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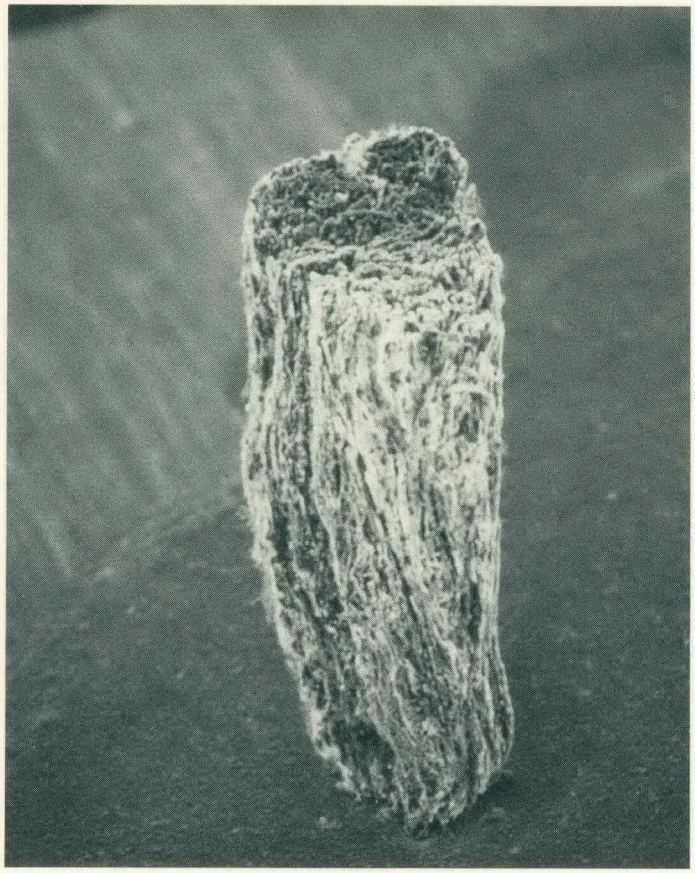
NEW DISCOVERY ON ORIGIN OF PLANT LIFE

Plate-like gold particle from the Carbon Leader Reef. The shape is very similar to gold particles occuring in recent placers, suggesting transport in a river environment. Scale 1:5.

ONE of the most exciting problems facing the South African mining industry is that of pinpointing and assessing accurately the gold quantities remaining in the reefs of the Witwatersrand Geological Basin, quantities which some believe to exceed those extracted in nearly 90 years of intensive gold mining. Success in tracing extensions to the known gold-fields or in finding new gold-fields depends to a large extent on the understanding and correct interpretation of geological observations made during mining of the known deposits, and requires the combined brainpower of scientists and engineers trained in disciplines such as geology, geochemistry and mineralogy, the most modern laboratories equipped with devices such as the scanning electron microscope, and the financial resources of a great mining industry.

The Witwatersrand Geological Basin has a surface area of about 25 000 square kilometres and extends downwards to a depth of perhaps ten kilometres. It has long been recognised that the conglomerate type of reef in this area can be related to a Precambrian alluvial form of environment where the gold was gravity-sorted and concentrated in a sheet-like body near the entry points of river systems into a large inland lake. At that time, about 2 500 million

Fossilized lichen-like plants preserved as coal or carbonaceous material which often occurs at the base of the Carbon Leader Reef, Basal Reef and others. Magn.65 X.



The filamentous structure of the fossilized plants can be observed when some of the pitch-like coal substance has been removed by a heating process. Magn. 100 X.

years ago, the gold reef was in the form of a thin layer of sand and pebbles with grains of gold and uranium, lying on the surface of an extensive plain along the shores and partly covered by the inland lake which was about the size of the Caspian Sea today.

Subsequently, as the lake basin subsided due to geological forces, layers of sand (to form quartzite) and of silt (to form shale) which were devoid of gold, were washed into the lake covering the thin layer of gold-bearing reef to an average depth of several kilometres. During the intervening periods of time, geological forces have caused these layers of rock to buckle and deform with the result that much of the gold-bearing reef has lost its continuous nature and has been broken up into detached sections mutually separated by the geological faults and dykes.

The fact that parts of the gold reef were relatively easy to find, in

Fungus-like micro-organisms preserved as gold from carbonaceous material of the Carbon Leader Reef seen after magnification in a scanning electron microscope. Magn. 12 000 X.

Fungus-like micro-organisms preserved as lead compound from carbonaceous material of the Basal Reef. Magnified 6 000 times in a scanning electron microscope.

places even being visible on surface as outcrops, made possible the original discovery of the deposit and the continued long-scale mining in the Witwatersrand Basin since that discovery. However, the great depth and the discontinuous nature of the gold reefs that remain are factors that complicate severely the defining of the positions of regions of reef that could be mined profitably. Traditionally exploration of new areas of reef has been carried out by the sinking of boreholes, but economic considerations restrict the number of such boreholes to less than the number desirable for a comprehensive probe of the profitability of any particular area of reef. This consideration has provided the incentive for research into other approaches for establishing the whereabouts of new areas for payable reef.

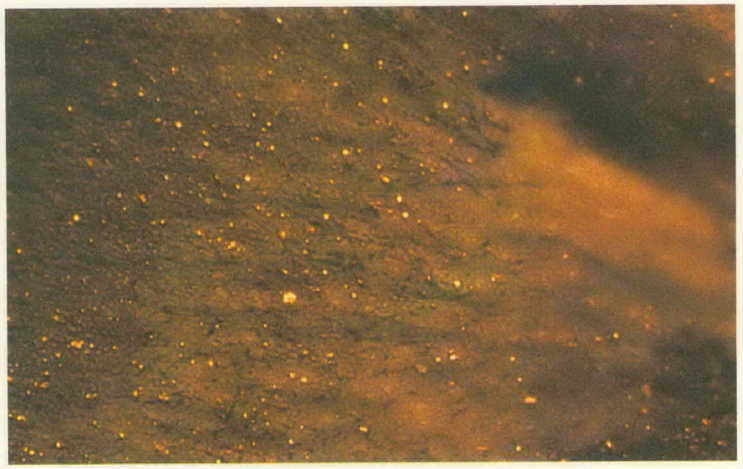
To this end considerable effort has been devoted to the collection of geological information relating to the gold deposits being mined and to conducting research towards closing the gaps in our knowledge by employing different geological and mineralogical techniques in the investigation of the reefs. The aim has been the building of a model of the environment and geology of the area as it was about 2 500 million years ago.

Such a model is now being created by Professor D. A. Pretorius of the Economic Geology Research Unit at the University of the Witwatersrand, and others. It must be exact down to the river estuaries where a heavy metal like gold would be most likely to be deposited.

A most exciting part of this reconstruction is the work of Dr. D. K. Hallbauer, Chief of the Geochemical Division at the Chamber of Mines, Mining Technology Laboratory. He has been largely responsible for a crucial discovery – that the carbon so often found in the gold reefs, especially in the unusually rich gold reefs of the Far West Rand gold-fields, is of plant origin.

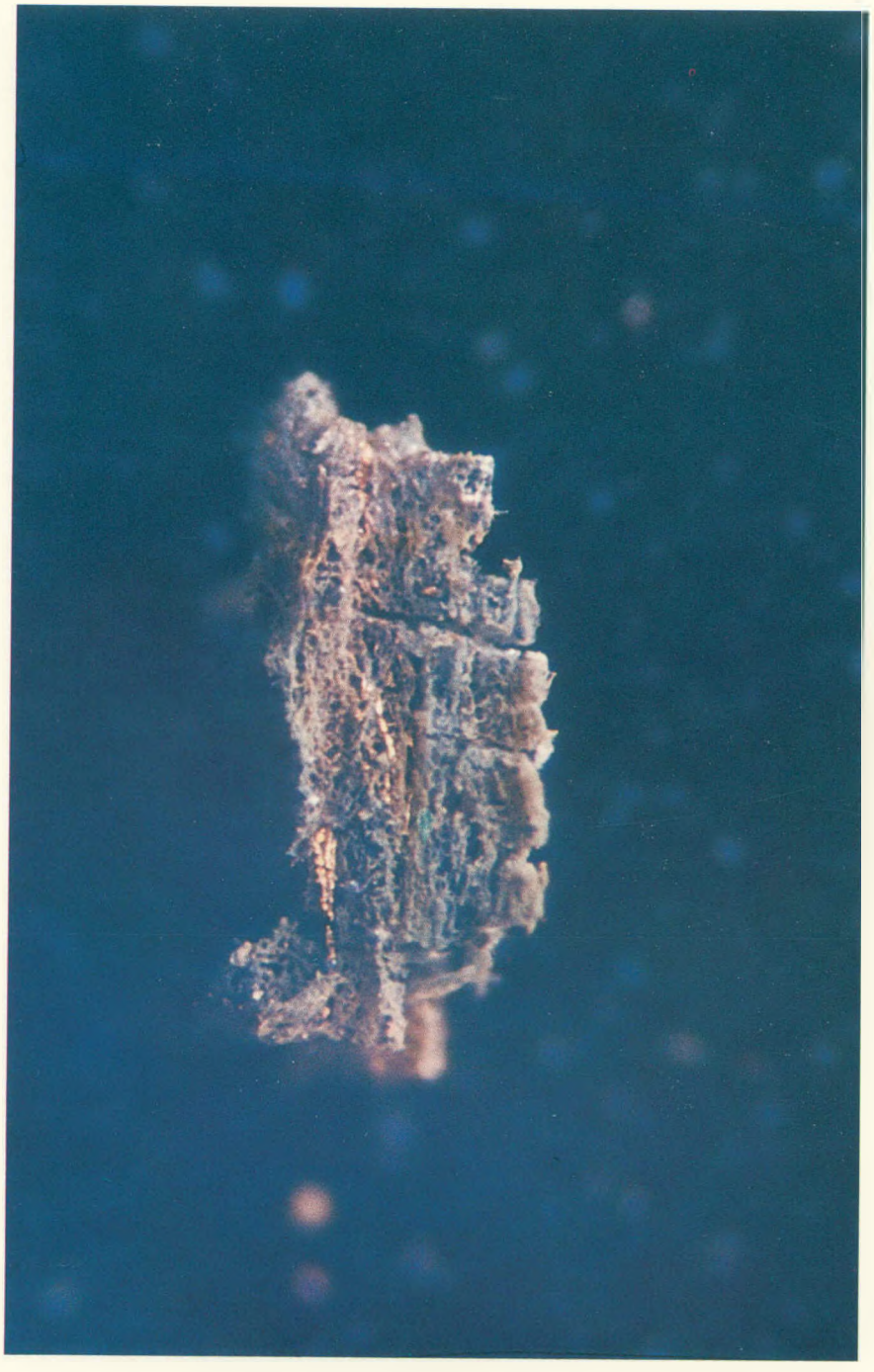
This is a vital discovery because the fact that there were plants alive 2 500 million years ago in the Precambrian times tells us a great deal about the climate, atmosphere and topography of the area at the time. The fact that plant life more complex than unicellular organisms existed so long ago is also a vital clue in the theory of evolution.

Previously scientists believed that there was no plant life as early as Precambrian times and the carbon in the gold reefs was postulated to be of gaseous and liquid hydrocarbon origin. The nature of these prehistoric plants, which Dr. Hallbauer has minutely examined, suggests that at the time there were carpet-like colonies of plants similar to lichens covering parts of a plain, hundreds of square kilometres in extent, which was partly submerged in water. Gold and other materials, such as uranium, were apparently extracted from



Gold concentrated by a presently living fungus growing on a gold-bearing nutriant.

Fossilized micro-organism recovered from carbonaceous material of the Basal Reef, St. Helena gold mine.



the surroundings by these organisms by biological processes, and were collected inside and outside the hyphae of the plants.

In addition to displaying this biological affinity for the gold, the plant colonies served to concentrate the gold particles through a mechanical action, similar to that of the well-known corduroy table, when water washed gold-bearing sand over these "carpet" colonies. This is in contrast to so many other gold reefs of the Witwatersrand Basin in which carbon is not present, and the gold was concentrated by wind, water, and wave action.

This work is important to gold mining in several respects:

It may assist in the construction of a realistic geological model and therefore in the discovery of new gold-bearing reefs and in the more accurate assessment of the value of existing mining properties.

Knowledge of the areal distribution of the gold in a reef could lead to the adaption of new mining techniques.

A practical application of the knowledge of the organisms which successfully concentrated gold could assist in the biological "mining" of old rock dumps and sand dumps containing residues of gold.

In addition the work is important to science generally and has provided additional information on the calendar for the development of early life forms on the earth. The fact that the carbon of the Carbon Leader and other Witwatersrand gold reefs had its origin in plants – at a time when no plants were thought to exist – means that the presently accepted biological time scale based on geology and other sciences must be changed to the following:

3 500 million years ago:	unicellular organisms.
3 300 million years ago:	unicellular organisms of a type able to form colonies.
3 000 – 2 800 million years ago:	blue green algae.
2 500 million years ago:	fungi and lichen-like plants.

Until now it was considered that fungi appeared only about 1 300 million years ago and lichens about 140 million years ago; thus life on earth in its more complex and organized form, appears to be considerably older than has been believed up to now.

Ashed carbonaceous material showing part of the fossilized plant structure and gold as filaments which was concentrated by the plant when it lived 2 500 million years ago.

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