John Clayton, P.Eng.: Letting the evidence speak

by Joan Bailey and Sharon Van Ihinger

Forensic engineering is the recording, analysis and presentation of relevant technical matters in such a way that can be understood by non-technical people, usually insurance companies, lawyers or courts.

The Gulf Moose Jaw Asphalt refinery fire in December of 1970 is a case that John Clayton remembers vividly: "I nearly got killed the day before." He was working on an unrelated oil field drilling project near Estevan, Saskatchewan, and there was an accident with a compressor. "It blew a line in front of me and we were all pretty shaken," says Clayton. The next day, Clayton left Regina to fly back to Toronto and he could see a column of smoke rising almost 1000 metres in the air from the oil refinery fire. "It took them three months before they asked me to investigate–and then only because no one else could figure this out," recalls Clayton. "The police, fire marshall, Gulf Research in the (United) States...they all gave up."

It would take more than three years of intense investigation into the cause of the Moose Jaw refinery fire, before both the crude oil storage tank fracture mechanism and the source of ignition were finally identified. It took several more years to bring the insurance case to trial and eventually to win. Work on the case contributed to a change in the Canadian procedures for filling American Petroleum Institute (API) storage tanks. Today, the tanks can be filled to only 75 per cent of capacity (compared to the previous 100 per cent) and must be rigorously inspected, because of previously unrecognized severe weather-induced stresses.

Recently inducted as a member of PEO's Order of Honour, John Clayton, P.Eng., does much of his investigative work at Hitachi High Technologies-Canada Inc., where he keeps his scanning electron microscope.

Clayton was born in Huddersfield, England, in 1933, and obtained his BSc (Hons.) in metallurgy in 1956 at the University of Leeds, and in 1957 immigrated to Canada. He attended the University of British Columbia, receiving a Master of Applied Science degree, then moved to Ontario and joined PEO. In 1985, the father of seven started a consulting firm that specializes in forensic engineering or failure analysis.

Clayton has been active with PEO's Mississauga and Brampton chapters, including 16 years as an executive member of the Brampton Chapter. He chaired the chapter from 1992 to 1994 and again from 1998 to 2000. In addition, he's worked tirelessly on many PEO committees and task forces.

According to his colleagues, Clayton has served his profession by organizing successful chapter events, involving all stakeholders in the governing process, and enthusiastically welcoming new members into the chapters. He's also admired for his hands-on approach, and seems equally comfortable in deep discussion with a university professor or speaking with an auto mechanic. Denis Dixon, P.Eng., PEO Councillor-at-Large, says that it was thanks to Clayton that he joined the Brampton Chapter Executive in 1988. Since that time, he says, Clayton has played an integral role in encouraging hundreds of new PEO members to get involved with their chapter. He credits him with helping the Brampton Chapter in working towards solutions to professional engineering issues. Another of Clayton's colleagues, John Powell, P.Eng., says that Clayton's attitude has been instrumental in spurring a large number of chapter members to serve PEO and the Ontario Society of Professional Engineers. As Powell puts it: "Clayton believes that service to the chapter is the 'springboard' to service at the provincial level."

In recognition for his outstanding contributions to PEO chapters, committees and task groups, Clayton was recently inducted into the Member category of PEO's Order of Honour at a special awards dinner held in Ottawa on Apr. 20 in conjunction with PEO's annual general meeting.

In 1995, Clayton chaired the PEO Government Affairs Committee Tractor Trailer Wheel Separation Task Force, which produced a 20-page brief to the Ministry of Transportation (MTO) and the Ministry of the Solicitor General and Correctional Services, analyzing the technical issues and recommending solutions. PEO appointed the task force as a result of concerns raised by more than 17 incidents in Ontario involving wheel separations. As a result of the brief, Clayton was asked in the fall of 1995 to testify at a Coroner's Inquest exam-

ining two deaths linked to truck wheel separations. MTO accepted many of the task force recommendations, resulting in changes to provincial law that have had a significant effect on safety enforcement and protection of the public.

Forensic engineering benefits greatly from a multidisciplinary background, according to Clayton. "In fact, it is mandatory," he says. His training includes working at a mine in Elliot Lake in his early career, the Avro Arrow project, and as a materials design engineer at Spar Aerospace in Brampton, before advancing to corrosion specialist and tribologist (studying wear) at Gulf Canada R&D Centre. Over the years, he's contributed to several space projects, including a transponder boom design used in the Apollo docking process. When NASA was facing delays of space missions, Clayton's successful failure analysis of contact corrosion problems contributed to changes in quality control standards for all aerospace connectors, and stopped the use of unqualified subcontractors.

He's also worked on projects that include pioneering and developing the use of the scanning electron microscope (SEM), which, Clayton says, has opened up a whole new world in failure analysis. It's capable of producing an image from 12 times to 250,000 times magnification and has great depth of focus combined with high resolution.

Analysis is done with the SEM analytical adjunct known as energy dispersion x-ray (EDX), which can analyze an area as small as three microns across. It has been used to study industrial corrosion problems and to measure the service life of the solid-state lubricants applied to the gears that operate the Canadarm. In cases involving the study of fractures, in pipeline ruptures for example, Clayton employs fractography to identify fatigue hydrogen embrittlement, corrosion fatigue and thermal fatigue.

When asked about the nature of his work, he says that unlike crime investigations, where there's often a suspect and the investigation is intended to build a case to prove innocence or guilt, in failure analysis a simple but extremely effective investigative technique is used: "let the evidence speak." This, combined with a sense of how "loud" each piece of the puzzle should be, is how Clayton describes his approach. But in essence, he explains, "one should never twist the evidence to fit the hypothesis, but rather proceed to modify the analysis to encompass and account for every bit of relevant evidence."