Henri-Georges Doll: 1902-1991

Henri-Georges Doll, for decades Schlumberger's technical guiding light, died after a long illness near Paris, France on July 25, 1991 shortly before his 90th birthday. He is buried, as he wished, next to his mentor Conrad Schlumberger in a small cemetery at the Schlumberger family estate in Normandy, France.

In a career spanning more than 40 years, he invented, designed, built and field tested geophysical instruments, developed interpretation methods, created research and engineering centers, and guided young scientists and engineers who could be trusted to carry on. He planted fertile seeds outside geophysics as well. During World War II he formed a company for developing a detector for metallic land mines. This venture later produced automatic guidance and telemetry systems, industrial instrumentation, photomultiplier tubes and sealed-tube neutron generators. Even after retirement from Schlumberger, his restless technical spirit couldn't desist. For more than a decade, Doll worked at his own expense developing medical instruments for the in-situ measurement of blood-flow rate. In all these efforts he was guided by faith that practical technical success rests on scientific research and engineering of the highest quality.

Henri-Georges Doll possessed a gentlemanly bearing that came as from another age:

"The first thing that impresses one about Henri-Georges Doll is his natural elegance… Surprise him in the field dressed in knickers, or at his work table in a tweed jacket, and what will strike you first is the ease with which he fits into his surroundings. One cannot imagine that a poten-

A page from Henri Doll's notebooks, featuring the development of the laterolog technique. This permitted logging formation resistivity with less borehole effect and much improved vertical resolution.

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Resistivity logging system with controlled guard rings

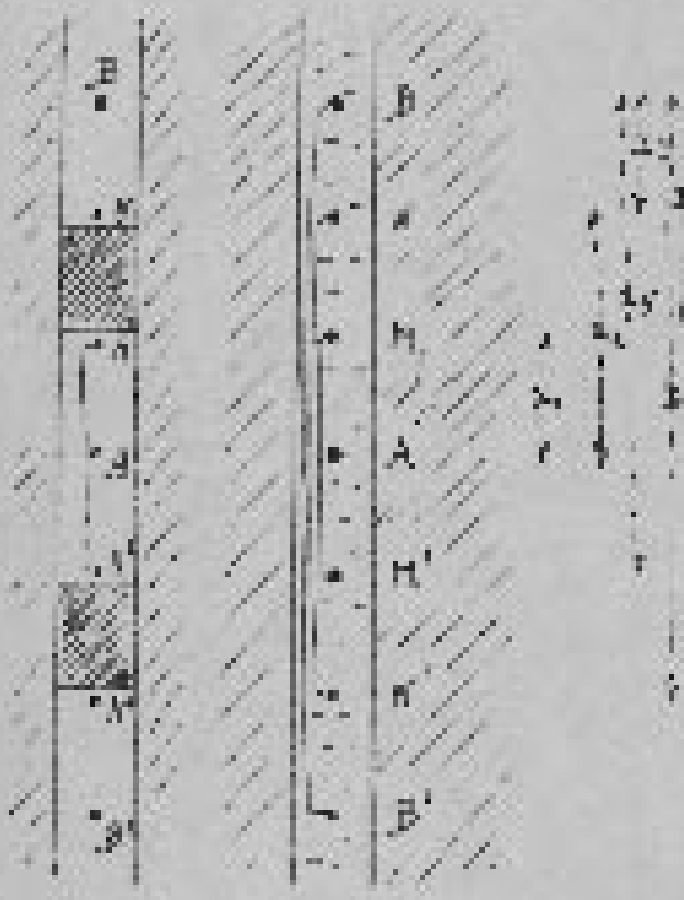

Fig 4 Fig 4a

The system consists of a conventional normal device MAM' surrounded by additional electrodes NB and N'B', as shown on the figure 4. Current of constant intensity i_o is fed through electrode A. In addition currents of intensity i' are fed through B and through B'. The intensities i' are controlled in order that the potential difference between MM' and NN' be permanently zero. This means that, if the system is in a symmetrical position with respect to the formations, no current is flowing in the mud between M and N and between M' and N'.

This is equivalent to plugging the hole with insulating plugs between M and N and between M' and N', as represented on the figure. In fact the system with the electrodes B and B' is even better than the system of plugs to improve the resolution. Due to the electrodes B and B' being fed with current of the same polarity as A, they have for effect to force the current lines issued from A in a more radial path.

The system may have advantages even in the case of thick beds, particularly when the mud is much more conductive than the formations and when, consequently, the invaded zone is not more resistive than the uncontaminated formation behind. It is however, probable in the case of beds of average thickness that the system would prove most useful.

tiometer would fail him, or that the lead would dare to break at the tip of his pencil....He seems to be one of those men who could walk across the Gobi Desert without getting dust on his shoes; the passage of years would only accentuate his neatness and complicity with matter."

So wrote his former wife, Annette Gruner Schlumberger, in her 1977 book *The Schlumberger Adventure*. In Doll, this complicity with nature joined forces with a roving mind, long-range vision, tenacity and mathematical ability to produce an engineer and inventor par excellence.

His work, chronicled by authorship of more than 70 patents and over 30 publications, drew the highest esteem from industry and government. During his lifetime, Doll received the Lucas Gold Medal of the American Institute of Mining, Metallurgical and Petroleum Engineers, the first Gold Medal Award of the Society of Professional Well Log Analysts, a Certificate of Appreciation from the US government and elevation by the French government to "Officier de la Légion d'Honneur."

Henri-Georges Doll was born in Paris, France, August 11, 1902, to a Swiss father and French mother. During World War I, while his father was serving as an officer in the French Army, young Henri attended a lycée in Lyons, where he and his three brothers lived with their mother, who was working in a hospital. A brilliant student, he was a natural candidate for the Ecole Polytechnique in Paris, from which he later graduated. He then went on to higher studies at the Ecole des Mines, also in Paris.

While still a student there, the 22-year-old engineer married Annette Schlumberger, Conrad's daughter, and in late 1925 joined Conrad and Marcel Schlumberger's small electrical prospecting group part-time. The following year, after graduation, he participated in electrical surface surveys of the Alsace plain. By 1927 he was to design and test equipment for Conrad's newly conceived carrotage électrique, or "electric coring." Using this equipment, he and two assistants a short time later ran the now legendary, hand-plotted first electric log in Péchelbronn, France.

A creative flowering filled the following decade. He started serious mathematical analysis of electrical logging and conceived a differential magnetometer. He was first to recognize the origins of small voltages called spontaneous potentials that appeared on the measurement electrodes of electrical logging tools even when no survey current was emitted—and to note that these differentiated shales from permeable conglomerates. He brought to fruition borehole measurements of temperature, dip and inclination, the last of these employing the first sonde containing complex downhole instruments—not merely wires and electrodes. He even developed a safe and simple method for such a mundane but ubiquitous operating problem as locating cable leaks.

Shortly after the outbreak of World War II in Europe, Doll was dispatched to Houston, Texas, USA to establish Schlumberger's first research and development activity outside France. When the United States entered the war, he offered his services to the US Army through a small nonprofit company that he had founded, Electro-Mechanical Research. Here Doll led the development of the jeep-borne mine detector for which he later received a Certificate of Appreciation from the US government.

After the war, Doll spearheaded the separation of research and engineering in Schlumberger by founding in 1948 what was then the Schlumberger Well Surveying Corporation's research laboratory in Ridgefield, Connecticut, USA. Upon his retirement in 1967, the board of directors named it the Schlumberger-Doll Research Center in his honor. No matter what his other responsibilities, the urge for technical creation came to the fore.

At Ridgefield, Doll not only led electrical tool development, but expanded the staff to include nuclear, sonic, mathematics/computer and log interpretation groups, among others. Although he was never as technically comfortable with nuclear and sonic logging as with electrical, his support and encouragement sustained these groups through their early, lean years. This foresight informed all his thinking. Nearly 40 years ago, Doll predicted the eventual demise of the log analyst's slide rule and colored pencil, and their replacement by truck-borne computers doing on-line interpretation.

Roughly coincident with Doll's tenure as Schlumberger's manager of technique in the decade following World War II, a second creative flowering took place. Two papers "The SP Log: Theoretical Analysis and Principles of Interpretation" and "The SP Log in Shaly Sands," now classics, described the current and voltage distributions of the spontaneous potential in and around the borehole. These clarified formerly puzzling aspects of the subject. Perhaps the most widely referenced of all papers on induction logging is his 1949 "Introduction to Induction Logging and Application to Logging of Wells Drilled with Oil-Base Mud." These were followed by important publications on the microlog, the laterolog and the microlaterolog.

Louis Allaud and Maurice Martin, in their book *Schlumberger, The History of a Technique*, give Doll full credit for the basic theory of resistivity determination in a permeable formation, which took into account all the parameters—borehole, depth of invasion and shoulders. The thin-bed problem challenged him also. From the beginning of logging, bed resolution had been a preoccupation of the Schlumberger brothers and Doll. As early as 1927, Conrad proposed a sonde employing long guard electrodes to force the survey current into a beam that would penetrate laterally into the formation, even in the presence of salty mud. Many years later he conceived a "point electrode" system aimed at the same goal. But it wasn't until Doll actually designed a workable system using the then barely adequate technology that the first laterolog was run in 1949.

Taking a cue from the success of the microlog, one of his earlier inventions that located permeable zones, he extended the laterolog concept to a pad tool. The microlaterolog was born, giving for the first time a reasonable estimate of invaded-zone resistivity (R_{xo}) and residual oil saturation. Then in 1958, Doll came up with the proximity log, which gave an even better determination of R_{xo}, one less affected by mudcake. He had already in 1946 successfully field tested a resistivity dipmeter sonde. This essentially employed three rudimentary laterologs on pads spaced around the borehole, with a common survey current electrode several feet below.

There is little doubt, however, that Doll's crowning technical achievement was inventing the induction log. The impetus for this tool was the felicitous joining of a problem, the increasing use of nonconductive oil-base mud, and a technique, electromagnetic induction, which Doll had already used successfully in mine detection. Schlumberger colleagues strongly opposed his proposal, citing problems posed by very small signal strength, huge direct mutual coupling interference and lack of adequate supporting technology. Nevertheless, Doll persisted in this complicated and difficult task, leading a small team that often developed order-of-magnitude improvements in technology as needed. History validated his vision, perseverance and faith in the eventual success of well grounded research. Induction logging became one of the most widely used logging methods in the world. It not only solved the oil-base mud problem, but also surmounted the obstacle presented to electrode methods by high-resistivity invaded zones.

Throughout his professional life, Doll was self-confident but reserved in manner, soft-spoken but precise and authoritative. Above all, he was a kind and considerate man. His legacy to geophysics and hydrocarbon exploration is a thriving technology and a clear image of the fruit that can grow from seeds of vision, knowledge, perseverance and integrity.

Doll is survived by his first wife, Annette Gruner Schlumberger, his daughters, Mrs. Frank Davidson, Mrs. Jean Lebel, and Mrs. Arnaud de Vitry, 10 grandchildren and 23 great-grandchildren.—JT

Acknowledgements and Further Reading

Schlumberger AG: The Schlumberger Adventure. New York, USA: ARCO Publishing, Inc. 1982.

Allaud L and Martin MH: Schlumberger: The History of a Technique. New York, USA: John Wiley and Sons, Inc., 1977.