square miles dotted with scores of working oil wells located just outside of town. After oil was first discovered in the area in 1860, it took 20 years to hit *the big one* in 1881. Then it was like the gold rush all over again. But the boom didn't last and by 1920 only a few wells were left.

Lighting the Frontier captures the legacy left by the early pioneers of the Colorado oil industry through photographs, interviews, re-enactments, and footage of the field as it looks today. It explains the geologic factors contributing to the formation of this important field in layman's terms, and highlights Colorado's numerous other natural resources, including coal, gold, and dinosaur fossils. This video documents the important role Florence Field played in establishing Colorado as a significant oil and gas producing state.

This video was produced by the Rocky Mountain Association of Geologists.

HENRY DARWIN ROGERS (1808-1866): ORGANIC METAMORPHISM IN PENNSYLVANIA AND THE ORIGIN OF PETROLEUM, 1863

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Henry Darwin Rogers, a young social reformer from Philadelphia, took ship for England in 1832. Somewhat unexpectedly he found himself welcomed into the world of geology, where his astute mind and ready adaptation to metropolitan ways enabled him to absorb and retain an incomparable grounding in the new science given by Edward Turner, Roderick Murchison and Henry de la Beche.

On returning to America, Rogers began research on the constituents of coal. In 1835 he was appointed Director of the first Geological Survey of Pennsylvania, and soon perceived from analyses of coals in the State that their volatile content varied from place to place, rising in an orderly way from southeast to northwest.

When, in 1859, drilling for petroleum began at Titusville, Rogers initially believed the rock-oil to be a product of devolatilized coal, though he soon abandoned that view when oil was found in quantity outside the coal-bearing districts. Convinced by proof of graded metamorphism among coals, Rogers leapt to the realisation that a similar gradient was present in organic-rich strata below the coal, naming Devonian Genesee and Marcellus shales, and Ordovician Utica shale as petroleum sources.

Rogers's findings were published in 1863 by *Good Words*, an English journal unknown to science. There they lay unremarked for 67 years, until noticed in 1930 by J. V. Howell and the American Association of Petroleum Geologists. But they were again ignored, and a further 40 years passed before the oil industry brought itself to understand what had been said in 1863.

HENRY DARWIN ROGERS AND THE ORIGIN OF PETROLEUM ORGANIC METAMORPHISM IN PENNSYLVANIA, 1863

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In May 1863, *Good Words* carried an article on coal and petroleum by Henry D. Rogers, Professor of Natural History in the University of Glasgow. It expounded new ideas on the genesis of petroleum- that it arose by thermal diagenesis of organic matter in source beds and migrated upward into reservoirs. A century passed before the heavy hand of oil industry science indicated that Professor Rogers had been right.

Henry Darwin Rogers was born in Philadelphia. By the age of twenty three he was an accomplished lecturer and an Owenite reformer. In the summer of 1832, he sailed for London to study science and social reform. He attended lectures on science and was welcomed into geology, not least by Henry de la Beche, founder of the Geological Society in Britain. Three years after his return, Rogers made Director of the Geological Survey of Pennsylvania.

Analyses of coal quickly made him aware of a progressive westward gain in volatile content across the Alleghenies. He thought that petroleum came from metamorphosed coal, but his knowledge of the coal told him that the newer oilfields were outside the coal district. He realized that other carbonaceous beds were the oil source, and identified them as thermally altered shales of Devonian and Ordovician age.

THE PREHISTORY OF SUBSURFACE EXPLORATION, 1533-1799. ORDER, THE GREAT CHIME AND SYMPHONY OF NATURE

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Practical stratigraphy long preceded any scientific theory of geology, it was always distinct from cosmogony or weird sucks of the earth. Exploration for a mineral commodity required skills learned on the ground, chiefly to balance economic worth against working hazards.

Experience with coal, iron ore, and quarried stone taught the facts of lithology, bed thickness, facies variation, and structural attitude. Genuine stratigraphy was always a dual activity of measuring strata and observing their natural order.

In the 17th century, strata were usually recorded in tables. Data came from operations below ground. Surface outcrops were not stratigraphically important until subsurface order and regularity had been realized. Early 18th century interest in agriculture, soil improvement, and a passion for antiquities, heightened awareness of landscape. Strata and soils were traced with some certainty over whole countries. Late 18th century crises of industrial transportation encouraged construction of new roads and canals. Bedrock scarification and excavation uncovered long sections of strata formerly hidden. In 1796, at one such site, William Smith discovered with delight and amazement that particular fossil assemblages could be identified with particular strata.

STRATIGRAPHIC STAND-OFF AT THE 49TH PARALLEL, 1956. IN MEMORY OF LAURENCE L. SLOSS

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Ask two geologists a question and you will get two different answers. That was the whole tiresome truth after drilling the No. 4 Charles, Garfield County, Montana.

Mississippian limestones in the Montana segment of the Williston basin were for years called Mission Canyon and Lodgepole. In 1942, a well in Garfield County found thick evaporates overlying the Mississippi Canyon. They were named Charles formation, and its base was put at the lowest massive anhydrite. This seemed clear enough, though the lowest anhydrite was not everywhere in the same bed, nor even near it. Thick anhydrites were afterwards found at lower and lower stratigraphic levels toward the basin rim.

Two explanations arose. Firstly, a *mineral-focused* or *American* view saying the Charles formation is diachronous, because it crosses time lines; or secondly, a *stratum-focused* or *English* view drew from the knowledge of coal miners and quarrymen, and resisted foreign dogmas.

THE EXTRATERRESTRIAL ORIGIN OF OIL - *or are we fossil fools and Thomas Gold was, like his name, a four nine five pure genius*

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This paper is not designed to defend either position in the abiogenic/biogenic controversy because I have a better theory that I will reveal in a book that will be available at Amazon.com for $29.95 hardcover. Meanwhile, stuck with our present state of knowledge, a series of events will be described that may be attributed to pure chance, luck, good fortune, amazing coincidence, divine guidance, or an amazing convergence of all of the above.

Though much of the data was compiled from astrophysical sources, at great expense, it is here presented so that the entire varsity football team of Colorado can follow it along with cab drivers everywhere, except in Houston, Texas.

Data included here is partially derived from the Cassini Huygens satellite to the moon Titan of Saturn and is not in real time because it takes 40 minutes for the signal to reach the earth.

This paper was reviewed by 4 peer groups, each more illustrious than the proceeding and given an A minus, not grade inflated, albeit the reviewers may well have been *in their cups.*

TIMETABLE OF PETROLEUM GEOLOGY

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This timetable is mainly about the modern theory of petroleum geology: the source, migration, trapping and production of petroleum. It is not a history of the discovery of oil and gas fields, and is not much concerned with early speculative theories as these are adequately treated in other sources. In selecting significant papers I have been guided by two principles: (i) the ideas presented are now known to have been at least partly correct, not simply those that may have been influential at the time; (ii) quantitative is favoured over qualitative expression. Use of these criteria signals a Whiggish approach to the history of petroleum geology, but is perhaps excusable in light of the large literature on the subject, much of which took little account of the then-known laws of physics and chemistry. For example, capillary action was known before Newton, and explained in modern terms at the beginning of the nineteenth century (its history was well reviewed by Maxwell and Rayleigh in an article on *Surface Tension* in the ninth and tenth editions of the *Encyclopedia Brittanica*). The laws of hydrostatics were also known very early. Darcy established the law for fluid flow through porous media in 1856. Svante Arrhenius proposed his equation for the rate of chemical reactions in 1889. One of the great achievements of King Hubbert was to draw the attention of the petroleum industry to the significance of much of this body of knowledge.

Many early texts of petroleum geology apparently regarded theories of the source and migration or petroleum, and even the mechanism of trapping, as too speculative to deserve much discussion: The bulk of the texts were devoted mainly to case histories illustrating the different types of traps and in only a few discussed theoretical matters. This time table does not concern itself with describing the different types and classification of traps.