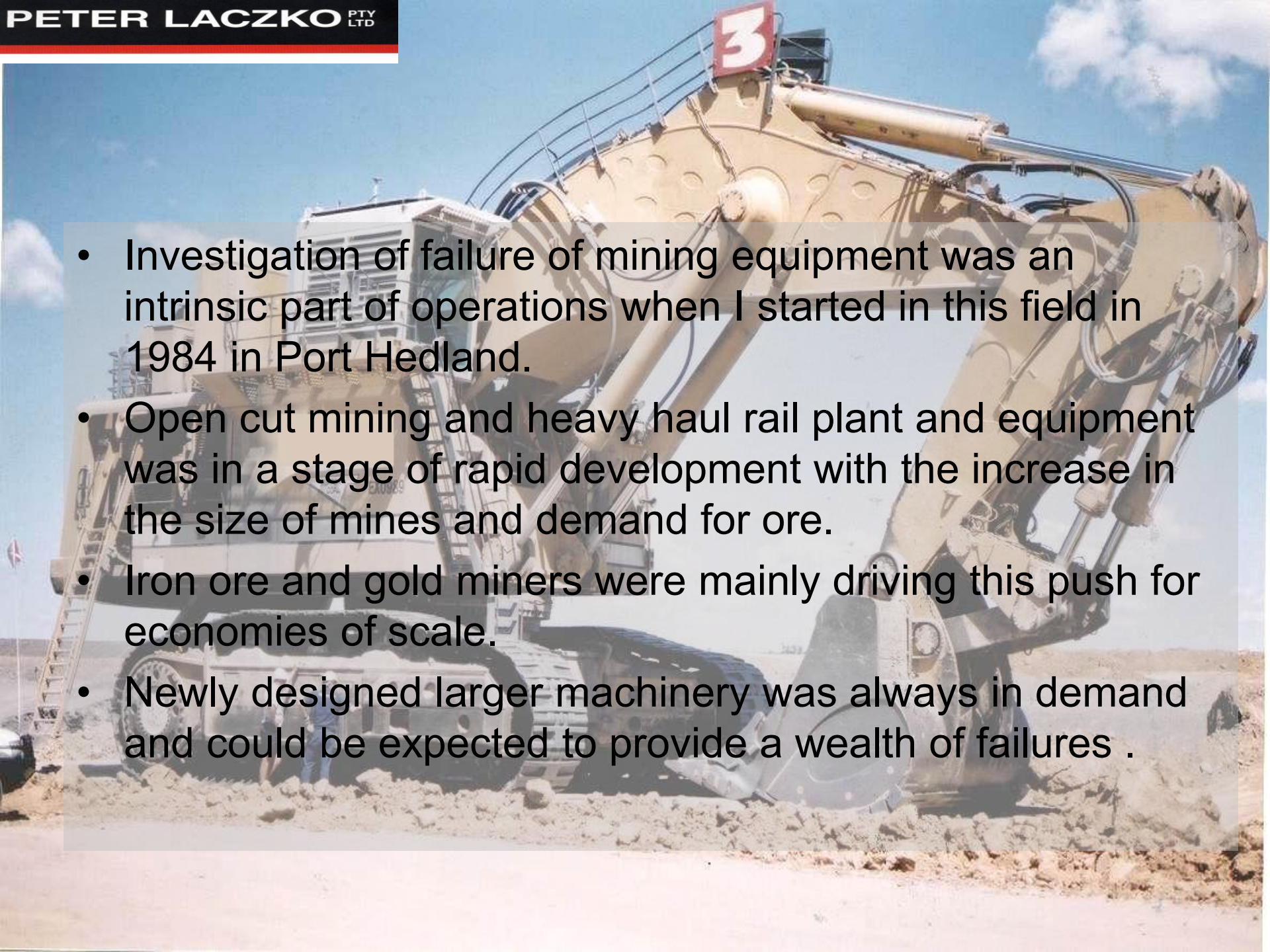
PETER LACZKO PTY LTD

Failure Analysis of Mining Equipment – Why Bother ?

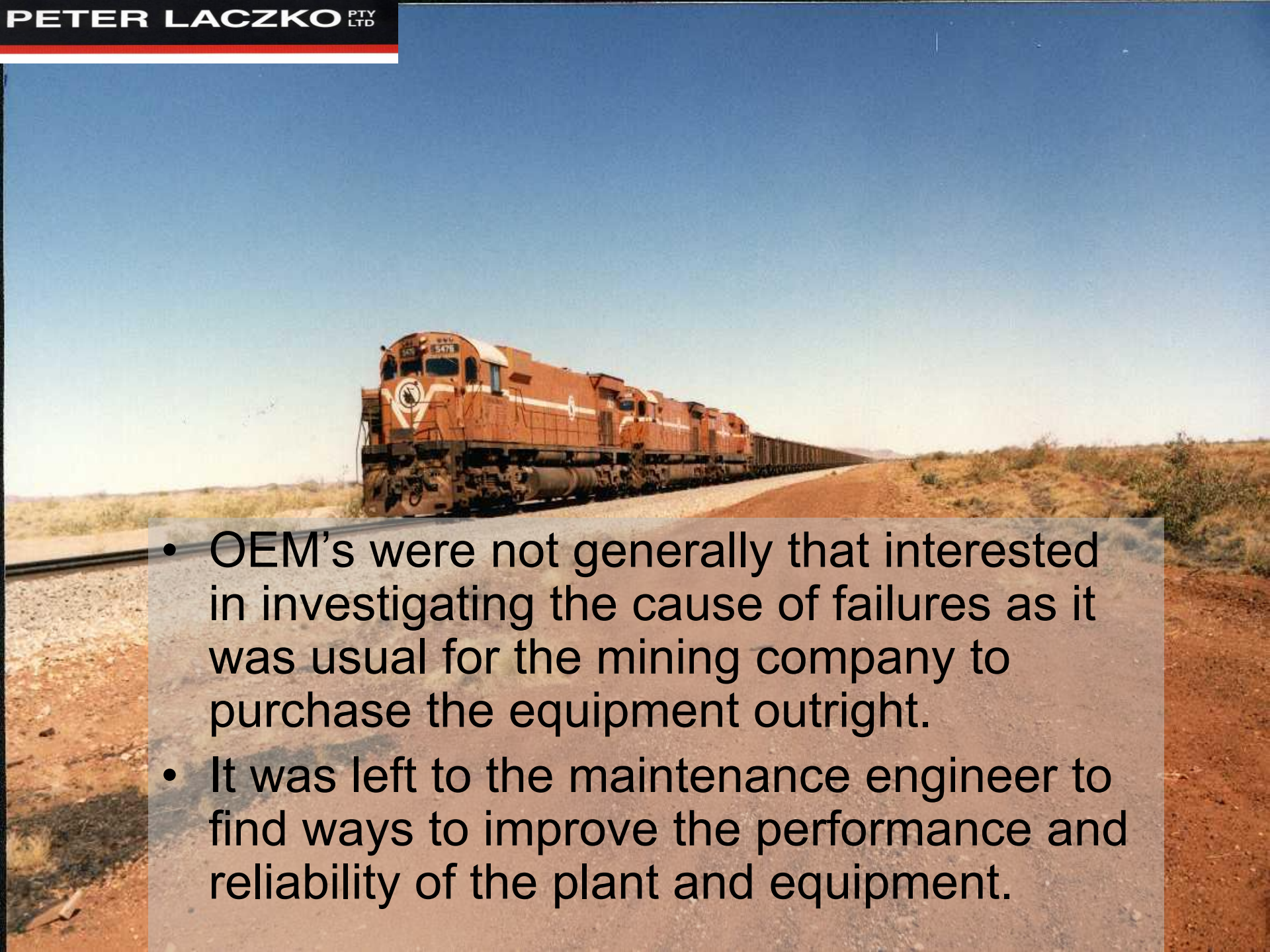


By

Peter Laczko (BSc)



- Investigation of failure of mining equipment was an intrinsic part of operations when I started in this field in 1984 in Port Hedland.
- Open cut mining and heavy haul rail plant and equipment was in a stage of rapid development with the increase in the size of mines and demand for ore.
- Iron ore and gold miners were mainly driving this push for economies of scale.
- Newly designed larger machinery was always in demand and could be expected to provide a wealth of failures .



- OEM's were not generally that interested in investigating the cause of failures as it was usual for the mining company to purchase the equipment outright.
- It was left to the maintenance engineer to find ways to improve the performance and reliability of the plant and equipment.

Dramatic Failures



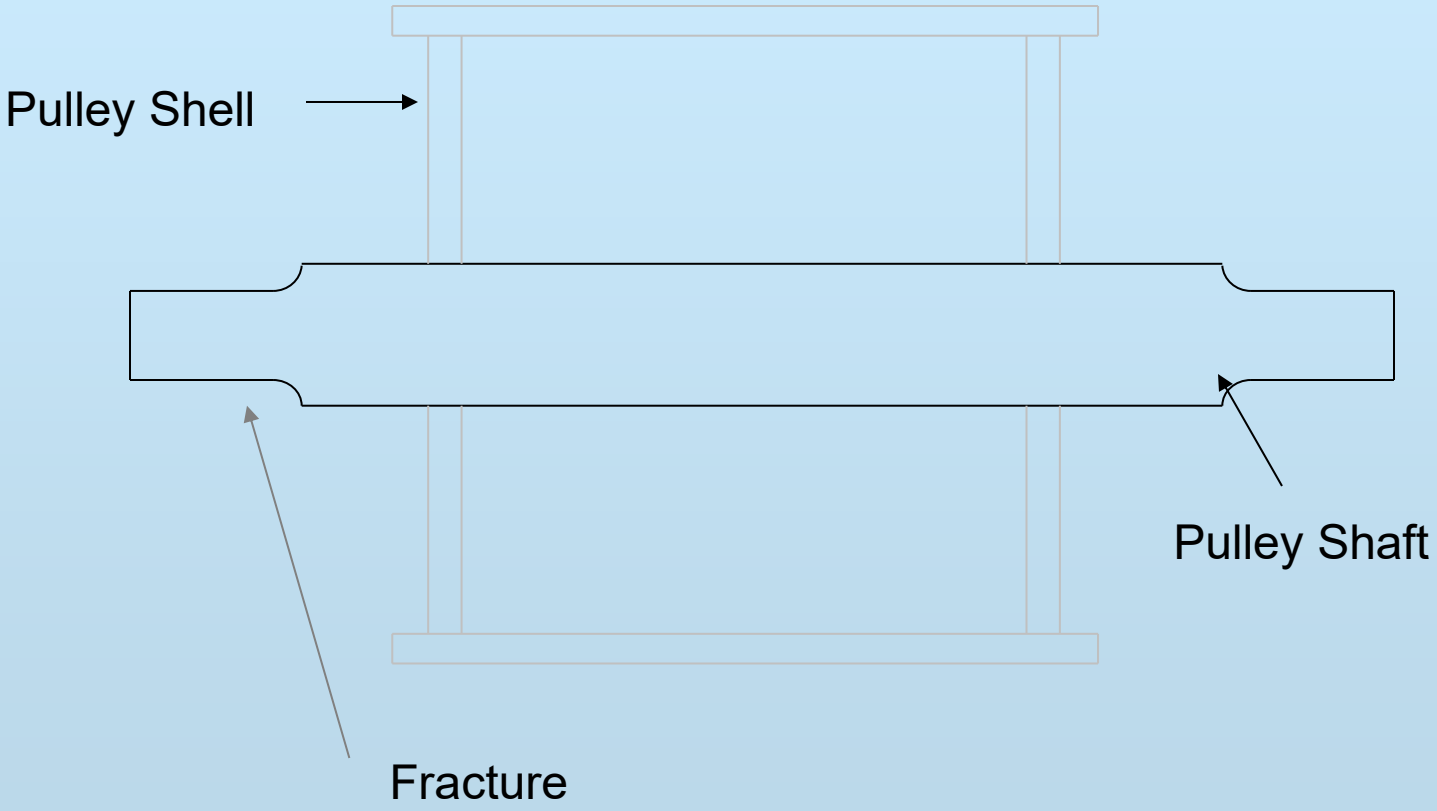
- Some of the more dramatic failures did get attention for the OEM, but it was still often left to the owner to insist on modifications to prevent reoccurrence.

A few examples



- Fatigue failure of two conveyor pulley shafts.
- Corrosion failure of high tensile cap screws.
- Fatigue failure of vibratory feeder hanger bolt.
- Failure of gearbox bearing cartridge retainer bolts.

Failure of a conveyor pulley shaft



Fractured shaft end journal



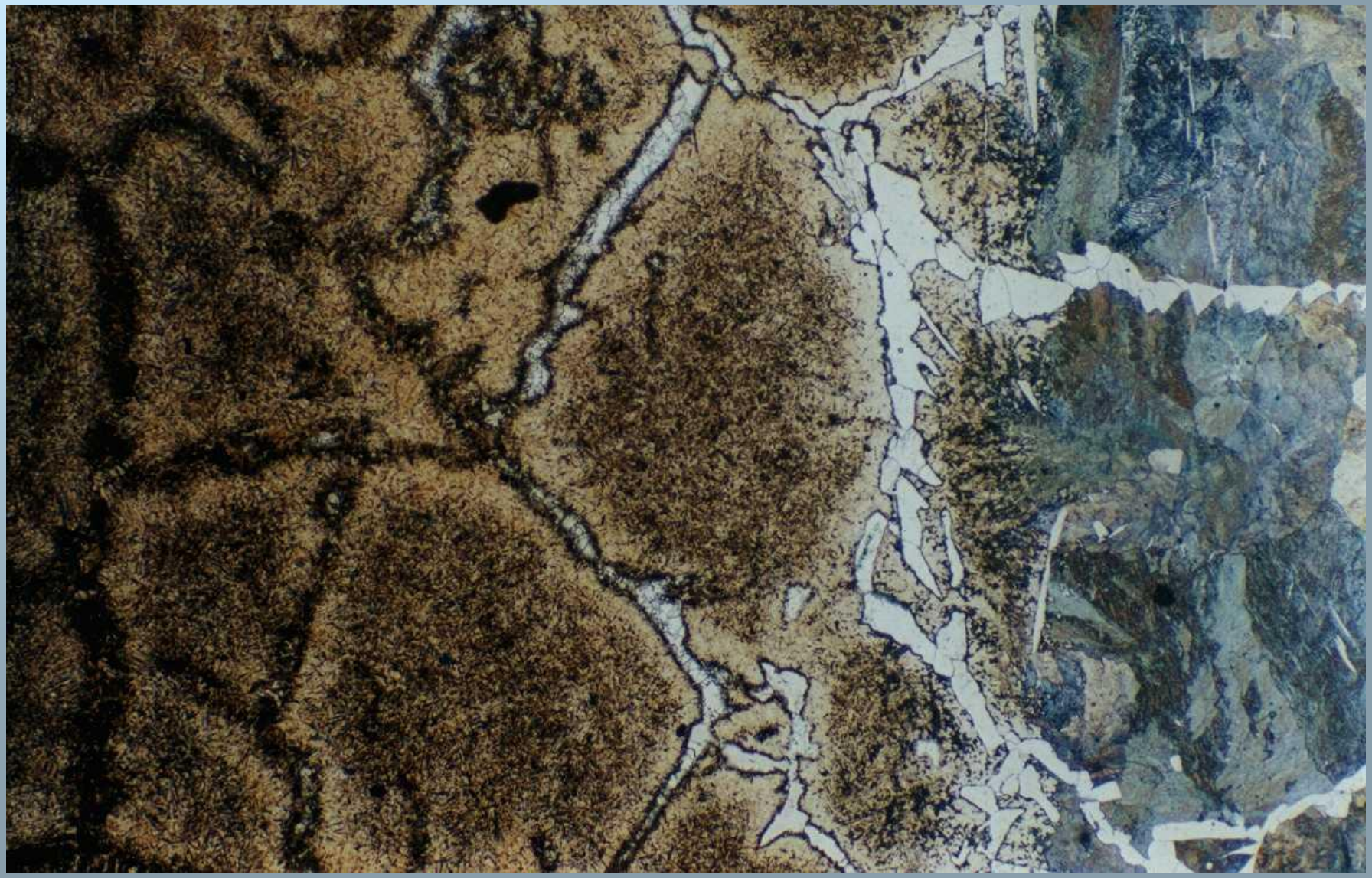
Surface gouging at the fracture



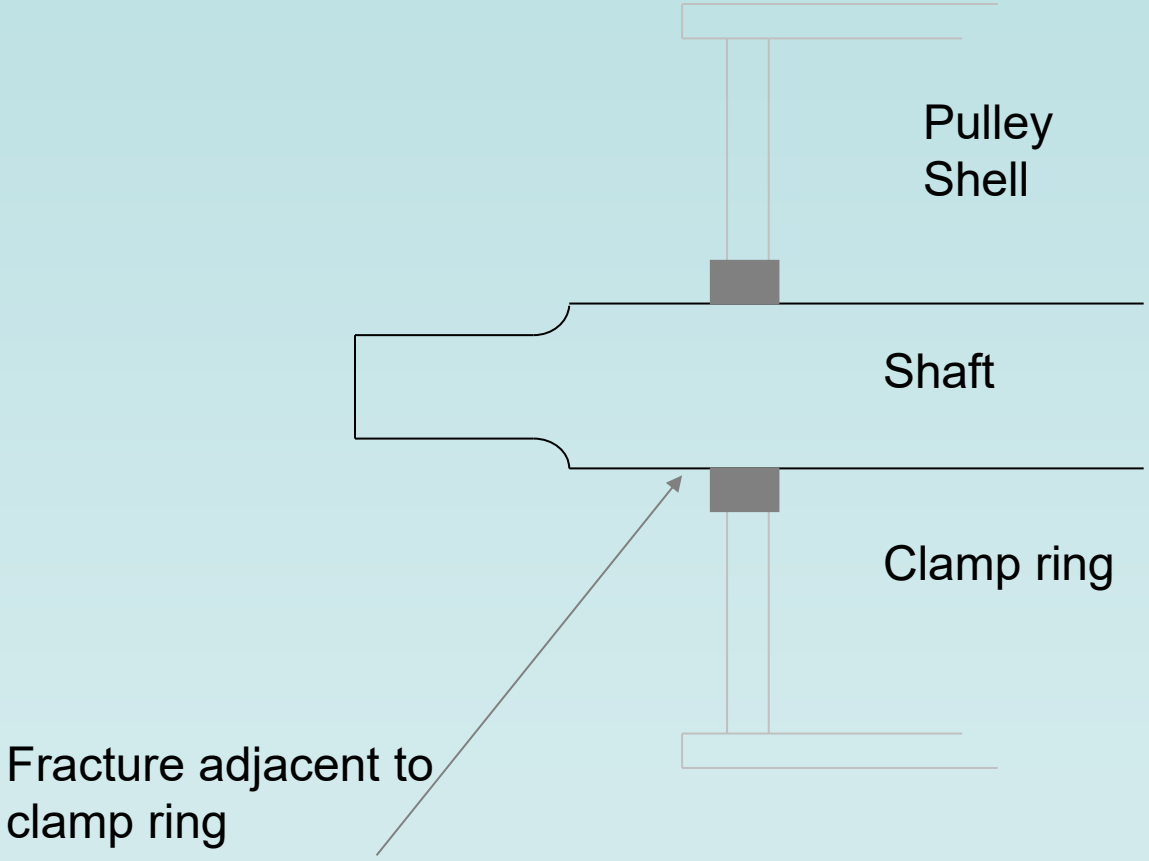
Oxy cutting gouge filled with slag



Microstructure changed from pearlite to untempered martensite



Another failed pulley shaft



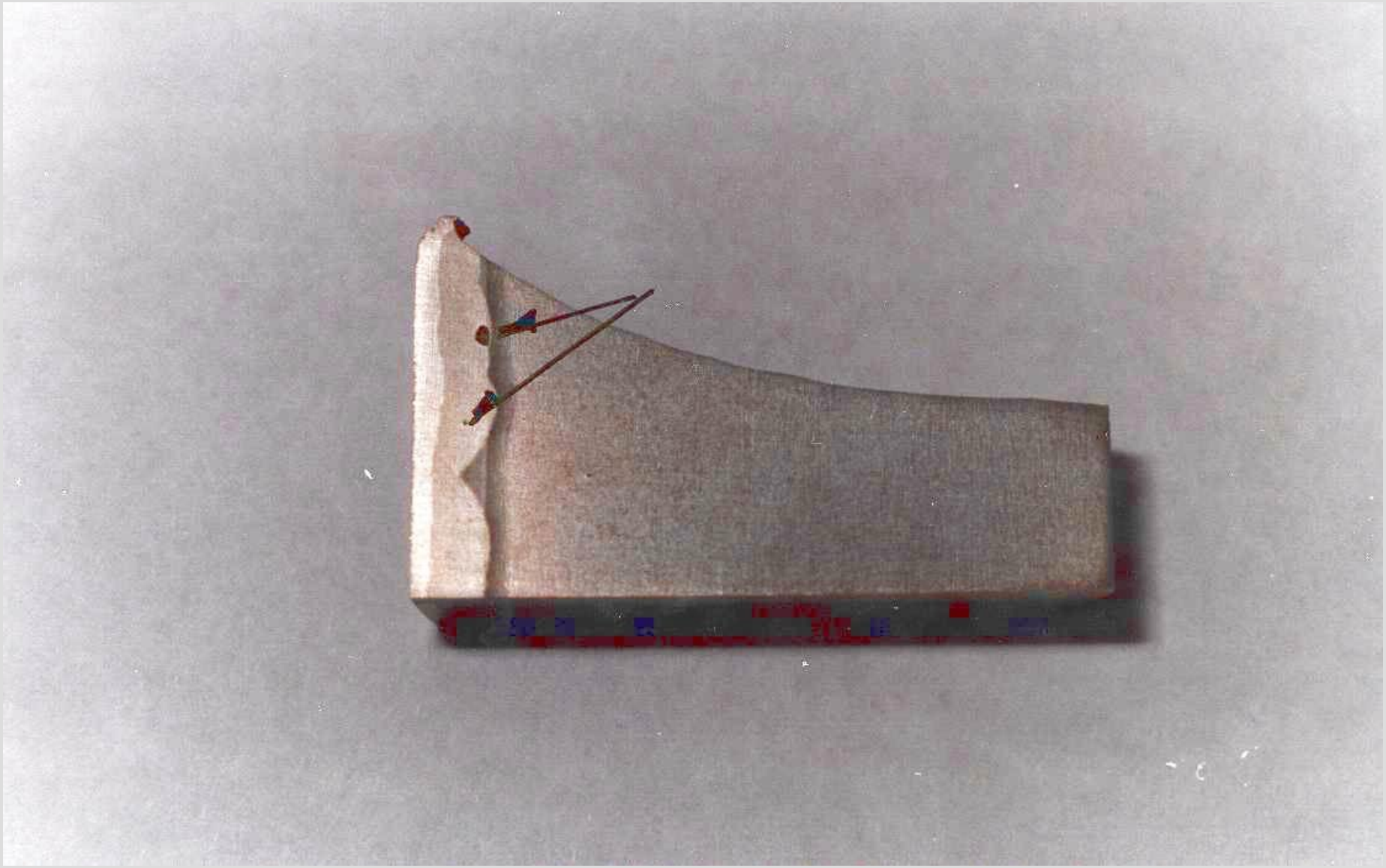
Fatigue fracture surface



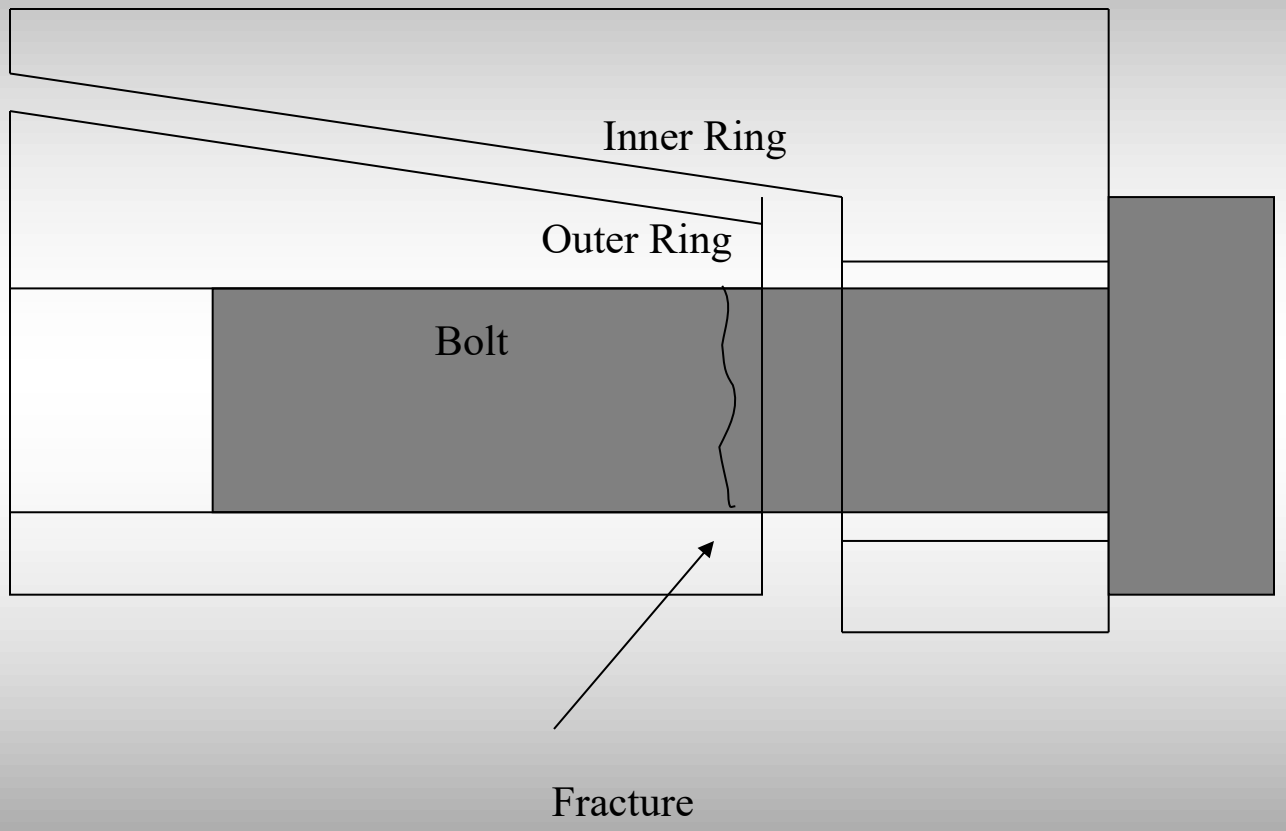
The fracture is right next to the edge of the clamp ring



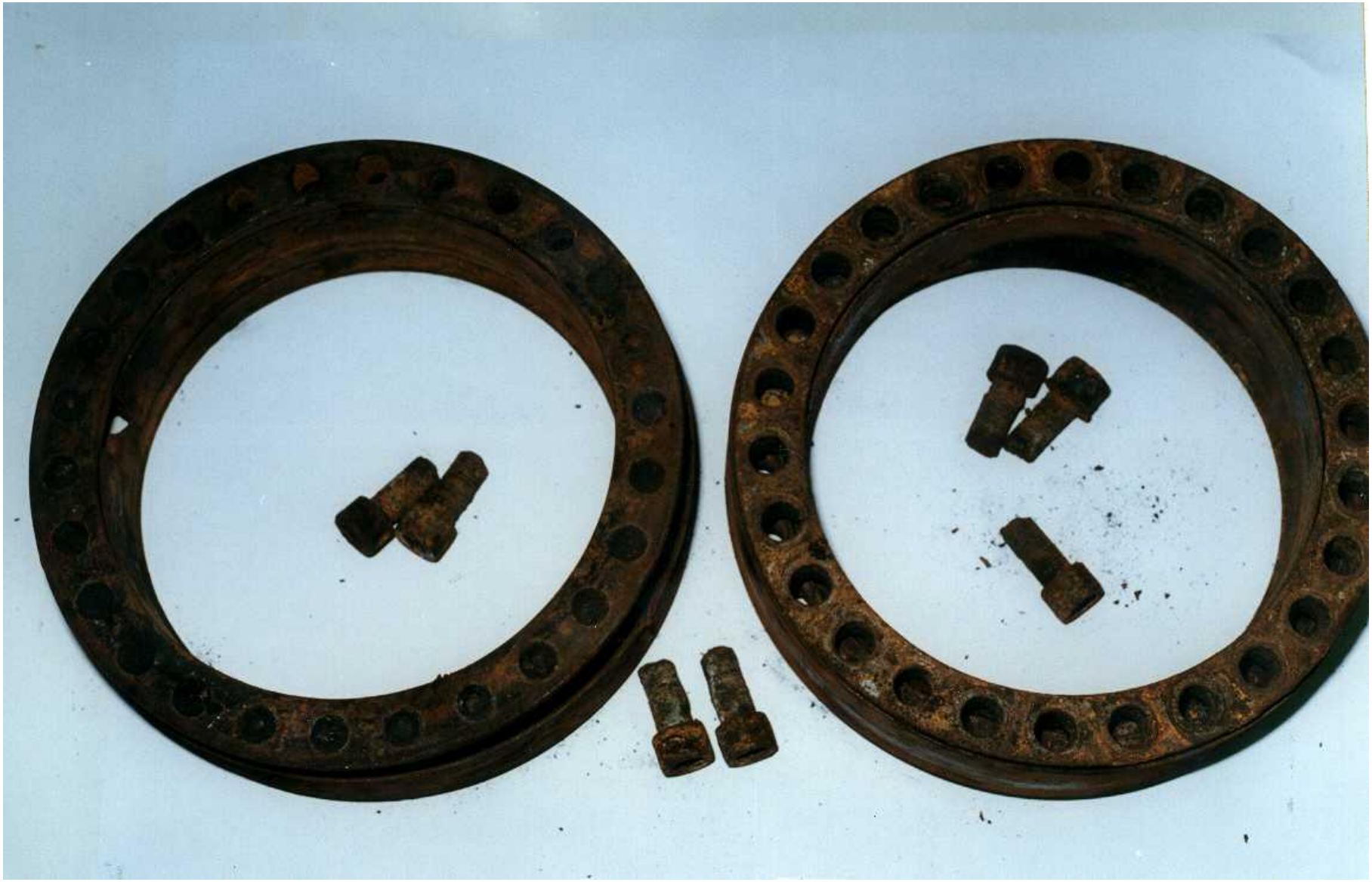
Macro etch of a longitudinal section including the fracture face.



Conveyor pulley clamp ring for holding the pulley shell onto the shaft



Corroded clamp rings and broken bolts



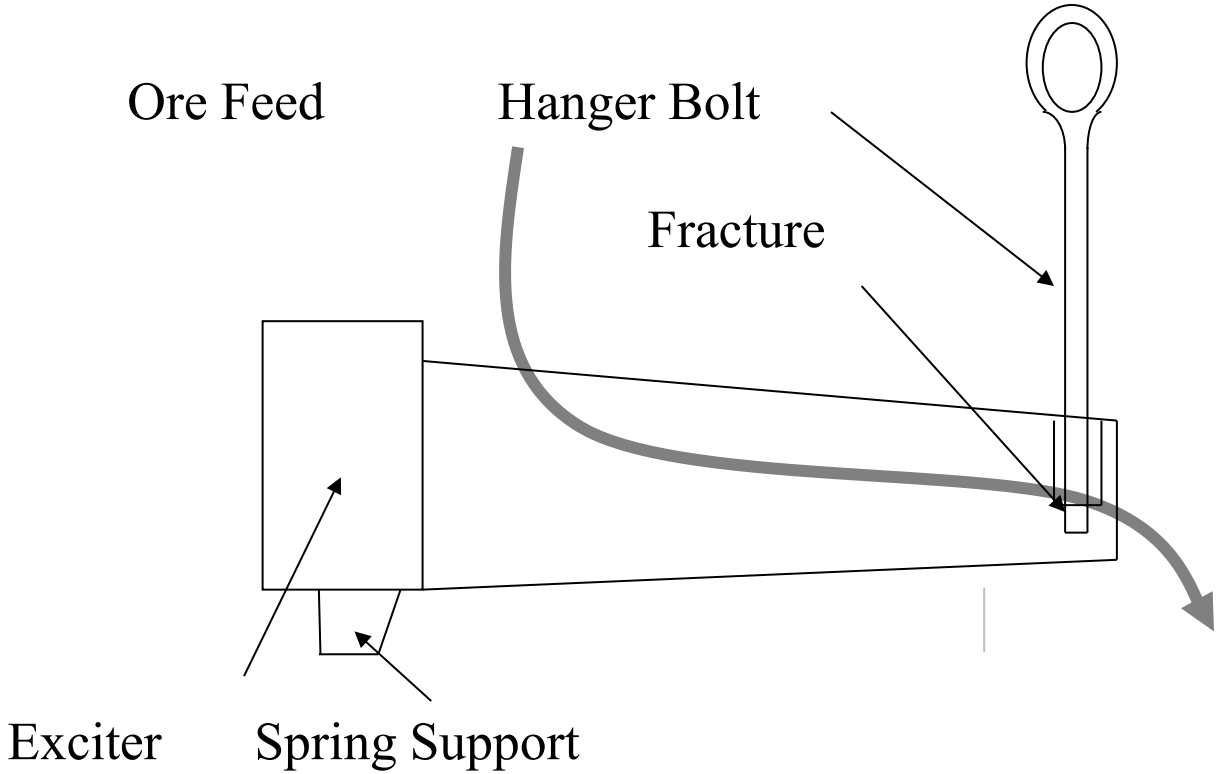
Corroded bolt fracture surfaces and cracks in the corroded ring itself.



Some of the bolts had less corrosion of the fracture surfaces.



Failed vibratory feeder hanger bolt



Failed hanger bolt, fractured at the threaded end.



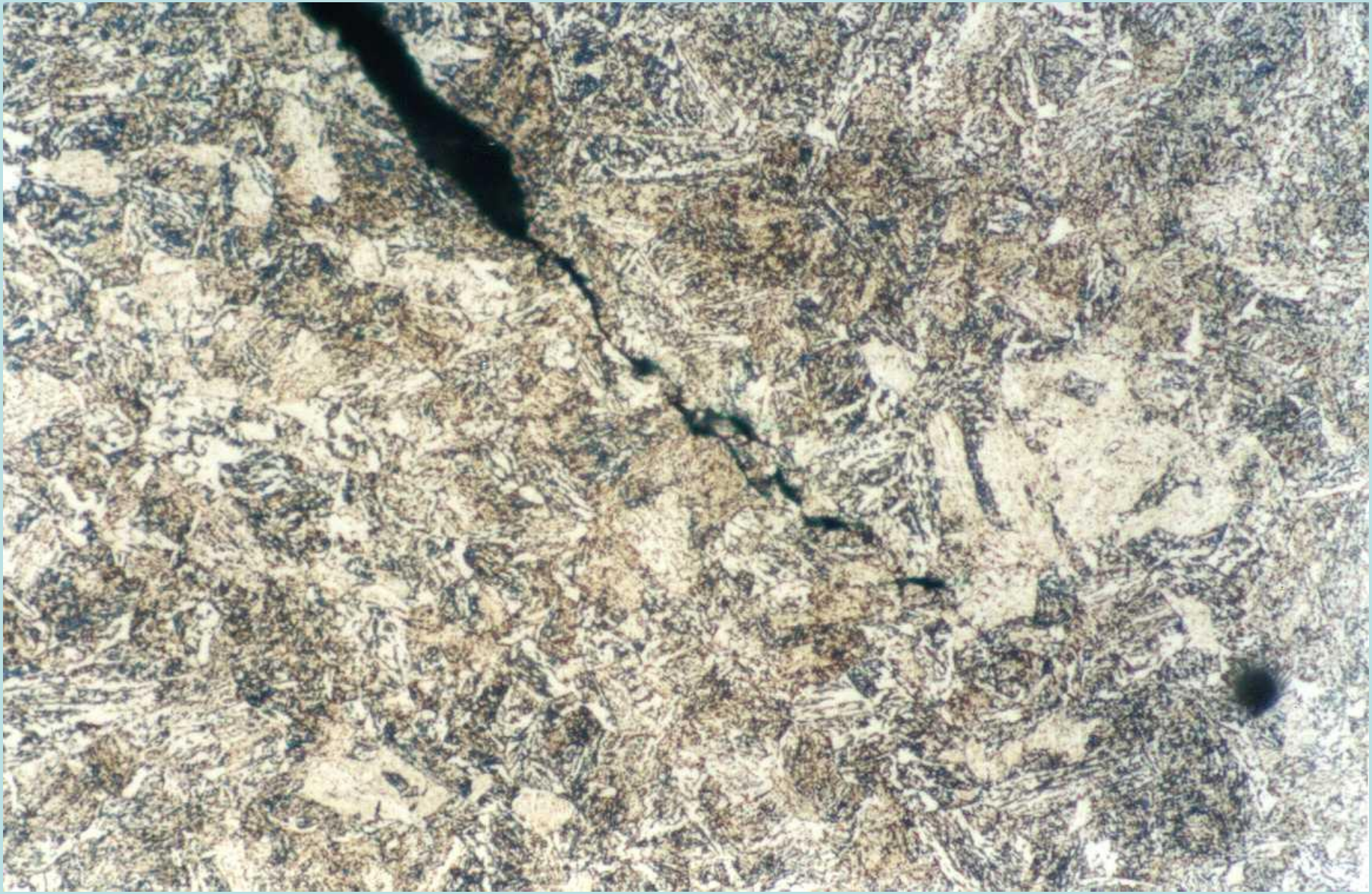
Fatigue fracture surface of the hanger bolt.



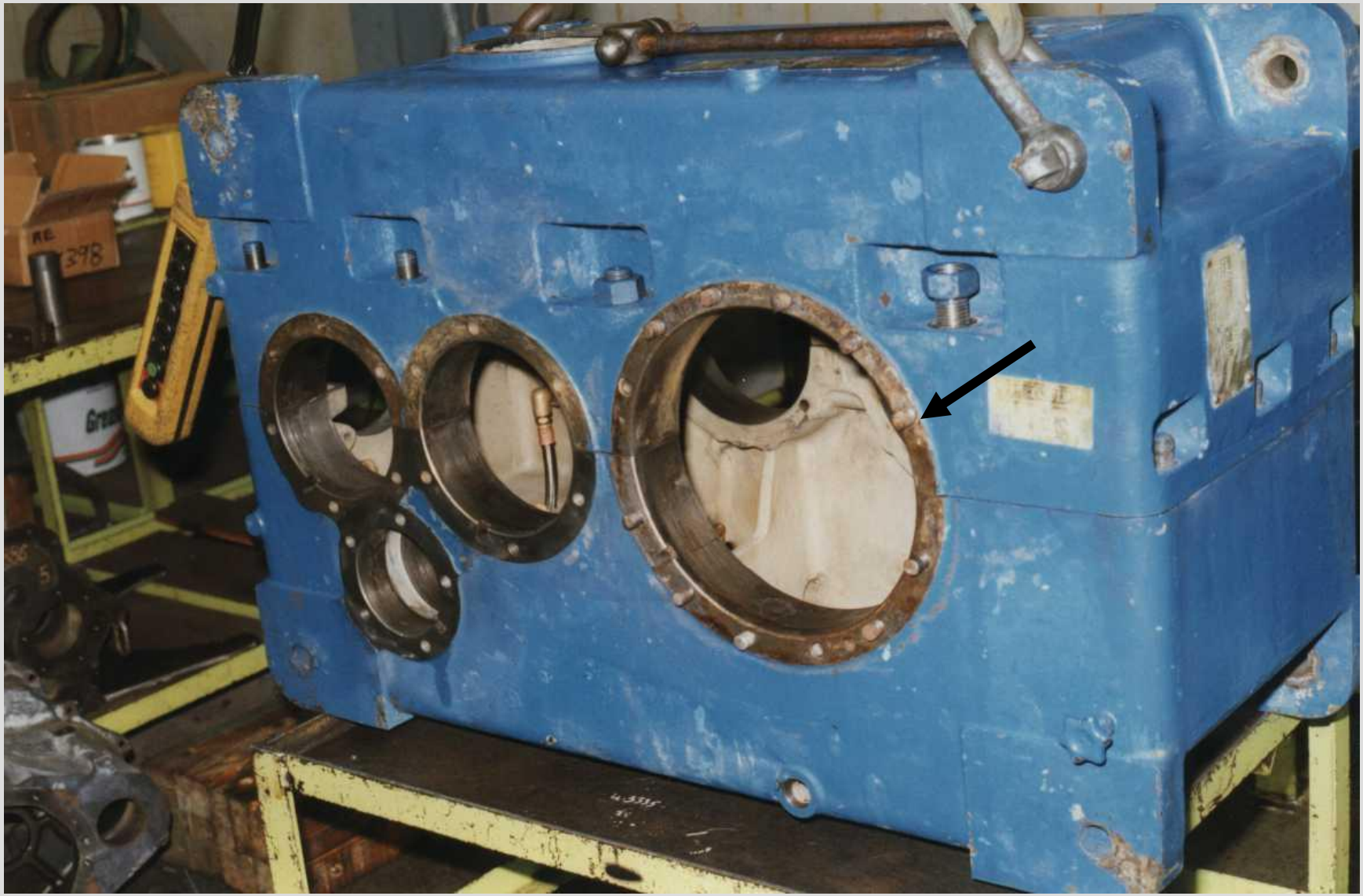
Magnetic particle crack testing showed fatigue cracks were present in adjacent thread roots.



Cross section of a crack. Micrograph X1000



Mixer gearbox bearing cartridge retainer bolt failure



Fretting wear of the cartridge mating surface in the gearbox casing indicated relative movement under load.



The steel cartridge had also fretted on the spigot diameter, but was not cracked.



Tapered roller bearing outer race was in good condition.

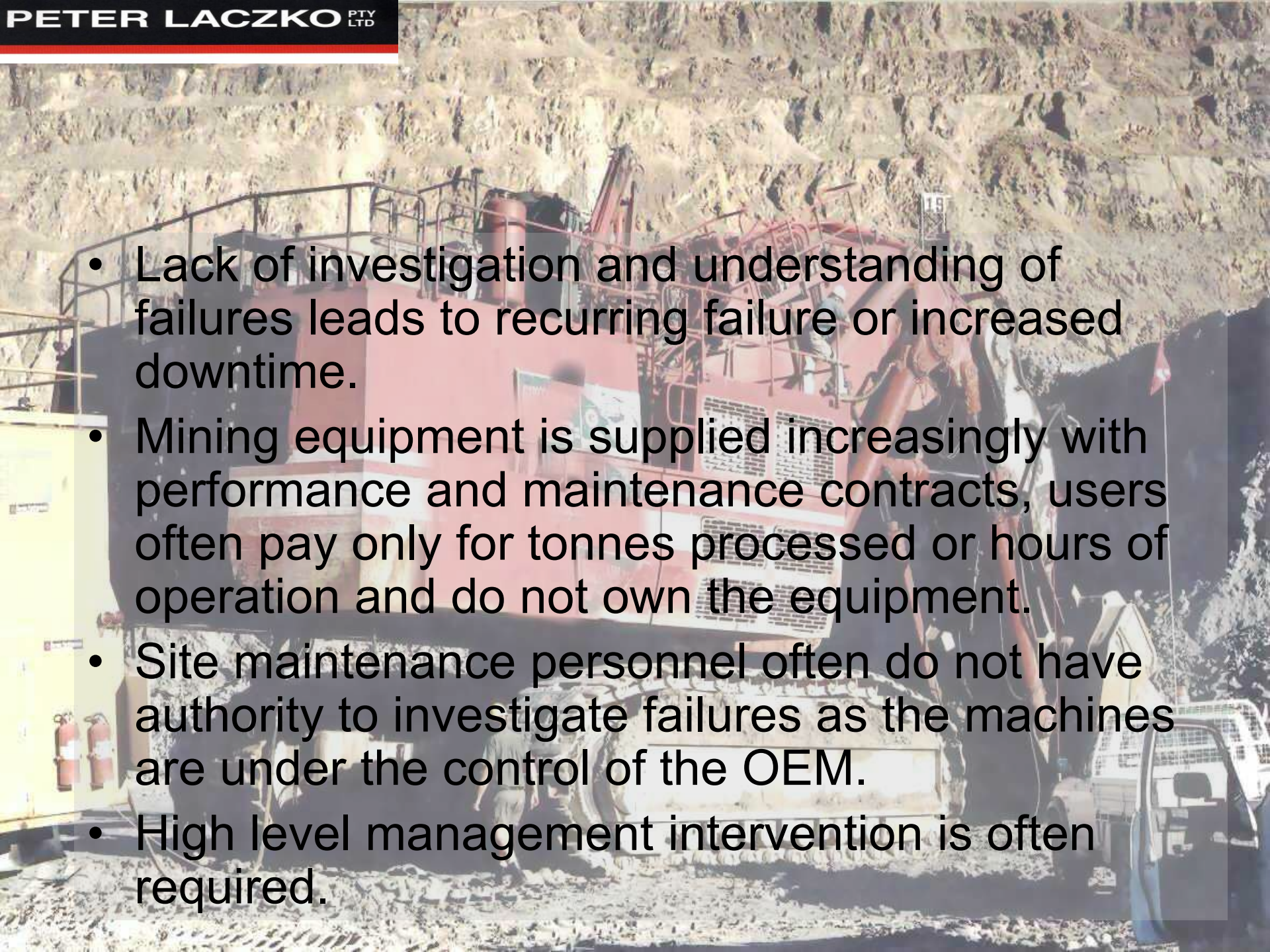


Wear in the output case hardened pinion due to misalignment after the bolts failed.

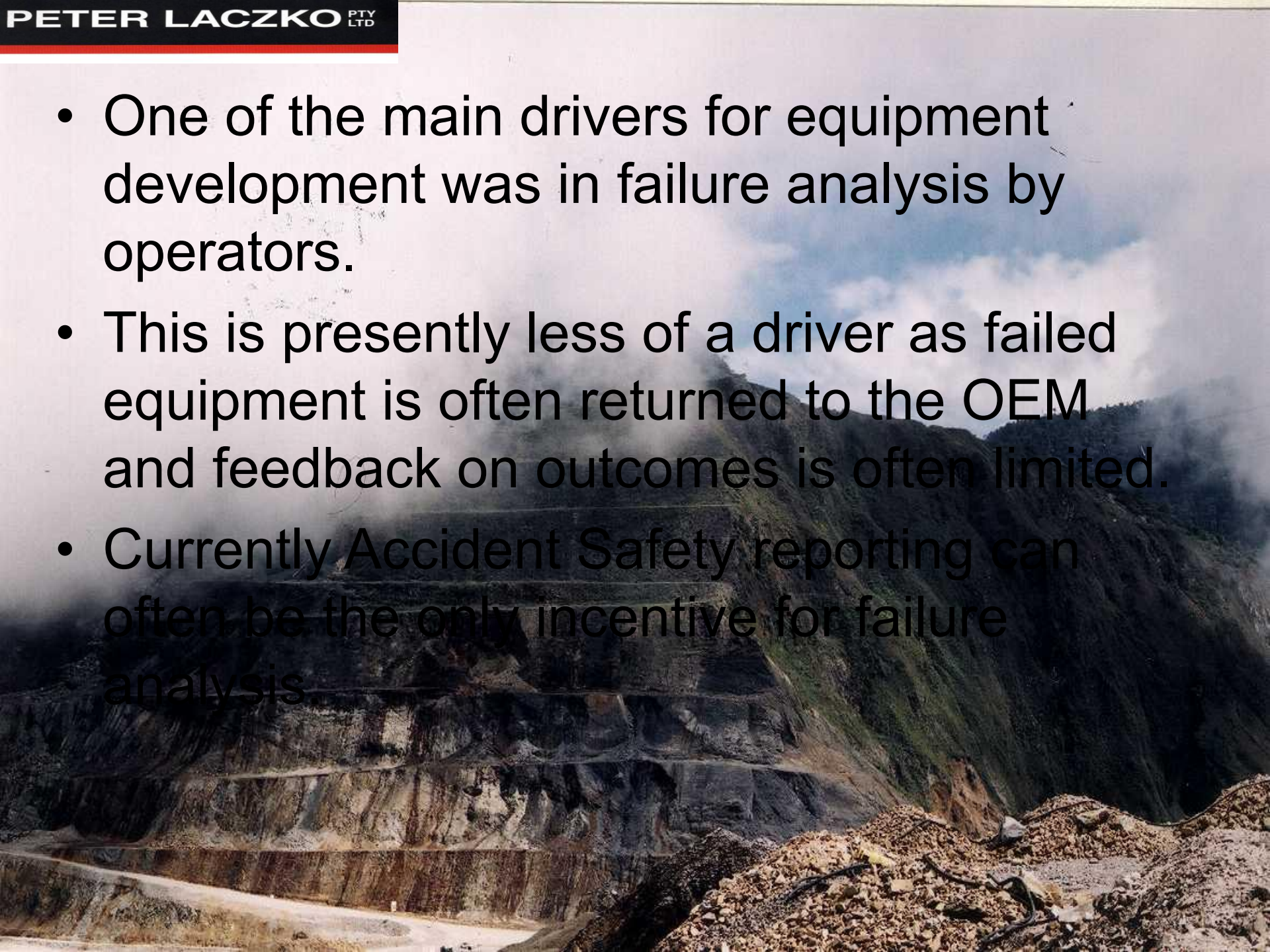


Fracture surface of the bolts, reversed bending fatigue.





- Lack of investigation and understanding of failures leads to recurring failure or increased downtime.
- Mining equipment is supplied increasingly with performance and maintenance contracts, users often pay only for tonnes processed or hours of operation and do not own the equipment.
- Site maintenance personnel often do not have authority to investigate failures as the machines are under the control of the OEM.
- High level management intervention is often required.



- One of the main drivers for equipment development was in failure analysis by operators.
- This is presently less of a driver as failed equipment is often returned to the OEM and feedback on outcomes is often limited.
- Currently Accident Safety reporting can often be the only incentive for failure analysis.

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