matses Indians use the secretions of a small electric-green tree frog as both a medicine and a magic hunting aid. Until 1986, when author Peter Gorman stumbled on it, few Westerners knew of its existence. But science has begun to look at the startling chemical makeup of the Matses medicine. And their discoveries suggest that once again, a preliterate people may wind up contributing a great deal to our culture.

The night air in the backwater lowlands of the Peruvian Amazon was thick with the insistent buzzing of insects. Overhead, bats flew, their shapes silhouetted by a half-moon rising behind the forest across the Rio Lubo. Though the rainy season had begun, the river was still near the low point of the year, and great gnarled tree trunks, swept from the banks during the last flood season, stood out against the water like monstrous sculptures in the pale light. From beyond the jungle clearing of the tiny Matses Indian puebla of San Juan came the howling of a distant band of monkeys and the melancholy cry of the pheasant-like pawfil.

In the camp, a handful of Matses children played our flashlights into the village trees, while their fathers combed the branches and nearby brush, hunting for a dow-kiet!, the frog that secretes sapo*, a vital element in the Matses pharmacopoeia. The men imitated the frog's mating call, a low, guttural bark, as they moved, and the women nearby giggled at the sound. I was surprised that the dow-kiet!s didn't respond. I had come to expect animals who heard the call of a Matses hunter to answer.

The Matses are a small, semi-nomadic, hunting-gathering tribe who live in the remote jungle along the tributaries of the Rio Jivari, on the border between Peru and Brazil. Unlike other tribes in the region, they possess only rudimentary weaving and ceramics skills, they have no formal religion, no ceremony or dance, and they produce nothing for trade. What they do is hunt, with bows and arrows, spears, clubs, and occasionally shotguns, when they can get shells. Theirs is the harsh world of the lowland forests and swamps, a world where malaria, yellow fever and venomous snakes keep mortality rates high. To survive such a place the Matses have become masters of the natural history of the flora and fauna of the region.

They know the habits and cycles of the animals that share their land, have studied the plant life that surrounds them,.and they have learned to see the jungle as their ally. For the Matses, the earth is a benevolent ti-ta, mother, who provides for all of their needs. Neighboring tribes recognize the Matses' knowledge. They say the Matses "can move like the wind and talk with the animals." They say the Matses know the jungle's secrets. Sapo is one of them.

I'd come to Peru to collect dow-kiet! specimens for researchers at the American Museum of Natural History, for whom I collected Matses' artifacts—mostly throw-away things like used leaf-baskets and broken arrows—and the Fidia Research Institute for the Neurosciences in Rome. My reports on the uses of sapo had sparked curiosity among scientists who were eager to see a specimen of the frog which produced the unusual material, in part because of the extraordinary experience it produced, and in part because of my description of its myriad uses. I was eager to see the dow-kiet! as well, because though I'd seen sapo used, and experienced it myself, I had never seen the frog which produced it either.

That Western science had taken an interest in sapo was encouraging: until recently most researchers have dismissed the natural medicines of indigenous groups like the Matses. Fortunately, that attitude is changing, but with the loss of an average of one tribe a year in Amazonia alone—to acculturation, disease or loss of their forest homes—the plant and animal medicines of these peoples are disappearing faster than they can be

studied.

The Matses are one of the tribes currently at risk. During the eight years I've been visiting their camps, both missionary and military contact has been steadily increasing, and they are quickly acculturating to a new lifestyle. Camps that planted no more than two or three crops to supplement their diet of game and wild foods just a few years ago now plant a dozen or more. And where most Matses had only a handful of manufactured things when I first met them—some clothing, a few metal pots, a machete and perhaps an old shotgun—in some camps the men now work for loggers and the sound of chainsaws fills the air. At San Juan, the most accessible camp on the Lubo, most of the Matses not only had new western clothing, but they have begun to refer to those Matses who continued to live deep in the jungle as animales, animals.

This was a very different group than the first Matses I'd run into, in 1984. It was my second trip to Peruvian Amazonia—I'd fallen in love with the jungle on my first—and I was studying food gathering and plant identification with my guide, Moises, a former military man who specialized in jungle survival. We had been working on a small river called the Auchyako for about a week when we ran into some local hunters who said they had seen signs that a family of Matses had moved into the area. Moises was excited by the news and said we should make an attempt to meet them. He explained that he had once been part of a military force sent to contain the Matses following several raids they had committed on river towns. He described the four-day battle as fierce and the Matses' courage in fighting automatic weaponry with their spears and arrows as immense. But since the battle, Moises said, he had come to respect the Matses ways and had even become friends with some of them. He explained that I would be foolish to pass up the chance to spend even a single day with them.

I was easily sold on the idea, so, hoping they would make contact, we hiked three days into the jungle and made a camp. Two days later, a young Matses hunter carrying a bow and arrows, his mouth tatooed, and his face adorned with what looked like cat whiskers, came into our camp and borrowed our gun.

When he returned later in the day, he was carrying two large wounded monkeys in hastily-made palm leaf baskets he carried from his forehead with templines. Clinging to his hair was a baby monkey, the offspring of one of the adults. The hunter returned our gun, left one of the monkeys, then disappeared into the forest. We followed him back to his camp and watched from a distance as he gave the remaining adult to a woman who began to roast it over an open fire, oblivious to its cries. The baby monkey he brought to a young woman who was nursing a child of her own. Without hesitation, she took the monkey and allowed it to nurse at her free breast.

Those dual images represented a combination of cruelty and compassion I'd never imagined, and taught me more about the reality of the jungle than anything I had previously experienced. More than that, those images had compelled me to return to the Matses again and again.

I remembered that initial meeting as I stood outside a stilted hut with Moises eight years later and we watched the Matses of San Juan hunt unsuccessfully for the dow-kiet!. I couldn't picture the women at this puebla breast feeding a baby monkey. And though it wasn't my right to be concerned with the changes I saw, I couldn't help but feel badly. None of the San Juan Matses wore their palm splint whiskers or their red and black face dyes that made them look like jaguars. If it weren't for the blue tatoo that circled their mouths and cut across their faces like a cat's grin they wouldn't have been recognizable as Matses at all.

I was hoping my friend Pablo would arrive soon to help with the hunt. It was at his former village that I'd been introduced to sapo, and I was sure that if there were any dow-kiet!s nearby he would be able to find them. Pablo was Moises' closest friend among the Matses, an adept hunter who fiercely resisted acculturation,

and we were surprised to have found him at San Juan. When we unexpectedly met him earlier in the day and asked what brought him here, he'd explained that three of his wives had fallen in love with sweet bananas, recently introduced onto the river. When he refused to plant them—he rarely planted anything but yucca, pumpkins and tobacco, an ingredient in an hallucinogenic snuff called nu-nu—they'd burned the village to the ground and abandoned him. The three wives had since settled at a puebla where there were bastante plantanos, a lot of sweet bananas, and he had come to San Juan with his remaining wife, Pa Mi Shua, as a temporary measure until he decided where to build a new camp.

I met Pablo in 1986, on my third trip to the Amazon. Moises and I had flown over the dense Peruvian jungle from Iquitos to the Rio Lubo, borrowed a small boat and made our way to his camp. The village, several days upriver and much more remote than San Juan, was home to Pablo, his four wives and their 22 children, and his brother Alberto, who had two wives and six children. Each wife had her own hut, so there were several in the puebla.

When we arrived, Moises and Pablo embraced like old friends, and we were invited to climb the steep and muddy river bank to the puebla. There, Pablo's main wife, Ma Shu, served us a meal of cold roast sloth and yucca. The meat, sinewy and still on the bone, was difficult to eat because of the physical resemblance of sloths to humans. But turning down Pablo's hospitality would have ruined any chance to spend time in the village, so I ate despite my hesitation.

After dinner, Pablo produced an old brown beer bottle and a hollow reed tube. From the bottle he poured a fine green powder into his hand and worked it into one end of the tube. Alberto put the other end of the tube to his nose and Pablo blew the powder into his nostrils. They repeated the process several times. Moises explained that the powder was nu-nu, and that Matses hunters used it to have visions of where to hunt. He said that after the visions they would go to the place they'd seen and wait for the animals in the vision to appear. I told him he was dreaming, but he insisted that was what happened and pressed Pablo to give me some. A few minutes later the tube was put to my nose.

When the nu-nu hit it seemed to explode inside my face. It burnt my nose and I began to choke up a wretched green phlegm. But the pain quickly subsided and I closed my eyes. Out of the blackness I began to have visions of animals—tapir, monkey, wild boar—that I saw more clearly than my limited experience with them should have allowed. Then, suddenly the boars stampeded in front of me. As I watched them thunder past my field of vision, several began to fall. Moments later the visions faded, and a pleasant sort of drunkenness washed over me.

Moises asked what I saw and whether I recognized the place where the vision happened. I told him it looked like the place where we'd eaten lunch earlier in the day. He asked what time it was in the vision, and I told him that the sun was shining, but mist still hung from the trees. He put the time between 7 and 8 A.M. Despite my suspicion that I'd invented the entire vision, Moises told the Matses what I'd seen.

At dawn the next morning, several of us piled into our boat and headed toward the spot I'd described. As we neared it, I was astounded to hear the thunderous roar of dozens of boars charging across the river in front of us. We jumped out of the boat and chased them. Several ran into a hollow log, and Pablo and Alberto blocked the ends with thick branches, while the others made nooses out of vines. Holes were cut into the top of the log with a machete, the nooses slipped through them, and the boars strangled. We returned to the puebla with seven boars, enough meat for the entire village for four days.

Improbable as it seemed, the scene was close enough to what I'd described that there was no denying the veracity of the vision. I later asked how nu-nu worked, and Pablo explained—in a mix of hand signals, Matses,

and pidgin' Spanish (which he'd learned from the occasional missionaries and river traders who came to the camp)—that nu-nu put you in touch with the animals. He said the animals' spirits also see the visions, and know what awaits them. He spoke as though I were a slow child, and everyone but me already knew what he was saying. For my part, I'll never understand how nu-nu works, but I've witnessed the success of its visions so frequently that I don't question what's seen in them.

The morning after the hunt, I was with Pablo, sitting on the bark floor of Ma Shu's hut, pointing to things and asking what the Matses word for them was. I made notes, writing down the phonetic spelling of things like bow, arrow, spear, and hammock. Pablo was utterly bored with the exercise until I pointed to a small leaf bag that hung over a cooking fire. "Sapo," he said, his eyes brightening.

From the bag he pulled a piece of split bamboo, roughly the size and shape of a doctor's tongue depressor. It was covered with what looked like a thick coat of aging varnish. "Sapo," he repeated, scraping a little of the material from the stick and mixing it with saliva. When he was finished it had the consistency and color of green mustard. Then he pulled a smouldering twig from the fire, grabbed my left wrist and burned the inside of my forearm. I pulled away, but he held my wrist tightly. The burn mark was about the size of a match head. I looked at Moises. "Una nueva medicina," he said, shaking his head, "I've never seen it."

Remembering the extraordinary experience I'd had with nu-nu, I let Pablo burn my arm a second time. He scraped away the burned skin, then dabbed a little of the sapo onto the exposed areas. Instantly my body began to heat up. In seconds I was burning from the inside and regretted allowing him to give me a medicine I knew nothing about. I began to sweat. My blood began to race. My heart pounded. I became acutely aware of every vein and artery in my body and could feel them opening to allow for the fantastic pulse of my blood. My stomach cramped and I vomited violently. I lost control of my bodily functions and began to urinate and defecate. I fell to the ground. Then, unexpectedly, I found myself growling and moving about on all fours. I felt as though animals were passing through me, trying to express themselves through my body. It was a fantastic feeling but it passed quickly, and I could think of nothing but the rushing of my blood, a sensation so intense that I thought my heart would burst.

For perhaps fifteen minutes the rushing got faster and faster. I was in agony. The pain became so great that I wished I would die just to get it over with. But I didn't die, and the pounding slowly became steady and rhythmic. I gasped for breath. And when it finally subsided altogether, I was overcome with exhaustion. I slept where I was.

When I awoke a few hours later, I heard voices. But as I came to my senses I realized I was alone. I looked around and saw I had been washed off and put into my hammock. I stood and walked to the edge of the hut's unwalled platform floor, and realize that the conversation I was overhearing was between two of Pablo's wives, who were standing nearly 20 yards away. I didn't understand their dialect, of course, but I was surprised to even hear them from that distance. I walked to the other side of the platform and looked out into the jungle: its noises too were more clear than usual.

And it wasn't just my hearing that had been improved. My vision, my sense of smell, everything about me felt larger than life, and my body felt immensely strong. When I saw Pablo later that evening, I explained what I was feeling, with hand gestures as much as language. He smiled. "Bi-ram-bo sapo," he said, "fuerte." It was good sapo. Strong.

During the next few days my feeling of strength didn't diminish: I could go whole days without being hungry or thirsty, and move through the jungle for hours without tiring. Every sense I possessed was heightened and in tune with the environment, as though the sapo put the rhythm of the jungle into my blood. I could see

animals before they saw me, and sense which plants were benevolent and which were not, particularly the chawki pawfil, vines which produce drinkable water if chosen correctly, or can poison you if you make an error.

During those same days I asked Pablo and Alberto about sapo's uses, and discovered there were several. Among hunters it was used to both sharpen the senses and as a way to increase stamina during long hunts, when carrying food and water was difficult. In large doses it could make a Matses hunter 'invisible' to poor-sighted but acute-smelling jungle animals, by temporarily eliminating their human odor. As a medicine, sapo also had multiple uses, serving as a tonic to cleanse and strengthen the body, and as a toxin purge for those with the grippe.

The women explained that they sometimes used sapo as well. In sparing doses applied to the inside of the wrist it could establish whether a woman was pregnant or not. And during the later stages of pregnancy it is used to establish the sex and health of a fetus. Interpreting the information relied on an investigation of the urine a woman discharged immediately following the application of the medicine: Cloudiness or other discoloration of the urine, and the presence or absence of specks of blood were all evidently indicators of the fetus' condition. In cases where an unhealthy fetus was discovered, a large dose of sapo applied to the vaginal area was used as an abortive. There was no way for me to verify what they said, though there was no reason to doubt them.

When I asked Pablo how the Matses learned about sapo, he said the dow-kiet! told them. Whether he meant the frog told them through their study of its behavior and habits or whether he believed he was in communication with it on some level, I don't know.

When I returned to New York, I was surprised to find that my description of nu-nu was old hat to the anthropologists I spoke with at the museum—several tribes evidently employed similar snuffs for shamanic purposes. What did surprise them, however, was my account of sapo. None of them had ever heard of it, and while several South American tribes have hunting myths about frogs, there were no records of the Matses, or any other tribe, utilizing a frog's secretions in the way I described. Moreover, even among those anthropologists who had recorded stories of tribal frog use, none had used or even witnessed it. But while my report was considered interesting, it was also inadequate, as I had no photographs of the frog, and no samples of the medicine.

The following year I returned to Pablo's village and discovered that sapo was also used as a shamanic tool. It was spring and the lowlands were flooded. Game had retreated deep into the forest to seasonal lagoons, so hunting was difficult, and even nu-nu failed to produce hunting visions. When Moises and I arrived, the Matses hadn't eaten meat for several days.

Pablo explained that when the river was so high it was trapping season, and that he was about to set a tem-po-te!, a tapir trap. The tapir, the largest animal the Matses hunt, would provide his village with meat for several days, perhaps a week. He had been giving himself five sapo burns each morning and night for three days in preparation for the task, and would continue until the trap was successful. Pablo explained, as well as I could understand it, that sapo, used in such large doses, allowed a hunter to project his animas—his spirit—to his trap while he slept. The animas would take the form of a tapir and lure real tapir to it. In the context of Pablo saying it in the middle of the jungle, it seemed like a reasonable thing he was talking about.

The day after we arrived, Moises and I went into the jungle with Pablo and Alberto. We walked for almost two hours before Pablo found a suitable site and began to construct the trap, a simple spring device set between two trees. A sapling set with a sharp hardwood spike was fixed to one, then bent across the narrow path

between the trees and affixed to the second. A trip-line was set so that when the tapir walked between the trees the sapling would snap across the path, impaling the animal.

Pablo called to the tapir constantly while he worked, telling it what a special path he was making. He called to the other animals as well, warning them to stay away, to leave this place for his friend. When he finished the trap, he chewed handfuls of leaves and spit them out across the trip-vine, both to cover his human scent, and as a signpost so that his animas could find it at night.

As we were returning to the puebla, Alberto explained that traps were only set when there was no other way to get meat, because once a trap was set no other animals could be hunted. When I asked why, he explained that animals talk to each other, and that killing them provokes their spirits, ruining the trap. Seeing that I didn't understand, Pablo added that when he sent out his animas masquerading as a tapir, the provoked spirits would warn the prey that what they saw was not a real tapir, but a Matses' animas in disguise. Exceptions to the taboo were large river turtles and sloth; the turtle because it doesn't bother to talk to other animals, and the sloth because it speaks so slowly that by the time it says what's on its mind the river has fallen, and trapping time is over.

During the next two days Pablo never returned to the trap, though he continued using massive doses of sapo. But on the morning of the third day he woke us before dawn and said he had a nu-nu vision that the trap was about to be sprung. He was insistent that we hurry. The rest of the Matses were waiting for us when we stepped from our hut.

The Matses moved through the forest effortlessly, almost at a jog, and the women chided me for having to struggle to keep up. But as we neared the trap area, everyone stopped and grew absolutely quiet. Pablo's eyes blazed. "Petro," he whispered to me excitedly, "tian-te, tem-po-te!". A tapir was about to be trapped.

We waited about ten minutes, then heard a sharp snap, followed by an agonizing animal scream. Suddenly, everyone began running toward the trap. The wounded and disoriented tapir crashed through the brush, bellowing in pain, then fell into a stream bed. The Matses women caught up with it, killed it, and began to cut it up. While they did, Pablo brought me to the sprung trap and gave me the bloody spike.

Back in camp we feasted. Afterwards, I asked Pablo for a sample of sapo, but he'd been using so much that he had none to give me. So once again I returned to the states with no hard evidence of the existence of the dow-kiet!

It took two more trips to Peru before I finally managed to secure a small amount of sapo, and when I finally did it was entirely by chance. Moises felt that we were wearing out our welcome on the Lubo, and decided against visiting the pueblas there. Instead, we had hiked across the forest to the Brazilian border at a point nearly 200 kilometers north of the Lubo. When we reached the border we hired a mestizo with a small boat to take us down the Jivari river to the point where it joins the Amazon. We'd been travelling on the sparely populated waterway for several days, when one morning, just after dawn, a man in a canoe paddled out from the Brazilian side of the river to meet us. When he got close we realized he was a Matses. He pulled within shouting distance and asked for beads and shotgun shells. When I said we would give him both he invited us back to his camp.

Moises and our boatman, wary of an ambush—not unusual in the frontier regions of Amazonia—refused to leave the boat, but I was so excited at meeting a Matses this far from any of their known settlements that I eagerly followed him up the steep bank to his camp. There, his wives fed me roast boar, and while we were eating he pointed to the scars on my arms. I told him they were from sapo and he laughed. After we finished,

I gave him the shotgun shells and glass beads I'd promised. He handed them to one of his wives, who bolted out of the hut and disappeared into the forest, as if I might reconsider the gift. I suddenly felt uneasy, but after she had vanished, he surprised me by offering me sapo. Without Moises, I didn't dare accept, but while I was making my excuses, he simply handed me a stick covered in it. I thanked him, then followed his wife's lead and fled.

Back home, I gave half of the stick to the Charles Myers, the curator of the museum's Herpetology Department, who passed it on to John Daly at the National Institute of Health. Having finally produced the material I'd frequently talked about, my reports began to circulate and prompted a letter from Vittorio Erspamer, a pharmacologist who worked with the Fidia Research Institute for the Neurosciences. He wondered whether sapo might not come from one of a number of frogs he'd randomly collected in Amazonia several years earlier. Research done on the chemicals found in their skin had shown that several produced peptides—proteins—that were similar to peptides produced by humans. If it could be shown, he wrote, that one of those frogs was already in use by humans, it would be an important scientific breakthrough. I wrote back and offered to provide him with a specimen if I ever managed to collect one.

A year after Erspamer's letter reached me, I travelled back to the Lubo with Moises. We hiked across the jungle to Pablo's, discovered his camp burned, and moved down the river, where we happily found him at San Juan.

"Malo casadores," Moises snarled, after we'd been watching the men of San Juan trying to find a dow-kiet! for nearly an hour. "Bad hunters. Everything is changed with them. They're finished."

He was still grumbling about the state of the Matses when I heard Pablo calling me. "Petro! Dow-kiet! Petro?"

He was standing on a hill at the back of the puebla with Pa Mi Shua and two of his children. "Bi-ram-bo, Pablo!" I laughed. "Bi-ram-bo dow-kiet!" Yes, I would like a dow-kiet!.

Pablo laughed and began to bark out the frog's mating call. The other men in the camp stopped their hunting and watched him. Between the guttural barking noises he was making we could hear him berating the frogs for making the hunt so difficult. Pa Mi Shua and his children, walking alongside him on the path toward the center of camp, roared at his antics.

Suddenly Pablo stood and stiffened. From the grasses on the side of the path came the same sound Pablo was making. He barked again, and again his call was returned. Then a second frog joined the first, and a third, and suddenly the whole camp seemed to resound with the barking of dow-kiet!s. Pablo bent down and picked one up. "Mas dow-kiet! Petro?" More, Peter?

I laughed and said yes. He bent down and picked up another. "Mas? Bastante sapo, Petro?" More? Did I want a lot of sapo?

I told him two were enough, and he came into the center of the camp, a frog in each hand. He gave one of them to me. It was beautiful. A little smaller than my palm, it had an extraordinary, electric-green back, a lightly-spotted white underside, and deep black eyes. It grasped my fingers tightly, and in seconds I could feel my blood begin to heat up as the sapo it was secreting began to seep into the insect bites and small cuts that covered my hands. I quickly put it down. Pablo giggled with delight, then broke a small branch from a tree and placed both dow-kiet!s on it, hilariously imitating my reaction.

One of the Matses men collected four sticks and stood them in the ground, making a small square. Another pulled apart some palm leaves, stripped out the fibers and rolled them into strings against his leg. He handed four of them to Pablo, who tied one to each of one frog's legs, then tied the free ends to the four posts, suspending the animal like some strange green trampoline.

Once the frog was secure, Pa Mi Shua knelt and gently began to manipulate the frog's elongated center toe between her fingers, stimulating it to secrete sapo. It was an unexpectedly sexual image, and the men joked about it. Pa Mi Shua blushed and told them to be quiet.

The man who had placed the sticks in the ground disappeared into his hut for a moment, then returned with a piece of split bamboo. He began to scrape the suspended frog's sides and legs, collecting sapo . When the stick was covered, he dried the secretions out over our tiny kerosene lamp, then gave the stick to me.

That night both frogs were tied by one leg to a low tree branch to keep them from escaping, and in the morning the sapo from the second frog was collected. Neither was hurt by the process, and, if I hadn't been taking the two specimens back to the States, they would have been set free.

One of the frogs died shortly after I returned home, and I gave its skeleton, along with part of the sample and some photographs, to the museum. The healthy dow-kiet!, along with a second sapo sample and similar photos, was sent to Erspamer in Rome. Six months later I received his report. He was very excited.

He identified the dow-kiet! as a phyllomedusa bicolor, a rare arboreal tree frog. The sapo , he said, was a sort of fantastic chemical cocktail with potential medical applications. "No other amphibian skin can compete with it," he wrote. "Up to 7% of sapo's weight is in potently active peptides, easily absorbed through burned, inflamed areas of the skin." He explained that among the several dozen peptides found in sapo, seven were bioactive—which meant that each has an affinity and selectivity for binding with receptor sites in humans. (A receptor is like a lock that, when opened with the right key—the bioactive peptides—triggers specific chemical reactions in the body). The peptide families represented in the dow-kiet! included bradykinins, tachykinins, caerulein, sauvagine, tryptophyllins, dermorphins, and bombesins.

Based on the concentrations and functions of the peptides found in and extracted from the sapo sample I'd sent, Erspamer was able to account for all of the physical symptoms I described as sapo intoxication. On the peripheral effects Erspamer reported, "caerulein and the equiactive phyllocaerulein display a potent action on the gastrointestinal smooth muscle, and gastric and pancreatic secretions....Side effects observed (in volunteer patients with post-operative intestinal atony) were nausea, vomiting, facial flush, mild tachycardia, changes in blood pressure, sweating, abdominal discomfort and urge for defacation." Phyllomedusin—a new peptide of the tachykinin family—strongly affects the salivary glands, tear ducts, intestines and bowels, and contributed to the violent purging I'd experienced. Sauvagine, causes a long lasting fall in blood pressure, accompanied by intense tachycardia—heart palpitations—and stimulation the adrenal cortex, which contributed to the satiety, heightened sensory perception and increased stamina I'd described. Phyllokinin, a new peptide of the bradykinin family, is a potent blood vessel dilator, and accounted for the rushing in my blood during the initial phase of sapo intoxication.

"It may be reasonably concluded," Erspamer wrote, "that the intense peripheral cardiovascular and gastrointestinal symptoms observed in the early phase of sapo intoxication may be entirely ascribed to the known bioactive peptides occurring in large amounts in the frog material."

As to sapo's central effects, he wrote, "increase in physical strength, enhanced resistance to hunger and thirst, and more generally, increase in the capacity to face stress situations—may be explained by the

presence of caeruelin and sauvagine in the drug." Caerulein, in man, produces "an analgesic effect...possibly related to release of beta-endorphin...in patients suffering from renal colic, rest pain due to peripheral vascular insufficiency (limited circulation) and even cancer pain." Additionally, "it caused in human volunteers a significant reduction in hunger and food intake."

The sauvagine extracted from sapo was given subcutaneously to rats, and caused "release of corticotropin (a hormone that triggers the release of substances from the adrenal gland) from the pituitary, with consequent activation of the pituitary-adrenal axis. This axis is the chemical communication link between the pituitary and the adrenal glands, which controls our flight or fight mechanism. The effects on the pituitary-adrenal axis caused by the minimal doses given the laboratory rodents lasted several hours. Erspamer notes that the volume of sauvagine found in the large quantities of sapo I'd described the Matses using would potentially have a much longer lasting effect on humans, and would explain why my feelings of strength and heightened sensory perception after sapo use lasted for several days.

But on the question of the 'magical' effects I described in tapir trapping, Erspamer says that "no hallucinations, visions or 'magic' effects are produced by the known peptide components of sapo." He adds that "the question remains unsolved" whether those effects—specifically, the feeling that animals were passing through me, and Pablo's description of animas projection—were due to "the sniffing of other drugs having hallucinogenic effects," particularly nu-nu.

With regards to sapo's uses relating to pregnancy, Erspamer did not address any of the issues but abortion. "Abortion ascribed to sapo," he wrote, "may be due either to direct effect of the peptide cocktail on the uterine smooth muscle, or, more likely, to the intense pelvic vasodilation and the general violent physical reaction to the drug."

From the medical-potential point of view, Erspamer says, several aspects of sapo are of interest. He suggests that two of its peptides, phyllomedusin and phyllokinin have such a pronounced affect on the dilation of blood vessels that they "may increase the permeability of the blood-brain barrier, thus facilitating access to the brain not only of themselves but also of the other active peptides." Finding a key to unlocking the secret of passing that barrier is vital to the discovery of how to get medicines to the brain, and could one day contribute to the development of treatments for AIDS, Alzheimer's, and other disorders which threaten the brain.

There is also medicinal potential in dermorphin and deltorphin, two other peptides found in sapo. Both are potent opioid peptides, almost identical to the beta-endorphins the human body produces to counter pain, and similar to the opiates found in morphine. Because they mirror beta-endorfins, however, sapo's opioid peptides could potentially function in a more precise manner than opiates. Additionally, while dermorphin and deltorphin are considerably stronger than morphine (18 and 39 times, respectively), because of their similarities to the naturally-produced beta-endorfin, the development of tolerance would be considerably lower, and withdrawal less severe, than to opiates.

Both phyllocaerulein and sauvagine possess medical potential as digestive aids to assist those receiving treatment for cancer. Other areas of potential medical interest in the peptides found in sapo include their possible use as anti-inflammatories, as blood pressure regulators, and as stimulators of the pituitary gland.

The only report thus far on sapo from John Daly's team at the National Institute of Health (written with seven co-authors, including Katherine Milton, who recently discovered the use of the phyllomedusa bicolor among several tribes closely related to the Matses) was recently published in the Proceedings of the National Academy of Sciences (Nov. 14, 1992), and concentrates exclusively on a newly discovered peptide found in sapo. One of the chemical fractions Daly's team isolated is a 33-amino acid long peptide he calls adenoregulin

which may provide a key to manipulating cellular receptors for adenosine, a fundamental component in all human cell fuel. “Peptides that either enhance or inhibit binding of adenosine analogs to brain ^t adenosine receptors proved to be present in extracts of the dried skin secretion,” Daly writes. According to an interpretive report on the Daly paper written by Ivan Amato and published in Science (Nov. 20, 1992), “Preliminary animal studies by researchers at the Warner-Lambert Co. have hinted that those receptors, which are distributed throughout the brains of mammals, could offer a target for treating depression, stroke, seizures, and cognitive loss ailments such as Alzheimer’s disease.”

Of course, medical potential only infrequently results directly in new medicines. Science may not be able to isolate or duplicate the peptides found in sapo, or side effects may be discovered that would decrease their value as medicines. But even if sapo's components do not eventually serve as prototypes for new drugs, sapo will become an important pharmacological tool in the study of receptors and the chemical reactions they trigger. Certainly the study of the unique activity of sapo’s bioactive peptides will advance our knowledge of the human body. Additionally, as possibly the first zoologically derived medicine used by tribals ever investigated for Western medical potential, sapo will help open the door to a whole new field of investigation.

Unfortunately, while science catches up to the natural medicines of tribal peoples, time is running out. That Pablo was the only man at San Juan still able to draw a response from the dow-kiet! is an indication that most Matses no longer rely on it. And we have no way of knowing how many other medicines the Matses—and others—once used but have abandoned, which might also have been valuable to us.

We do know that nearly 80% of the world’s population continues to rely on natural medicines for their primary health care. Investigations into a small portion of them have already provided us with hundreds of drugs, from aspirin and atropine to digitalis and quinine. Fully 70% of the anti-tumor drugs used in the treatment of cancers are derived from traditional medicines as well. Yet our investigations have hardly begun. Obviously, there is much to learn from peoples like the Matses before acculturation strips them of their traditional knowledge. It remains to be seen whether the discoveries that have begun to be made in connection with sapo spark the interest of investigators while there is still time to learn it.

As for the Matses, some, like Pablo, will continue to live in their forest homes. Others, like those at San Juan, will probably continue to acculturate until they are no longer capable of living in their forests and are forced to move into river towns where they will be little more than tatooed people in a non-tatooed world. When that happens, all of us will have lost.