

Leonard Tushnet (GIFTS FROM THE UNIVERSE, May 1968) brings his distinctive brand of storytelling to this tale of Dr. Zvi Ben-Ari, who tracks down a myth and makes an extraordinary discovery in a small tent village in the desert of the Negev.

THE WORM SHAMIR

by Leonard Tushnet

LIKE MOST OF HIS COLLEAGUES at the Weizmann Institute of Science at Rehovoth, Zvi Ben-Ari, Ph.D. in biochemistry, was an amateur archeologist. But while they used their vacations to dig at Massada or Caesarea, he spent all his spare time reading the Bible and the commentaries thereon, laying the groundwork for their searches. A suggestion of his had led to the discovery of the long-lost smelting plant near Timna. He also had truly predicted that the excavations for the housing project in the Old City of Jerusalem would disclose a series of underground chambers painted with scenes of sacrifices to Phoenician deities.

Dr. Ben-Ari had a simple explanation for his studies. "I don't believe in shoveling and sifting dirt," he said. "That's too haphaz-

ard. What do you find if you're lucky? Another piece of parchment, a bill of divorcement? Or a pot full of Herodian coins? Or a stack of broken wine jars? No, the best way is the scientific way. Go to what's at hand, scrape it clean of the overlying encrustations and ornamentations, and try to find the truth that's hidden. In the biblical legends lie buried ancient techniques. Uncovering them is more fun and easier on the back than using a pick and shovel."

His reasoning convinced one of his students, Moshe Gofen, that he was right. Finding a disciple filled Dr. Ben-Ari with enthusiasm. He explained Project Shamir to Moshe.

"When Solomon built the First Temple," he said, "he recalled the words of Exodus 20:25, 'If thou

make an altar of stone unto Me, make it not of hewn stones; for if thy tool be lifted on it, thou hast polluted it.' Iron tools signified the sword and all weapons of war. Iron, therefore, could not be used to hew the stones for a building dedicated to the God of peace and of life. We know from the descriptions of the Temple, nevertheless, that it was not built of rough stones from the quarry but from hewn stones. The legends of the Midrash say in several places that to break the huge rocks Solomon placed on them the worm Shamir, which had the power to break rocks and make iron as brittle as glass merely by its presence. That fantastic fiction must have had some basis in fact, but between the ninth century before the Christian era and the third to the fifth after, the trials and tribulations of the Jews made them remember with longing the glamour and the glory of the great king. The stories of that time, told and retold as they were in the Oral Tradition, became so elaborate that the original fact was lost. It's the job of the scientist to find the fact interred under the fairy tales."

Moshe chuckled. "And you think there really was a worm Shamir?"

"Not at all," Dr. Ben-Ari replied. "Such a creature is as mythologic as the basilisk and the hippogriff. But there was something King Solomon used to break

the stones, call it the worm Shamir or what you will. It's our job to find it."

The two men used what little time they had painstakingly going over the commentaries on Kings and Chronicles. From there they went on to the Solomonic legends, both in Hebrew and Arabic. The story of the worm Shamir began to appear in apocryphal fragments in dubiously dated narratives from long before the Hasmonean dynasty. Then there was no mention of it until after the destruction of the Second Temple, when it again occurred in folk tales and miracle stories. The Kabbalists of the medieval German ghettos and the traveling preachers of Poland added so many more fanciful details about the virtues of the worm Shamir that in the most recent stories its original function was forgotten.

All the reading led up blind alleys. One thing, however, was accomplished. Dr. Ben-Ari and Moshe definitely established by their studies that the land of Ophir whence came "gold and algum trees" was not Monomotapaland, as had been suspected, but Eritrea. A British syndicate headed by Sir Albert Stern, acting on the much publicized report, rediscovered the lost gold mines, richer than those of South Africa. In gratitude, Sir Albert gave Dr. Ben-Ari an enormous grant of funds for further research.

Freed from their academic tasks and with so much money to spend, the two men started all over again on Project Shamir. This time they used a computer into which they fed the material from the legends. "Now we'll do it right," said Dr. Ben-Ari. "We'll start from the latest stories and work backwards in time."

With the techniques developed by Christian exegetists to determine the authorship of the books of the New Testament, they gave the computer everything that was known about the worm Shamir. What came out was two surprising bits of information: that seldom was the worm Shamir mentioned without mention of the woodcock and that the worm Shamir could not abide dryness.

"Woodcocks? What are woodcocks?" asked Moshe, who was, like all *sabras*, native born Israelis, more acquainted with soccer than with hunting.

"I think they're like pheasants. Or maybe quail?" Dr. Ben-Ari was equally ignorant. "But it's easy to find out. Check with the ornithologists."

"There are no woodcocks in Israel," Moshe reported later, "and there have been none since the days of the Romans."

"Ah-ha!" Dr. Ben-Ari's eyes glistened. "That makes its mention more significant. The worm Shamir and the woodcock are somehow tied together."

Moshe laughed: "Such close contact would be bad for the worm. The woodcock would have eaten it long ago." He stopped short, as though an idea had suddenly struck him. Dr. Ben-Ari nodded; he had had the same thought. Moshe continued his report. "Dr. Shechem says that woodcocks are allied to snipes and sandpipers, and like them inhabit wet areas such as river bottoms. The ecology of Palestine has changed over the centuries. Woodcocks and other game birds, formerly plentiful here, disappeared from the land when their food supply vanished because of the increasing aridity, which he attributes to the devastation by the Romans after the Bar-Kochba revolt and to the progressive deforestation of the post-Exilic period. One thing more—quite significant. The woodcock's beak is specially adapted for digging for earthworms."

Both Moshe and his mentor felt the thrill that told them they were on the right track. Woodcocks and earthworms. The worm Shamir. Their researches took a new turn in the direction of Lumbricidae. On that subject there was a wealth of material, so much so that were it not for the computer they would have been lost in it. The computer helped them to cut out non-essentials, and by combining its information with the worm Shamir's legendary fear of dryness they came to the conclusion that in the

mucoid slime excreted for lubrication by all lumbricoids lay the secret of the worm Shamir. They also discovered, to their dismay, that the earthworms indigenous to Palestine had long been superseded by new peregrine varieties in the irrigated and cultivated areas. Again Project Shamir seemed to be at a dead end.

Before giving up they sat down to think. Dr. Ben-Ari said, "We seek a substance secreted by a species of earthworm, a substance that has adsorptive and penetrating powers similar to dimethyl sulfoxide, a substance that can alter the structure of rock. The problem is where to find that earthworm, if it still exists anywhere in Israel."

Moshe made a suggestion. "Well, it wouldn't be in the kibbutzim or any newly developed farm areas. If it's remained here since King Solomon's time, it can only be in relatively isolated naturally watered areas in the desert. We need a topographic survey map of Israel that will show oases."

The map showed dozens of tiny oases in the desert of the Negev, some named, some unnamed. The prospect of visiting them all, digging for earthworms, and then identifying the species dismayed the two men. Again they felt they had reached an impasse, but Sir Albert's money was still available, so they hired a couple of Bedouins and started their explorations at a

small oasis fed by a spring near Beersheba.

Of earthworms there were many. They collected them, placed them in little plastic boxes filled with moistened dirt, and brought them back to the helminthologic specialist at the Institute. He sorted them out according to species and variety, showed Moshe how to distinguish them, and confidentially told his colleagues he was convinced that Moshe and Dr. Ben-Ari were victims of a peculiar *folie a deux*. The two men heard the gossip about their mania and at times felt it was well founded, because the most careful analysis of the slime from every kind of lumbricoid they collected showed it had an identical chemical composition. It was a mucopolysaccharide. But by now the spirit of the chase was in them. They would not give up. Dr. Ben-Ari set up a portable laboratory in a truck, got a small bus to transport more workers, and planned to go deep into the desert to another spring-fed oasis.

The Bedouins who worked for them also thought they were crazy. Yussuf ibn Mahmud Cefik, the foreman, discussed the matter with his kinsmen, who made up the work crew. "The Jews are filled with a madness. It will not be long before the authorities place them in a House of Mercy, and then our jobs will be lost. They seek earthworms. Let us take them

back home to the Wadi Malikat-yar, where earthworms abound. There while they play with their glass bottles and brushing machines we can be near to our families." His cousins and brothers and uncles nodded. It was a good idea.

Yussuf approached Dr. Ben-Ari and made the polite obeisance. "Sir, I have wondered at your work. If you seek earthworms there is one place where they are fat and many. We can take you there. It is not far from Yotvata, at the Wadi Malikatyar."

Yotvata, Dr. Ben-Ari knew, was a garden spot not far from Timna, but his eyes lit up at the mention of the wadi's name. "Why is it called the Wadi of the Kingbirds?" he asked. "And if it is indeed a wadi, a dry river course, then how are earthworms found there?"

Yussuf shrugged. "Such has been its name since before the time of the Prophet. The wadi is dry, of course, but in the spring rains it becomes a torrent that feeds into the village." He boasted, "It is the village of my fathers, like no other. It has deep wells with pure water and grain grows freely thereabouts."

"Let us go then to the Wadi Malikatyar," Dr. Ben-Ari said.

Moshe was a little doubtful when he heard of the proposed expedition. "Hopping around from place to place is very unsystematic," he objected.

Dr. Ben-Ari held up his hand. "Maybe it is an omen that the wadi is named after birds."

The tiny tent village was indeed as Yussuf had described it. Situated in a small depression in the desert, evidently a natural catch basin, its gnarled olive trees gave shade to the goats wandering in the surrounding pasturage; small fields of wheat surrounded it; a communal sheep fold was at one end. What lifted up Moshe's heart was the sound of birds twittering, a rare occurrence in the desert. "Where there are birds, there must be food for them, and not merely grain." Actually, birds were so abundant that the little boys and girls of the village were given the task of periodically running around with brass clappers to drive them from the fields.

On the day after their arrival, the sheikh, Yussuf's maternal uncle, invited the learned doctor and his assistant to a feast of welcome. After the dinner of lamb and *burghul*, eaten with the fingers, had been eaten and sweetened coffee passed around, the visitors were entertained with wailing songs, dissonant music, and finally by the story-teller with a tale from the Arabian Nights. The visitors applauded vigorously and then Moshe, with the enthusiasm of youth, inquired of the story-teller whether he knew any tales of King Solomon or how the wadi got its name.

The story-teller, a venerable old man, replied, "It is one and the same story. It is one my grandfather's grandfather learned from his grandfather." He clapped his hands for silence and began, "Long, long ago, before the days of the Prophet, King Solomon, to whom Allah had given the gift of wisdom, journeyed from Jerusalem to Eilat because in a dream had come to him word that the idolators of the south were preparing a rebellion. In those days the roads were bordered with fruit trees of all kinds. Wherever the king stopped the people brought him grapes and figs and pomegranates and honey-sweetened water to refresh himself. In those days the wadi was a wide gently flowing stream abounding in fish and by its banks was a dense forest where all manner of birds sang in the branches. While the king was sitting in the sheikh's tent, even as we sit now, he heard one bird say to another—for Allah had given the king knowledge of the language of birds and beasts—that an evil man in the pay of the idolators was preparing a snare for him. The king . . ." The richly embroidered Oriental fantasy went on with Moshe and Dr. Ben-Ari listening intently. It ended, ". . . and from that day, the king ordered that the bird who had warned him be no longer called Tairsheen but Maliktair and from that day the river was called the

River of the Kingbirds, alas! now no river, but a wadi."

The tale excited Moshe. He asked, "What does Tairsheen mean?"

The story-teller wiped his lips. "No man now knows. Those birds flew away long ago, when the forests were destroyed by the anger of Allah against the idolators." Trembling in his agitation, Dr. Ben-Ari gave generous gifts to the sheikh and to the story-teller.

Back in the truck, both men danced for glee. "This is the spot!" they laughed. "Here we shall find the worm Shamir!"

Yussuf was right. The earthworms of his village were fat and juicy. Hundreds of them were collected in a single day, and while the Jews went on with the tedious task of classifying them, the Arabs relaxed in the bosoms of their families.

The investigations showed that the earthworms were no different from those collected near Beer-sheba, except that the mucus they secreted was thicker and more tenacious.

The mucus from the exterior of the earthworms was collected mechanically by tiny rotating brushes. From one earthworm about 0.2 milliliters was obtained; at least 100 milliliters was necessary for proper analysis. On the sixth day, after thousands of earthworms had been brushed and five flasks filled with the mucus, the chemical

analysis was started, with both Moshe and Dr. Ben-Ari in high hopes that they would discover something unusual.

Alas! Chemical analysis showed the same mucopolysaccharides they had become familiar with from other earthworms. Crestfallen, the two men were about ready to give up Project Shamir when came the lucky accident.

One flask, sitting too near the edge of a shelf, was dislodged by the vibration of the centrifuge directly under it. It fell, and the glutinous foul-smelling mess splattered over the work table beneath the shelf. With a curse, Moshe flung down the test-tube he held in his hand and said, "That does it! I'm finished, Doctor. This was a hopeless task that we set ourselves."

Dr. Ben-Ari sighed. "You're right, Moshe. Let's wash up and go outside away from this stink. Tomorrow morning we'll have the men help us clean up in here and we'll leave."

That night the sheikh again invited them to a feast, a farewell feast this time, because the laborers had spread around the sad news of the departure. Again the two men ate lamb and *burghul*, drank bitter coffee, and listened to the songs and music. The storyteller, to please them, had a new tale about the wisdom of Solomon. It was new to him but not to the Jews; they had read it in a collec-

tion of Hebrew demon tales. Their gifts were generous, nevertheless.

At dawn Yussuf and his cousin Achmed helped with the packing up of the instruments and the apparatus. The microtome was wiped dry of the slime spilled on it the previous day, dismantled, and the parts handed to Dr. Ben-Ari, who stowed them into a chest. Achmed was clumsy. He dropped a blade and it fell to the floor and shattered as though it had been made of glass, not finely tempered steel. "Don't worry," Dr. Ben-Ari reassured him. "Sometimes a fine crack will make—will make—" He stopped short and called Moshe. "Look here," he said, pointing to the tiny slivers on the floor of the improvised truck-laboratory.

Moshe heard what had happened. He ran to the work table, saw there a screwdriver used to tighten the gears on the brushes. It, too, had drops of mucus clinging to it. He held it up and twanged it at the end. Tinkle, tinkle. Only the handle remained in his hand. The rest fell like a snow of powdered glass to the floor.

The Arabs were hustled out of the truck. Dr. Ben-Ari and Moshe picked up every instrument on the work table and dropped it on the hard plastic surface. Nothing happened to those uncontaminated by the slime or those made of aluminum or stainless steel or those chrome-plated, but plain steel ob-

jects, like the finger forceps or the staples, that the mucus had touched, broke into tiny pieces with the slightest jar. Moshe tapped the base of the colorimeter where several screws had lost their plating. They fell apart. He caught the colorimeter barely in time to keep it from falling.

Of the five original flasks, only one was left. Dr. Ben-Ari went out to the waiting workmen and gave them the good news that they would stay another week on condition that more thousands of earthworms be collected and that he get two men to help in the collection of the mucus. The thousands of earthworms were readily promised but not the two men. The Arabs wanted nothing to do with such lunacy. At last a compromise was reached. Four boys from the village were provided; the sheikh, stimulated by an additional gift, told them to do what the afflicted of Allah ordered. They, also afflicted, being feeble-minded, could raise no objections. As a matter of fact, they enjoyed the process, making a game out of running the hapless earthworms through the brushes.

In a week twenty-six flasks of slime were collected. They were carefully packed away and the convoy started back to Rehovoth.

On the way Dr. Ben-Ari conducted a few experiments. Contrary to legend, rock was not split by the mucus; only iron was af-

fected and those ferruginous rocks like red sandstone to a limited extent. "That's how the stories got started," he said. "Sandstone is good for building. You recall how many times the Temple was depicted as being all red and gold?"

A tiny drop, if allowed to stay long enough in contact with iron or steel, made the metal brittle. It was quite easy for the men to construct a chart showing how much and how long a time was needed for varying sizes of surfaces of the metal. Weight and cubic volume meant nothing; the linear equation was applicable to areas only.

They speculated on the value of the discovery. It seemed to them quite useless, merely an interesting confirmation of legend. "Industrial application is nil," Dr. Ben-Ari said. "Who needs iron as brittle as glass? Now, if the worm Shamir could harden iron, that would be a different story." Moshe suggested that they inform their benefactor, Sir Albert Stern, of the successful outcome of their research. He was a businessman; he would know whether it had any commercial value.

Sir Albert flew from London to see a private demonstration of the almost magical properties of the worm Shamir's slime. He pursed his lips and thought a while before commenting. "First, the method of collecting this goo is too expensive and time-consuming. Second, the earthworm population would be

rapidly depleted. A very thorough chemical analysis has to be made of the slime and the substance responsible for this very unusual action must be isolated. If it is not too complex, after analysis perhaps artificial synthesis will be possible. If synthesis is not too involved, the substance can be made in quantity. Then and only then can a possible use for it be looked for."

A laboratory was set up on the outskirts of Sodom, near the great chemical complex, and a team of chemists set to work on the analysis under the close supervision of Moshe and Dr. Ben-Ari. They were there to see that no iron came in contact with the slime. After a month of intensive work, the substance was isolated and its formula determined. It was a mucopolysaccharide, all right, but one that had a carbon atom weakly linked to an organic side chain, ammonium tetraethyl sulfomolybdenate. Separately the ammonium salt and the polysaccharide had no effect on iron; the conjoined molecule had the power to change any of the four allotropic forms of iron into a fifth amorphous form; how this came about was still undetermined. Dr. Ben-Ari's equations were checked, their validity confirmed, and a new discovery made. The compound, now named shamirite, was effective in extremely dilute solution and had great spreading power. One part

in a thousand of water sprayed on a square metre of an iron surface changed the metal into its shatterable form in fifteen minutes.

Synthesis was easier than had been expected. Sir Albert, with the blessing of the Israeli government, which said it was desirous of increasing industrialization and decreasing unemployment, set up an enormous chemical plant for that purpose. Dr. Ben-Ari asked him why. "What possible use can there be for shamirite, and when can Mr. Gofen and I publish our results?"

Sir Albert shut one eye and peered quizzically at Dr. Ben-Ari. "Are you joking? There will be no publication. This information is strictly classified for security reasons. Israel and Great Britain have already reached agreement on that. This is a better weapon than the atomic bomb. The bomb makes a conquered territory potentially uninhabitable besides causing great destruction of life and property. This in a water pistol, so to speak, renders tanks and guns worthless." He laughed. "Who can fight with glass weapons? Who will dare attack a country armed with shamirite?"

Dr. Ben-Ari was taken aback. He had never conceived of the worm Shamir being used for warfare. He conferred with Moshe. "I feel like the atomic scientists. Out of a theory I have made a Frankenstein monster. What are we to do?"

Sir Albert, being astute, felt it would be wise to show the two men shamirite in action. He arranged for them to pay a visit to Kfar Dovid, on the Syrian border, where troops guarding the settlement had been equipped with the new weapon. They stayed there almost a month before a friendly Arab brought the army units information that an attack was imminent.

The Israeli troops were ready. They had no weapons other than truncheons and huge wheeled ceramic tanks with long hoses, looking like old-fashioned fire engines. When the reconnaissance patrols returned and said a dozen armed jeeps and a force of machine gunners was on its way, capsules of shamirite were dropped into the tanks and the high pressure units activated. Dr. Ben-Ari and Moshe watched the battle from a rooftop. Just at dawn the Syrians came into view. They met no resistance until they were within range of the hoses. Then they were sprayed with the shamirite solution. They kept advancing but within a matter of minutes the jeeps began to fall apart as they hit the tiniest obstacle in their path; the rifles and machine-guns splintered; even the steel buttons on the ammunition belts disintegrated. The attackers were quickly surrounded and captured, all but two, who fled back across the border.

Word of the new weapon

spread rapidly throughout the Arab League. The delegate of the Soviet Union to the United Nations accused Israel of using a barbarous technique worse than the atom bomb or poison gas, but he was laughed down when the Israeli delegate showed pictures of the Arabs being attacked by streams of water. The delegate from Guatemala, coached by the United States ambassador, sarcastically remarked that the jeeps and the weapons must have been held together by spit since they fell apart so easily.

Shamirite was quickly distributed to all the Israeli troops at the borders. When the next wave of the indeterminate war started, it ended in a few hours. This time newspaper correspondents and TV cameramen were at hand to record the amazing effectiveness of shamirite, the composition of which remained a closely guarded secret.

There were a few drawbacks to its use, as General Gabriel Melamed, the Israeli Chief of Staff, pointed out. No water cannon could reach long range artillery and no way had yet been devised to use shamirite as a defense against aerial attack. No stream of water could be projected far enough or high enough without a fine mist forming that would descend to earth and ruin the defenders' equipment. Shamirite could be used only for defense, and then only at the borders of the country.

Dr. Ben-Ari smiled grimly when he heard through Sir Albert about the general's critical comments. "Good!" he said later to Moshe. "Aerial warfare is useless for conquest. So is long range artillery. Both can destroy but no occupying army can invade a country

equipped with shamirite." He clapped Moshe on the back. "Thanks to the worm Shamir we shall have peace in our time!"

The following year every nation in the world used only chrome-plated steel in its armamentarium.
