

## GEOLOGY

# World's Deepest Mine

At the Kolar Gold Field in India man has burrowed almost two miles into the earth to take out one of his most precious metals.

By BARBARA TUFTY

► IN SEARCH OF gold, man has burrowed nearly two miles into the earth at the Kolar Gold Field in India, the deepest mine in the world. Here temperatures are so high and rock pressures so great that solid rock is beginning, almost imperceptibly, to flow into the open excavations—yet man still digs deeper at the rate of 250 feet per year.

On the hot plains of South India, 13 degrees north of the equator, stand gaunt headings of three mining companies, recently nationalized by the Mysore State Government from the British concern, John Taylor and Sons, Ltd. These derricks mark entrances into a 650-mile network of tunnels that stretch 10,030 feet below the surface of the earth.

Here man is encountering mining problems in intensities never before met, according to John K. Walker, manager of Champion Reef Mine, deepest and one of the most prolific of the mines.

As man digs through the crust of the earth, rock temperatures increase one degree Fahrenheit for every 110 feet. At the bottom of deep shafts, rock temperatures are 150 degrees Fahrenheit, hottest mining temperatures yet encountered. Heavy pressures built up from excavations release inherent stresses in the ancient rock and cause some of the most violent and frequent "rock bursts" ever recorded. And at these new plumbed depths, Mr. Walker went on to say, man is beginning to find that the rock is stressed beyond its natural rigid state and it is possible to find evidence of the commencement of a gradual plastic flow.

Yet from these problematical tunnels have trickled over 958 tons of gold during the past 83 years when the area has been technically mined. A thousand years ago, people began digging the gold with primitive tools and methods of quenching heated rock with water to demolish the gold-bearing quartz. Today, Kolar Gold Field leads the world in deep-mining techniques, and 98% of the gold is removed from its surrounding rock, the highest gold recovery anywhere. The yellow-green metal streams from these fields at a rate of 20,000 ounces each month, about three percent of the total world output.

## Gold-Bearing Reefs

The finely divided gold, normally invisible to the eye, occurs in 26 quartz reefs or veins which run north and south through hard schist rock. At the surface, these reefs slant into the earth at a 45-degree angle, but they become nearly vertical at greater depths. The reefs are three or four feet wide on

the average, but sometimes swell out to 25 feet or dwindle to a foot. They were formed millions of years ago by volcanic action which squeezed the gold-containing quartz into the hornblende schist, one of the hardest and most ancient rocks in the world.

The indigenous country rock at Kolar is exceptional in its unyielding nature and its high resistance to rupture. This means it resists heavy pressures, but when stressed beyond its rupture point, the rock explodes with violence. Geologically of great age, the hornblende schist possesses internal pressures which are violently released after excavation.

When a rock explodes in a "rock burst," the shock wave may be felt many miles away and, like a small earthquake, causes considerable damage even to buildings above the earth's surface. Normally, pressure in mine workings is relative to depth, commented Mr. Walker, but in these mines, rock bursts have occurred almost as frequently at 500 feet as at 10,000 feet.

Rock bursts at Kolar occur more frequently and with more destructive and widespread effects than at any other mining field.



**GOLD TOWER**—Beneath this girdered tower men work almost two miles underground digging for gold. Topping off the deepest mine in the world at the Kolar Gold Field in India, this derrick marks the entrance to a 650-mile network of tunnels.

Other mines encountering rock burst problems throughout the world include the copper mines of the United States, the copper, gold and nickel mines of Canada, and the gold mines of South Africa. Rock bursts are also occurring with some intensity in the coal mines of the United States, Nova Scotia, India, and in the United Kingdom and the continent of Europe.

In order to minimize and localize the damaging effects of rock bursts at Kolar, the rock is mined in strict sequence, in accordance with what engineers have learned about ground control and rock bursts. Extraordinarily careful measures are taken to prevent building up over-great stresses in the rock, and to investigate constantly the areas where a burst might occur.

## Granite "Plugs" Prevent Bursts

Most important preventive measure to ease devastation from rock bursts is the huge job of packing granite blocks into the "stopes" from which the reef has been extracted. These granite cubes, 8 or 12 inches in size, are quarried above surface and then lowered underground in trucks. There they are carefully packed, stone by stone, against each other to form three-dimensional jigsaw walls which are more or less continuous and rigid. Each month, more than 5,000 tons of granite blocks are lowered and fitted into these reef excavations. This of course entails tremendous costs and a slowing down of production in the mines. Before further reefs can be excavated, abandoned reefs must be refilled with granite to offset pressures. Eighty-five percent of the area mined at Kolar is now plugged in this manner.

As other preventive measures against sudden explosions, Kolar tunnels are girded with heavy steel rails every three and a half feet, and strapping steel pieces are bolted into the rock walls.

At 10,000 feet the virgin rock temperature is 150 degrees Fahrenheit. Work at these depths would be impossible without two air-conditioners which send dehydrated air cooled to 37 degrees Fahrenheit down shafts at the rate of 125,000 cubic feet per minute. By the time this air reaches the shaft bottom, its temperature has increased to 86 degrees, and when it reaches the far ends of the tunnels, it is 125 degrees hot. Another cooling plant will soon be placed 8,000 feet below the surface, explained Mr. Walker—the first air-conditioner at this depth.

In the constant heat, machine crews find their machines so hot to operate that they have to use a piece of sacking to protect their hands. Steel drills, ladders, buttresses and other metal equipment are hot to handle. Water is too hot for drinking, and supplies of cool water have to be lowered and retained in coolers at each level. Water is normally drunk with salt to prevent muscular cramp resulting from saline losses when the men perspire excessively.

Workers acclimatize to the hot working

conditions fairly quickly, commented Mr. Walker. After about a week, the sweat glands of a new laborer adjust to the high temperatures, and he sweats profusely in nature's own method of counteracting heat.

**Flowing Walls of Rock**

As a result of the enormous pressures in some of the deepest tunnels of Champion Mine, Mr. Walker stated, hornblende schist walls are showing evidences of a natural plasticity which accentuates the normal closure of the rock to such an extent that within 24 hours after initial drilling, walls have sometimes perceptibly moved into the excavation as much as six inches.

The deep mines are reached from the surface by circular shafts which vary from 4,000 to over 6,500 feet in depth.

One of the deepest single-wind shafts in the world permits men to plunge in an elevator cage nearly one and one-half miles straight into the earth in about three minutes. This is Gifford's shaft on the Champion Mine, a circular shaft 18 feet in diameter which reaches 6,586 feet deep. Two steel ropes, each weighing 20½ tons, pull two double-decked cages made of duraluminum, each capable of carrying 50 men or five tons of ore.

Present official estimate is that the Kolar mines will continue probing the earth to the depth of 11,500 feet. Controlling factors for reaching these great depths are three-fold, Mr. Walker said: rock pressure, ventilation and plastic flow. Kolar gold mines have advanced as far as feasible by existing methods of mining, he added.

The problems now seem rather beyond the province of the practical mining engineer and have entered the field of the scientist and the specialist.

Science News Letter, September 7, 1957

**MEDICINE**

**Car Headrest Stops Whiplash Neck Injury**

➤ A CAR HEADREST that prevents whiplash injuries of the neck during highway accidents was recommended by Dr. Albert D. Ruedemann Jr. of Detroit, in the *Journal of the American Medical Association* (Aug. 24).

Whiplash injuries occur when a car is struck in the rear and its occupants have their heads snapped back. Both super highways and the new lower seat models are factors causing an increasing number of such injuries, Dr. Ruedemann reports.

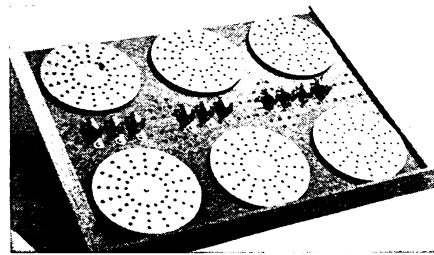
The headrest is six inches wide, six inches high and is fitted on the top of the present seat. It follows the backward curve of the seat so that the driver cannot rest his head on it and become drowsy.

An experimental model that can be screwed to the seat frame and is removable was made by officials at the Chrysler Corporation.

It should be used along with a shoulder-type seat belt to keep the body from being thrown forward, Dr. Ruedemann recommends.

Science News Letter, September 7, 1957

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